PROPOSED PINJAR TO CATABY TRANSMISSION LINE

PUBLIC ENVIRONMENTAL REVIEW

VOLUME 1 & 2

JUNE 2001

Western Power
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Proposed Pinjar to Cataby Transmission Line Public Environmental Review

Volume 1

VOLUME

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. If you are able to, electronic submissions emailed to the DEP Project Assessment Officer would be most welcome.

Western Power proposes to construct and operate a 330kV transmission line from Pinjar to Cataby. In accordance with the Environmental Protection Act, a Public Environmental Review (PER) has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a public review period of 4 weeks from 11th June 2001 closing on 9th July 2001.

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in the EPA's report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: 9th July 2001.

Submissions should ideally be emailed to
emma.hopkins@environ.wa.gov.au
(Please Note: One complete submission should be emailed following thorough consideration of the document)

OR addressed to:
The Environmental Protection Authority
Westralia Square
141 St George's Terrace
PERTH WA 6000
Attention: Emma Hopkins

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Executive Summary

ES1 Introduction

Western Power intends to construct and operate a new transmission line from its gas turbine generating station at Pinjar to a substation at Cataby. This transmission line is the first stage of a planned transmission system development in the Great Northern Region of Western Australia.

The existing power system in Western Power's North Country Region between Muchea and the Geraldton area is presently being supplied by two 132 kilovolt (kV) transmission lines. Current indications are that these transmission lines would have reached the limit of their capacities by the summer of 2002/2003. The new transmission line is needed to reinforce the existing power system and improve the quality and reliability of the power supply to regional customers located north of the Perth metropolitan area.

On site works associated with this project are expected to commence sometime in the middle half of 2001 to avoid jeopardising the reliability and quality of customer electricity supply from the summer of 2003/2004 onwards.

The location of the proposed transmission line was determined by examining several route options through a route selection process involving consultation with affected stakeholders, the use of comprehensive digital environmental information and the detailed evaluation of the environmental and social impacts of the options considered. The main focus of this Public Environmental Review (PER) is the environmental assessment of the proposed transmission line route located to the west of the Brand Highway. In this document the proposed transmission line route is also referred to as the Western Option.

ES2 The Proposal

The proposed transmission line route is approximately 123km in length, traverses 18 private properties and approximately 60km of native vegetation. Of the native vegetation traversed, 22km is within State Forest 65 North, 8.2km within State Forest 65 South, 2.15km in Gingin Stock Route Nature Reserve and approximately 24km on private properties.

Where possible the alignment follows existing roads and tracks to minimise the clearing of vegetation. The key characteristics of the transmission line proposal are summarised in the table below.

ES3 The Approvals Process

The proposed Pinjar to Cataby transmission line is subject to the requirements of the Environmental Protection Act 1986 and requires formal environmental assessment and approval in accordance with Part IV of the Act (Environmental Impact Assessment). The Environmental Protection Authority has determined that the proposal is to be assessed at the level of Public Environmental Review (PER), the second highest level of assessment.

The specific factors identified by the EPA as requiring consideration in this PER include:

- Remnant Vegetation;
- Existing and proposed conservation reserves and regional conservation values ;

Table ES1: Transmission Line Characteristics

Line Distance	Approximately 123 km
Line Construction	330,000 volt (330kV)
Average tower height	50 metres
Minimum phase conductor-to- ground clearance	9.0 metres (15.0 metres in vegetated areas)
Typical span between towers	Approximately 400 metres
Width of corridor	60m
Approximate area of temporary vegetation disturbance	38.4Ha
Approximate area of permanent vegetation clearing	2.9Ha
Target project completion date	30 November 2003
Target project start date	Oct 2001

- Weeds and disease, including Dieback (Phytophthora);
- Declared Rare Flora, Priority Listed Flora and other significant flora;
- Threatened Plant Communities;
- Terrestrial Fauna including Specially Protected (Threatened) Fauna;
- Wetlands including lakes and watercourses;
- Land degradation;
- Noise;
- Dust;
- Electro-magnetic fields;
- Visual amenity;
- Aboriginal culture and heritage;
- Places listed in the *Register of the National Estate* and places listed in the Interim List of the Register of the National Estate; and
- Risk and hazard-Unexploded ordinance.

The PER examines each of these environmental factors, indicating potential impacts of the proposed transmission line and management strategies to ensure that the actual effects of the proposal on people and the natural environment meet and in some instances exceed the EPA objectives listed in Appendix 1.

ES4 Community and Stakeholder Consultation

The transmission line route selection process relied heavily on input from parties potentially affected by the proposal. Stakeholder interests have been considered from project inception, and all decisions about the proposal have endeavoured to minimise the overall effect on stakeholder interests.

Methods of consultation employed to inform Western Power's decision-making process involved providing details about the proposal to potentially affected parties, obtaining information from potentially affected parties on the social, environmental and economic issues associated with the proposal, discussions with stakeholders regarding modifications to the proposal, and public meetings to explain the proposal and answer questions on specific issues.

The major issues raised by the various stakeholders and a brief statement of Western Power's responses are provided in Table 6.1.

ES5 Existing Environment

The proposed transmission line traverses two geomorphic units that are common throughout the Swan Coastal Plain, the Bassendean and Spearwood dune systems. The Bassendean Dunes extend east from the Coastal Belt to the Gingin Scarp. This dune system, considered the oldest of the three dune systems along the Swan Coastal Plain, has swampy areas and small lakes common in the internal swales. The Spearwood Dune System is a gently undulating landscape, varying from 30 to 130 m above sea level, and consists of fixed dunes that are characterised by the presence of Tamala limestone and weakly coherent brown to yellowish brown siliceous sands. The proposed transmission line also traverses the Moore Soil Unit, which consists of sandy terraces and slopes of the Moore River.

A botanical survey report has been prepared for the proposed alignment which provides detailed accounts of the methodology, findings, field data and regional assessments of flora and vegetation values of the area traversed by the proposed transmission line (see Woodman Environmental Consulting, 2000). The proposed transmission line route passes through blocks of native vegetation in State Forest 65-South and State Forest 65-North, the Gingin Stock Route Nature Reserve and areas of remnant vegetation on private property and Vacant Crown Land (VCL). The majority of this route lies within the Swan Coastal Plain subregion of the South-West Botanical Province, as defined by Beard (1990). The southern part of the route lies within the Drummond Botanical Subdistrict, characterised by Banksia low woodland on leached sands, interspersed by swamps and Tuart, Jarrah and Marri woodlands. The northern part of the route lies within the Irwin Botanical District of the Northern Sandplains Region. This District is characterised by scrub heaths on sandplains.

A total of 355 vascular plant taxa belonging to 59 plant families were recorded from the proposed line route (Woodman Environmental Consulting 2000). Of these, 32 were introduced (weed) species. This is a relatively low number of weeds and reflects the very good condition of vegetation within State Forest 65 – North and the VCL at the northern end of the proposed route. Weed invasion was generally restricted to tracks and block edges. Pasture areas and areas mapped as disturbed were not surveyed for weeds during this study.

A single infestation of *Phtophthora cinnamomi* was found on the proposed transmission line route at the proposed Moore River crossing. The remainder of the proposed alignment was found to be either uninfested or uninterpretable. The uninterpretable areas were

primarily cleared agricultural land or degraded or cleared areas associated with roads and agriculture.

The region traversed by the proposed transmission line provides habitat for 10 freshwater fish (one introduced), 12 frog, 64 reptile, 166 bird (3 introduced) and 32 mammal (5 introduced). In addition, 5 bird and 16 mammal species are locally extinct. Six species of invertebrates recorded from the region are included under the WA *Wildlife conservation Act 1950* or are in the Department of Conservation and Land Management's (CALM) priority list.

The proposed alignment is approximately 123km in length, affects 18 private properties and traverses State Forest and the edge of a reserve linking areas of State Forest. Approximately 60km of the route traverses native vegetation, of which approximately 30km within State Forest and approximately 35km on private properties. Extensive consultation with potentially affected landowners and government agencies indicate that the most significant landuse concerns associated with the proposal are:

- potential conflicts with intensive agriculture;
- effects on the conservation estate and Natural Heritage values;
- loss of public timber resources in *State Forest 65-South* and;
- effects on future subdivision potential of private land holdings.

The Natural Landscape Character Units traversed by the proposed transmission line include the Coastal Plain, Coastal Ridges and a short section of Valleys. The majority of the proposed transmission line corridor traverses the Coastal Plain Unit. A substantial part of the corridor traverses the Coastal Ridges Unit (potentially high visibility) and a short section traverses the Valleys Unit (potentially high visibility depending on vantage points and siting in relation to ridges). Significant visual and aesthetic features affected include a short section of the Moore River valley and a longer section of high ridges in the Coastal Ridges Unit, including a number of ridge crossings.

No sites of significant natural or cultural heritage value were identified for the area traversed by the proposed transmission line. Aboriginal heritage values will be determined by detailed archaeological and ethnographic surveys of the proposed transmission line corridor.

ES6 Environmental Factors and Management Strategies

The proposed Pinjar-Cataby transmission line has the potential to impact on the existing social and biophysical environment. However, by implementing appropriate management strategies, the impacts can be effectively managed. A summary of the potential environmental impacts and the management strategies, which Western Power is committed to implement for the proposed transmission line, is provided in Table ES2.

Table ES2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route.

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Terrestrial Flora including: • Remnant Vegetation; • State Forest 65 South, State Forest 65 North and Gingin Stock Route Nature Reserve • Weeds and disease, including dieback (*Phytophthora*) and; • Declared Rare Flora, Priority Flora and other significant flora.	The EPA's objectives for this proposal in relation to terrestrial flora are to: Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities. Ensure that the conservation values and management of existing and proposed reserves are not compromised. Ensure that regionally significant flora and vegetation communities in these reserves are protected. Ensure that regionally significant flora and vegetation are adequately protected from the spread of weeds and diseases, including Dieback. Protect Declared Rare (DRF) and Priority Listed Flora (PLF), consistent with the provisions of *the Wildlife Conservation Act 1950* and the Commonwealth *Environmental Protection and Biodiversity Act 1999*	Detailed flora, vegetation and dieback surveys undertaken for the project provided the following description of the existing environment: • 29 plant communities and 1 disturbance community were described and mapped along the proposed line route. • 335 taxa of vascular flora belonging to 59 plant families were recorded from the proposed line route. • 32 weed species from 14 plant communities were recorded in the native vegetation along the proposed line route. • A single infestation of Dieback was identified at the proposed crossing of Moore River. • 2 declared rare flora and 4 priority listed species were recorded within close proximity of the proposed transmission line route corridor • The proposed transmission line corridor traverses State Forest 65 South, State Forest 65 North and Gingin Stock Route Nature Reserve.	The key potential impacts on terrestrial flora, vegetation and conservation estates resulting from the proposed Pinjar to Cataby transmission line may include: • Fragmentation and severance of State Forest 65 North, State Forest 65 South and Gingin Stock Route Nature Reserve. • Clearing of remnant native vegetation. • Loss or disturbance of significant flora species populations. • Introduction or spread of weeds. • Introduction or spread of soil borne diseases. • Increased risk of fires. • Generation of dust and waste. • Disturbances associated with increased access. • Positive impacts such as rehabilitation and controlled vehicle access	The following environmental management strategies have been identified that will enable the project to meet the objectives of the EPA: • Existing access tracks will be utilised where-ever possible. See Section 2.4.1 and Section 5.2.1.1 for details. • Vegetation control methods and transmission tower structure design and location will result in minimal vegetation clearing and temporary vegetation disturbance. See Section 2.4.1 and Section 5.2.1.1 for details. • An Environmental Management Plan (EMP) for both the construction and maintenance phase of the project will be implemented that will address issues of vegetation clearing controls, DRF & PLF, weed & dieback hygiene, fire management, dust suppression and waste management. • With the exception of one area, all areas of identified DRF, PLF and Threatened Ecological Communities have been avoided. See Section 5.2.1.2 for details on proposed management of affected DRF.	EPA Objectives can be met.

Table ES2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Fauna including: • Specially Protected (Threatened) Fauna	The EPA's objectives for this proposal in relation to fauna are to: • Maintain the species abundance, diversity and geographical distribution of fauna. • Protect Specially Protected, Threatened and Priority Fauna and their habitats, consistent with the provisions of the *Wildlife Conservation Act 1950* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*	An assessment of the fauna within the project area provided the following description of the existing environment: • 7 fresh water fish species, 1 of which is introduced. • 12 frog species. • 52 reptile species, 2 of which are of national conservation significance and another 2 of which are listed by Cogger et al (1993). • 53 wetland bird species, 3 of which are of national conservation significance. • 108 dryland bird species, 7 of which are of national conservation significance and another 2 of which are introduced. • 28 mammal species, 6 of which are of national conservation significance and 5 of which are introduced.	Potential impacts on fauna resulting from the proposed Pinjar to Cataby transmission line may include: • Fauna loss due to habitat removal and fragmentation. • Habitat loss as a result of increased access and the introduction of weeds, dieback and/or fire. • Direct fauna kills during the construction phase of the project. • Removal of habitat suitable for threatened species. • Creating a barrier to fauna movement.	The following environmental management strategies have been identified that will enable the project to meet the objectives of the EPA: • The potential for habitat fragmentation has been minimised by avoiding where-ever possible native remnant vegetation, e.g. traversing pine plantations and aligning the transmission line route near existing access tracks. • Vegetation control methods and transmission tower structure design and location will result in minimal vegetation clearing and temporary vegetation disturbance. See Section 2.4.1 and Section 5.2.1.1. • Habitat suitable for threatened fauna has been avoided. • An Environmental Management Plan (EMP) for both the construction and maintenance phase of the project will be implemented that will address issues of vegetation clearing controls, weed & dieback hygiene and fire management.	EPA Objectives can be met.

Table ES2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Wetlands including: Lakes Watercourses	The EPA's objectives for this proposal in relation to wetlands are to: Maintain the integrity, functions and environmental values of wetlands. Ensure Environmental Protection Policy Lakes (EPP Lakes) are protected and their key ecological functions are maintained. Maintain the integrity, function and environmental values of rivers, creeks and ephemeral streams.	An assessment of the wetlands within the project area provided the following description of the existing environment: The proposed transmission line route traverses the Moore River at one location. The southern portion of the proposed line route avoids damplands and EPP Lakes located near the eastern boundary of State Forest 65 South. The northern portion of the proposed line route does pass through a complex of sumplands and damplands. The proposed line route does not traverse any EPP Lakes.	Potential impacts on wetlands resulting from the proposed Pinjar to Cataby transmission line may include: Alteration to existing hydrological processes through the removal of wetland dependent vegetation. Degradation of wetland vegetation and impacts on wetland fauna.	The following environmental management strategies have been identified that will enable the project to meet the objectives of the EPA: Utilise existing access tracks located near wetland areas for construction and maintenance activities. All tower structures will be placed outside a 50m vegetation buffer surrounding each wetlands. All construction and maintenance activities will occur in dry conditions. All towers located near wetland areas will be placed in already cleared areas	EPA Objectives can be met.

Table ES2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Land Degradation	The EPA's objectives for this proposal in relation to soil is to: Ensure that vegetation clearing does not result in land degradation.	A review of the soils associated within the project area provided the following description of the existing environment: • The proposed line traverses Bassendean, Karrakatta, Cottesloe and Moore River soil units	Construction works have the potential to cause land degradation through soil erosion resulting from the removal of vegetation.	Where ever possible, exisiting access tracks will be utilised thereby minimising the removal of vegetation Construction Specifications will include the following: • Low vegetation to be retained where possible in drainage lines; • In vegetated areas, drainage to be directed into undisturbed bush; • No tree, soil, rock or debris to be pushed into drainage channels; • Drainage paths under/ through bridges, culverts shall not be blocked; • Exsting road or track drainage lines to be maintained as required. • See Section 5.2.4 of this document for further details.	EPA Objectives can be met.

Table ES2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Noise	The EPA's objective for this proposal in relation to noise is to: • Protect the amenity of residents from noise impact during construction, ensuring that noise levels meet statutory requirements and acceptable standards.	The proposed transmission line corridor is generally located away from areas of human settlement and traverses no townships or rural residential subdivisions. The closest rural residence is at least 200m from the proposed transmission line.	Transmission line construction activities having the potential to create noise emissions include the general movement of construction vehicles and the use of heavy materials. Post construction noise emissions is the use of helicopters for patrols and maintenance activities.	Construction acitivities will comply with the conditions set out for special cases in the Environmental Protection (Noise) Regulations 1997. See Section 5.3.1 of this document for further details.	EPA Objectives can be met.
Dust	The EPA's objective for this proposal in relation to dust is to: • Ensure that dust and particulate emission levels generated by the proposal, both individually and cumulatively, meet appropriate criteria and do not cause environmental or human health problems.	The proposed transmission line corridor is generally located away from areas of human settlement and traverses no townships or rural residential subdivisions. The closest rural residence is at least 200m from the proposed transmission line.	Transmission line construction activities having the potential to generate dust emissions include the general movement of construction vehicles and the use of heavy materials.	Special measures for dust control will be employed if an assessment of the corridor during construction activities indicates that there is a risk of a nuisance arising due to dust. Rehabiliation of rural land following construction (Section 2.8) will ensure that there will be no post construction dust impacts.	EPA Objectives can be met.

Table ES2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Electro - magnetic Fields	The EPA's objective for this proposal in relation to Electro-magnetic fields is to: • Protect the amenity and health of residents from potential impacts of electro-magnetic fields, ensuring that levels meet statutory requirements and acceptable standards.	Electro-magnetic fields (EMFs) can occur over a wide range of frequencies and are found whereever electricity is used. They are a natural by-product of the use of electricity and occur around all electric wires and electrical appliances. Hence, they are present in domestic and workplace environments as well as near ordinary street distribution lights and high voltage transmission lines such as the proposed transmission line from Pinjar to Cataby.	For most people the greatest exposure to power frequency EMFs arises from distribution lines in the street, household wiring and domestic electrical appliances. Based on field profiles (see Section 5..3.3), living near the proposed transmission line would not substantially increase this exposure.	Western Power is committed to the concept of prudent avoidance as a means of controlling exposures to EMFs if there is any doubt that they are harmless; it designs, constructs and operates all it's plants and facilities prudently within the guidelines recommended by the NH&MRC of Australia. See Section 5.3.3 for further details.	EPA Objectives can be met.
Effects of Electric Fields on Honeybees	The EPA Guidelines for the proposal also state that Western Power must identify the potential impact of EMFs on mating, navigation and physiology of honey bees, specifically Queen Bees.	An apiary site is located in the north western boundary of State Forest 65 North within the vicinity of the proposed transmission line route.	All the research studies undertaken to date have shown that there is no detrimental effects to commercial apiary operations such as queen bee breeding and honeybee production if the apiary sites are located in areas where the electric field exposure is less than 2kV/m.	The maximum electric field produced by the proposed Pinjar to Cataby 330kV transmission line is less than 2kV/m. Based on the studies identified in Section 5.3.3.1, it can be concluded that the proposal would not have a detrimental effect upon any commercial apiary operations such as queen bee breeding and honey production in the area.	EPA Objectives can be met.

Table ES2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Visual amenity	The EPA's objective for this proposal in relation to the visual amenity of the area is to: • Ensure that the visual amenity of the area is not significantly affected by the proposal.	A consultant Landscape Architect was engaged to investigate the visual resources of the project area. The Natural Landscape Character Units traversed by the proposed line route include the Coastal Plain, Coastal Ridges and a short section of valleys.	Potential impacts on visual amenity resulting from the proposed Pinjar to Cataby transmission line may include: • Impacts of views and small areas of significance and wilderness. • Impacts on the natural character in the vicinity of the proposed transmission line route.	The landscape study conducted for this proposal identified that the proposal had a moderate or high compliance with management objectives related to landscape character, visual aesthetic significnace and wilderness quality. See Section 5.4.1 of this document for further details of study. The study also found that the proposal had a low to moderate compliance with objectives related to views. As a result the study recommended modifications to the proposed line route, of which Western Power has investigated and will adopt two of the four proposed changes. Social issues related to impacts on small private holdings and existing landuse make the adoption of two of the proposed modifications problematic.	EPA Objectives can be met.

Table ES2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Aboriginal culture and heritage	The EPA's objective for this proposal in relation to aboriginal culture & heritage is to: • Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act 1972*. • Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Western Power will engage appropriately qualified consults to conduct archaeological and ethnographic surveys of the proposed transmission line alignment. The proposal traverses two Registered Native Title Claims. A Notice of Entry has been sent to the Representatives for the Claims stating Western Power's willingness to meet with Claimants or their representatives.	Potential impacts on Aboriginal Culture and Heritage resulting from the proposed Pinjar to Cataby transmission line may include: • The physical presence of the transmission line • Ground disturbing activities such as vegetation clearing, the preparation of tower foundations ans constructing access roads. • Indirect impacts may be due to increased erosion or to improved access to vulnerable sites.	The consultancy brief for the archaeological and ethnographic surveys will require the consultants to make recommendations on any modifications to the location , construction and operation of the transmission line necessary to ensure no heritage values are adversely affected. Western Power commits to the modification of the location of the transmission line to ensure that no Aboriginal Heritage values are adversely affected by the proposal.	EPA Objectives can be met.

Table ES2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
National Estate	The EPA's objective for this proposal in relation to the National Estate is to: • Ensure that the proposal complies with the requirements of the Western Australian *Heritage Act 1972* and the *Australian Heritage Commission Act 1975* and protects the identified values of places listed in the register of the National Estate and places listed on the Interim List of the Register of the National Estate.	The Heritage Council of Western Australia conducted a search of the Register of the National Estate, the State Register of Heritage Places and the State Places database. The search of the databases identify places of cultural significance within the region of the project area.	Construction activities has the potential to adversely affect National Estate Places. Activities include: • The physical presence of the transmission line • Ground disturbing activities such as vegetation clearing, the preparation of tower foundations ans constructing access roads. • Indirect impacts may be due to increased erosion or to improved access to vulnerable sites.	Whilst the search of the databases identified places of cultural significance within the region of the project area, there are no places in which the proposed transmission line route will impact on these places or the values associated with them.	EPA Objectives can be met.
Risk and hazard – Unexploded ordinance	The EPA's objective for this proposal in relation to Unexploded ordinances is to: • Establish the area potentially affected by unexploded ordinances in the vicinity of the proposed route.	The proposed line route traverse three WW2 era gazetted live firing areas and portions of the Defence Training area north of Lancelin. Therefore an assessment of the extent of unexploded ordinances (UXO) present within the proposed line route was undertaken.	Activities associated with the construction of the proposed transmission line preserns a risk to human health if UXOs are detonated.	The UXO Unit of the Fire and Emergency Services Authority (FESA) of Western Australia was commissioned by Western Power to conduct detailed search and remediation of the impact areas identified in the UXO assessment. Should any additional changes to the proposed Pinjar to Cataby transmission line arise from the environmental planning or EIA process, these changed alignments would be assessed for UXO contamination and where necessary remediated to eliminate UXO hazards.	EPA Objectives can be met.

ES7 Environmental Management Commitments

Western Power commits to the following outlined in Table ES3.

Table ES3: Proponent's Environmental Management Commitments for the Pinjar to Cataby Transmission Line.

Topic	Objective/s	Action	Timing	Advice
General Environmental Management	Manage environmental effects of the proposal.	**Commitment 1** Develop and implement an Environmental Management Program (EMP) that: 1. includes specific plans and procedures developed in consultation with concerned stakeholders through ongoing stakeholder liaison and discussion by the proponents officers, which addresses construction impacts and stakeholder concerns; 2. includes monitoring procedures and control of the activities of employees, agents and contractors to ensure adherence to environmental requirements identified in the EMP; and 3. is integrated into the existing Western Power Corporate Environmental Management System and documented in the Environmental Management Information System (EMIS).	Pre-Construction	CALM W&RC Aboriginal Groups/ Agencies
		Commitment 2 Implement the approved environmental management program referred to in Committment 1.	Construction Post Construction	CALM W&RC Aboriginal Groups/ Agencies
Vegetation	Minimise the impact of the proposal on remnant native vegetation including threatened species and vegetation communitites.	**Commitment 3** Prepare a vegetation plan that addresses: 1. a system of environmental offsets; 2. procedures to ensure that the transmission line does not reduce the overall area of remnant native vegetation within the State's secure conservation estate; and 3. the protection of Declared Rare and Priority Species.	Pre- Construction	CALM
		Commitment 4 Implement the approved vegetation management plan required by Committment 3.	Construction	CALM

Table ES3: Proponent's Environmental Management Commitments for the Pinjar to Cataby Transmission Line continued...

Topic	Objective/s	Action	Timing	Advice
Weeds	Control the spread of weeds along the transmission line corridor.	**Commitment 5** Prepare a weed management plan that addresses: 1. appropriate hygiene techniques to control the spread of noxious and environmental weeds along the proposed transmission line corridor between areas of native vegetation and agricultural land; 2. the conduct of post construction audits; and 3. where necessary the eradication of introduced weeds.	Pre-Construction	CALM WRC Agriculture WA Landowners
		Commitment 6 Implement the approved weed management plan referred to in Committment 5.	Construction Post-Construction	CALM WRC Agriculture WA
Phytophthora cinnamomi (Dieback)	Control the spread of *Phytophthora cinnamomi* resulting from activities associated with the proposal.	**Commitment 7** The proponent will prepare and implement a *Phytophthora* hygiene management plan based on the protectable areas protocol that addresses: 1. land tenure, vegetation condition and identified access routes; 2. specific strategies addressing post-construction activities associated with transmission line maintenance; and 3. the conduct of all activities within the Tiwest Joint Venture lease in accordance with the company's Dieback Management Plan.	Pre-Construction	CALM
		Commitment 8 Implement the approved *Phytophthora* hygiene management plan referred to in Committment 7.	Construction Post-Construction	CALM

1.0 Introduction

1.1 Purpose and Scope of Document

The purpose of this PER document is to provide the Department of Environmental Protection (DEP), the relevant government agencies and the general public with details on the environmental issues and the proposed management strategies associated with Western Power's proposal to construct and operate a new transmission line from Pinjar to Cataby.

Details are also provided on the transmission line route selection process (Section 3.0) based on environmental and social issues associated with the three transmission line route options investigated (i.e. the Western Option, the Common Corridor Option and the Eastern Option). The document also details the reasons for the selection of the **Western Option as the proposed transmission line route**. An overview of the location of the preferred transmission line route (the Western Option) is shown in Figure 2.1.

Details are also provided on the vegetation clearing activities that will occur in relation to the construction and maintenance of the proposed transmission line route option (Section 2.4 and Section 5.2.1.1).

The PER document is presented in two volumes. Volume 1 details the above-mentioned information, Volume 2 provides the maps and figures related to the proposal.

The following three supporting documents are also available which provide further details on the surveys and studies that were conducted as part of the line route selection process.

1) Woodman Environmental Consulting (2000) *"Flora, Vegetation and Dieback (Phytophthora cinnamoni) Survey"*, prepared for Western Power, Perth Western Australia.

2) Bamford, M.J. (2000) *"Fauna; impacts and their management in relation to the construction and maintenance of a 330kv transmission line between Pinjar to Cataby"*, prepared for Western Power, Perth Western Australia.

3) Cleary, J. (2001) *"Pinjar to Cataby Proposed Transmission Line Landscape Study"*, prepared for Western Power, Perth Western Australia.

Bamford (2000) and Cleary (2001) are available for public viewing at the DEP library, the JS Battye Library, the Environment Centre, and the relevant Shire libraries. They are also available for purchase from Western Power. Due to the confidentiality requirements of the Department of Conservation and Land Management (CALM) concerning the location of Declared Rare Flora, Woodman Environmental Consulting (2000) is available only on request and only after approval has been given by CALM and Western Power.

Please Note: The PER document (Volume 1 and Volume 2) is also available on Western Power's website at www.westernpower.com.au/per_pinjar and is also available in electronic form from Western Power.

1.2 The Proponent

The proponent for the project is:

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PERTH WA 6842

The proponent's contact person is:

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1.3 Overview of the Proposal

The existing power system in Western Power's North Country Region between Muchea and the Geraldton area is presently being supplied by two 132kV transmission lines. Current indications are that these transmission lines would have reached the limit of their capacities by the summer of 2003/2004. It is proposed to construct a new overhead transmission line approximately 123km in length between the Pinjar Gas Turbine Station and the Cataby Substation. The new transmission line would both reinforce and improve the quality and reliability of the power supply in an area in Western Australia which has also been experiencing regular power supply interruptions.

Note: This PER refers to a 330kV transmission line whereas the Referral document described a 132kV transmission line. The reason for the difference is that though a decision has not been made on the voltage of the proposed new transmission line, 132kV seemed more likely at the time of referral. However 330kV now seems more likely. Also, Western Power preferred to have a 330kV transmission line proposal assessed as this has in all respects a greater environmental impact than a 132kV transmission line proposal.

A 330kV transmission line would have greater physical environmental impacts associated with clearing and land requirements because of its larger ground footprints at tower sites. Clearing between tower sites to establish required electrical clearance and access to tower sites would be comparable although at the Moore River crossing clearing for a 330kV transmission line would be greater than for a 132kV transmission line. The 330kV line towers would also be significantly taller than the 132kV line towers resulting in greater visual impact.

1.4 Programme of Work

Load forecasts indicate that the existing transmission lines in Western Power's North Country Region would have reached their firm capacities by summer 2003/2004, hence requiring a new transmission line to be completed by November 2003. To meet this deadline it is imperative that Western Power obtains environmental approval by mid 2001.

On-site work associated with the construction of the line is programmed to commence in October 2001 in unrestricted areas and restricted to periods between November and April in areas subject to inundation.

2.0 The Proposal

2.1 Need for the Project

The construction of this line is necessary to ensure that the quality and reliability of the power supply in the North Country Region is adequately maintained beyond 2003. The Region is currently connected to Western Power's metropolitan transmission system via two 132 kV lines as illustrated in Figure 2.1.

These two transmission lines are presently operating close to their power transfer and operating capabilities, and given the anticipated growth in power demand in the Region over the coming years, the ability for these lines to cope with the load growth is expected to diminish by the summer of 2003/2004.

One of the consequences of not building the transmission line would be low voltages on the power system between Muchea and Geraldton. As Western Power has to meet statutory voltage limits the only alternative to building the transmission line would be the installation of equipment to shed large numbers of customers, during Summer and Winter peak electrical load times.

Another consequence of not building the transmission line would be the imposition of limits on electrical load in the region, resulting in constraints to growth and economic development.

The construction of this new transmission line is necessary to support and maintain the anticipated increase in power demand in the Region and mitigate the following problems:

- **Quality and Reliability of Supply**

The design of the existing 132 kV lines does not incorporate overhead earths, and the high isokeraunic levels (electric storms) result in poor local power quality due to numerous fault trips. The proposed new line will be designed to operate in this high isokeraunic region with higher levels of security.

- **Generation Expansion**

Due to transient and dynamic stability limitations, Western Power is unable to substantially add to the generation capacity in the North Country area without significantly reinforcing its existing transmission system, or reducing the security of the system. The installation of the transmission line will accommodate the generation expansion in the Region.

Following construction of the Pinjar to Cataby transmission line and other transmission lines to the north of Cataby it will become possible to connect gas powered generators at certain locations to supply customers in the Great Northern Region or at more distant locations on the South West Interconnected System. Possible locations for Gas Turbine generating stations are being investigated at present. The alignment of the proposed transmission line has not been influenced by the future location of generation sites. There is a degree of flexibility in determining Gas Turbine generating station locations, although sites near existing gas pipeline compressor stations may be favoured. Also additional sections of transmission line will be constructed to connect generation plant to the transmission system as and when required.

- **New Loads**

It is predicted that by 2002/2003 Western Power would not be able to supply new loads in the North Country Region to the current levels of reliability and security. The new transmission line will allow Western Power to accommodate significant or unexpected expansion of residential, commercial and industrial developments in the Region. Developments at Yanchep, Guilderton and Lancelin indicate that expansion along the north coast will continue. Without the proposed new line, regional growth may be constrained and problematic.

Though the transmission line will enable new industrial and commercial loads to be connected to the power system, the primary reason for building the transmission line is to ensure a satisfactory power supply to residential customers and landowners in the region into the foreseeable future.

- **Additional Transmission Lines and Long Term Strategy**

The new Pinjar-Cataby transmission line is part of a planned transmission system development in the Great Northern Region. The Pinjar-Cataby transmission line is the first stage of the system expansion plan. Western Power's current plans also include the construction of additional transmission lines between the Cataby substation and its gas turbine station at Mungarra approximately 50km south east of Geraldton.

At this time there are no plans for additional transmission lines other than those identified above linking Pinjar to Mungarra, although system expansion plans are subject to change depending on the growth of electrical load and the connection of additional generation capacity.

2.2 Location of the Proposed Transmission Line Route

The proposed transmission line route is approximately 123km in length, traverses 23 private properties and approximately 60km of native vegetation. Of the native vegetation traversed, 22km is within State Forest 65 North (SF65-North), 8.2km within State Forest 65 South (SF65-South), 2.5km in Gingin Stock Route Nature Reserve and approximately 24km on private properties.

Figure 2.1 provides an overview of the proposed transmission line route. South of the Moore River the proposed transmission line route, which emanates from the Pinjar Power Station, traverses the Gnangara Pine Plantation in SF65-South (approximately 25km), and areas of native vegetation within SF 65-South (approximately 8.2km) and also the Gingin Stock Route Nature Reserve (approximately 2.5kms) as well as private land. The Western Option crosses the Moore River in private land, traverses more private land, State Forest 65 North (SF 65-North) (approximately 22km), private land, Vacant Crown Land (VCL) and the TiWest Cataby Mine site. Where possible the alignment follows existing roads and tracks to minimise the clearing of vegetation.

Figure 2.2a and Figure 2.2b illustrate the location and some of the environmental factors associated with the proposed transmission line route including:

- Remnant Vegetation,
- State Forests
- Nature Reserves,
- Declared Rare Flora and Priority Listed Flora;
- Threatened Ecological Communities, and
- Conservation Wetlands

A number of different alignments along the proposed transmission line, (i.e. the Western Option), were investigated as part of the line route selection process.

One alternative alignment investigated was along the western boundary of SF65-North. This alignment along the proposed transmission line route was discarded after vegetation and flora surveys identified a CALM listed Threatened Ecological Community.

Other alternative alignments along the proposed transmission line route that were investigated were as a result of visual impact assessment of the area undertaken by Cleary (2001). Recommendations from this assessment suggested that Western Power investigate four alternative alignments along the proposed line route to minimise visual impacts. Two of the alternative alignments, one at the crossing of Sappers Road and the other in SF65-North were adopted. The other two recommended alternative alignments along the Western Option were not adopted as significant problems were identified on these alignments. They were within SF65-South and where the proposed line traverses the Moore River.

The recommended alternative alignment to reduce the visual impact of the proposed transmission line from view points at Wabling Hill in SF65-South and from Wanneroo Rd would require the transmission line to be located approximately 2.2km from the existing Gravitational Observatory and approximately 2km closer than the proposed alignment. Locations more distant from the Gravitational Observatory (between 2.2 and 4.2km from the observatory) would not significantly reduce visual impacts as the transmission line would be located on a ridge and would still be visible from Wabling Hill and Wanneroo Rd. However, studies performed by the Energy Systems Centre at the University of Western Australia indicate that there is a substantial risk that multi-spectral noise generated by corona discharge from normal transmission line operations 2.2km from the Observatory would jeopardise recordings of sensitive equipment used in the gravitational wave measurement process. As this Gravitational Observatory is part of an international monitoring network, Western Power has accepted

2.3 Description of Proposed Development

Line Specifications	
• Line Distance	→ Approximately 123 km
• Line Construction	→ 330,000 volt (330kV)
• Average tower height	→ 50 metres
• Minimum phase conductor-to- ground clearance	→ 9.0 metres (15.0 metres in areas of native vegetation)
• Typical span between towers	→ Approximately 400 metres

requests from Professor David Blair of the Physics Department at the University of Western Australia to locate the transmission line on the alignment approximately 4.2km from the observatory.

The other alternative alignment recommended as a result of the visual impact study was in the vicinity of the Moore River crossing. This alignment is not considered viable because of the effect it would have on private properties traversed. The area proposed for the alternative alignment contains small holdings, a poultry farm and pivot irrigation systems. The proposed alternative alignment would be located too close to dwellings or buildings forming part of the poultry farm to achieve safe electrical clearances or distances preferred by Western Power under its EMF prudent avoidance policy. More distant deviations would entail wider crossings of the Moore River, which would be unacceptable to the Water and Rivers Commission.

2.4 Vegetation Clearing

2.4.1 Vegetation Clearing for Construction Purposes

It will be necessary to remove or disturb vegetation during the construction stage of the project; this will involve permanent and temporary removal or disturbance depending on the area. **The total area of remnant native vegetation within secure conservation reserves affected by the proposal is 24.9 ha, including 23 ha of temporary vegetation disturbance and 1.9 ha of permanent clearing.** A description of the terms 'permanent vegetation clearing' and 'temporary vegetation disturbance' is provided below.

Table 2.1 provides further details on the construction activities that will require vegetation clearing or disturbance of some form.

- **Permanent Vegetation Clearing**

It will be necessary to permanently remove vegetation in some areas of the transmission line corridor to enable tower construction activities and to provide access to tower sites where access tracks do not already exist. Access to tower sites will be provided by cut in spurs from existing tracks and roads. Such spurs will be no longer than 300m in length.

Wherever possible, the proposed transmission line route has been aligned along-side existing access tracks. As such, these existing access tracks will be utilised as access tracks during both the construction stage and maintenance stage of the project.

In the areas where there is presently no access to a tower site, an initial 4m wide access track will be created to enable large vehicles to access the tower sites during the construction stage of the project. These 4m wide access will be created using a rubber tyred Front End Loader to push vegetation over. The Front End Loader blade will be raised above the ground to avoid disturbance to seed stock in the soil. At the completion of construction the 4m wide track will be able to regenerate to a width of 2m that will enable 4WD access to the tower site.

- **Temporary Vegetation Disturbance**

During the construction phase of the project it will be necessary to temporarily disturb or remove vegetation in some areas along the transmission line route in order to carry out the activities associated with tower erection and stringing of wire (conductors) between towers. After construction, vegetation that has been disturbed or removed for such activities will be allowed to regenerate.

In the areas where an access tracks does exist to enable access to each tower site, but is less than 4m in width, the existing access track will be widened to 4m to enable large vehicles to access the tower sites during the construction stage of the project. The 4m wide access will be created using a rubber tyred Front End Loader by pushing vegetation over to enable a 4WD vehicle to drive to the tower site. The Front End Loader blade will be raised above the ground to avoid disturbance to seed stock in the soil. At the completion of construction the 4m wide track will be able to regenerate to a width of 2m that will enable 4WD access to the site.

Temporary vegetation disturbance will involve driving over vegetation with a 4WD vehicle.

Temporary removal of vegetation will also involve the selective clearing of vegetation that can not be driven over by a 4WD vehicle.

Table 2.1 Construction activities that will require permanent vegetation clearing and/or temporary vegetation disturbance.

Vegetation Impacy	Activity	Description
Permanent Clearing	*Permanent vegetation clearing for new access track.*	The majority of the proposed transmission line route has been aligned along side existing access tracks thereby reducing the extent of permanent clearing of remnant native vegetation as well as reducing the necessity for creating permanent access tracks. Permanent vegetation clearing for access to tower sites will be necessary where existing access tracks veer away from the centreline of the proposed transmission line. Access to tower sites will be provided by cut in spurs from existing roads and tracks. Such clearing would involve the use of a Front End Loader to push vegetation over. There would be minimal soil disturbance.
	Permanent vegetation clearing for tower site.	A 14 metre x 14 metre permanent clearing for the tower site. Such clearing would involve the use of a Front End Loader to push vegetation over. There would be minimal soil disturbance.
Temporary Disturbance	*Temporary vegetation disturbance for access track.*	The vegetation clearing and tower erection stage requires heavy vehicle access along the line route to each of the tower sites; this will require an access track 4 metres in width during the construction phase. Wherever possible the transmission line route has been aligned to follow existing access tracks which, if less than 4m in width, will be temporary widened to 4m. At the completion of construction, the 4m wide track will be able to regenerate to a width of 2m that will enable 4WD access to the site. Vegetation disturbance would involve driving over vegetation with a 4WD vehicle and in some cases selectively removing tall shrubs and trees.
	Temporary vegetation disturbance for tower site construction.	During the construction phase the tower erection activities involve the transport of materials to the tower site, the installation of foundations and the erection of towers. Vegetation within an area 50m x 50m (2304m2) around each tower site will need to be temporarily disturbed for these activities to occur. At the completion of construction, the vegetation that has been temporarily disturbed for tower erection activities will be able to regenerate.
	Temporary vegetation disturbance for stringing access.	The stringing of the conductors onto the towers requires the running out, tensioning and clamping of the line conductors and earthwires onto the insulators and their fittings. This will require the temporary disturbance of vegetation along a temporary 2m wide strip between each tower. Vegetation disturbance would involve driving over vegetation with a 4WD vehicle and in some cases selectively removing tall shrubs and trees. At the completion of construction, the vegetation that has been temporarily disturbed for stringing access will be able to regenerate to a height of 9m.

2.4.1.1 Vegetation Clearing Scenarios

Table 2.2 describes the four vegetation clearing scenarios for remnant native vegetation that will be employed along different sections of the transmission line route during the construction phase of the project. Figures 2.3 to 2.5 illustrate these vegetation clearing scenarios. Vegetation clearing scenarios proposed within specific areas of remnant vegetation along the proposed transmission line route corridor are detailed in Section 5.2.1.1.

2.4.1.2 Vegetation Rehabilitation

All activities associated with remnant native vegetation clearing, construction and maintenance of the transmission line will be managed to ensure no loss of soil seed stock. No process will involve removal of topsoil. This should ensure successful vegetation regeneration following clearing and construction activities.

Past experience with transmission line projects that have employed processes that avoid the disturbance of

Table 2.2 Remnant Native Vegetation Clearing Scenarios Proposed Along the Transmission Line Route.

Scenario	Description
Vegetation Clearing Scenario #1 (See Figure 2.3 for an illustration of this vegetation clearing scenario)	• Towers will be placed approx 400m apart. • Access track already exists. • Transmission line route will be aligned to follow existing access track. • Towers will be placed in centre of existing access track. • Permanent diversion access track will be created around each tower. • No clearing required for stringing conductors. • No clearing required for majority of access track if existing track is 2m wide. • **Clearing Required:** → Permanent Clearing - approx 196m^2 tower site and a 2m wide by approximately 55m long diversion access track. → Temporary Clearing - approx 2304m^2 for tower construction activities. Possible temporary clearing of existing access track if track is not already 4m wide.
Vegetation Clearing Scenario #2 (See Figure 2.4 for an illustration of this vegetation clearing scenario)	• Towers will be placed approx 400m apart. • Access track already exists. • Transmission line route will be aligned to run along-side existing access track. • Towers will be placed to the side of the existing access track. • No clearing required for access track if existing track is already 4m wide. • **Clearing Required:** → Permanent - approx 196m^2 for tower site. → Temporary - approx 2304m^2 for tower construction activities; 2m wide by 400m long temporary track for conductor stringing. Possible temporary clearing of existing access track if track is not already 4m wide.
Vegetation Clearing Scenario #3 (See Figure 2.5 for an illustration of this vegetation clearing scenario)	• Towers will be placed approx 400m apart. • Access track already exists. • Transmission line route will be aligned to run along side the existing access track as close as is possible. • 'Cut-in spurs' will extend off the existing access track in order to erect towers and access tower sites. • Final width of 'cut-in spurs' will be 2m. • Length of 'cut-in spurs' will range from 10m to 300m depending on location of existing track in relation to tower site. • **Clearing Required:** → Permanent – approx 196m^2 for tower site; 2m wide 'cut-in spur'. → Temporary – approx 2304m^2 for tower construction activities; 2m wide by 400m long temporary track for stringing conductors. Possible temporary clearing of existing access track if track is not already 4m wide.

Table 2.2 Remnant Native Vegetation Clearing Scenarios Proposed Along the Transmission Line Route continued...

Scenario	Description
Vegetation Clearing Scenario #4	• This clearing scenario relates to the area where the proposed transmission line traverses the Moore River. • Existing tracks located near the Moore River will be utilised for access for construction and maintenance activities. • All tower structures will where possible be placed in existing cleared areas. • No tower structures will be placed within the Moore River. • Trees taller than 9 m within a corridor of 60m will be selectively removed, leaving the tree roots in place to bind the soil; trees taller than 9m will be cut on a continuing basis to maintain safety clearances (see Section 2.4.2). • Further consultation with WRC will determine the exact location of crossing the River and the placement of towers.

soil seed stock and removal of topsoil indicate that there should be no need for vegetation rehabilitation by planting of seedlings or direct seeding in areas of native vegetation.

On agricultural lands rehabilitation will be conducted to ensure no land degradation. Rehabilitation will include the provision of seedlings to landowners where individual trees are removed.

Rehabilitation will only be conducted in areas of native vegetation where this is necessary because of a lack of natural regeneration. Stakeholders including CALM and the WRC will be consulted to determine the need for rehabilitation in specific locations such as river crossings.

2.4.2 Vegetation Control for Safety Requirements

To ensure that the transmission line operates in a safe and secure manner, and to prevent bushfires, vegetation clearing and control will be required within the transmission line corridor. However, the extent of vegetation clearing will be dependent upon local vegetation height and the height of the conductors above the ground.

Where vegetation clearing is required, every effort will be made to minimise the impact on the local environment. Clearing will conform to a predetermined 'clearing profile', based on safe operating clearance limits. These limits also take into consideration the maximum allowable height of trees, undergrowth and scrub that may be retained within the corridor. As Figure 2.6 illustrates, the 'clearing profile' relevant to the proposed Pinjar to Cataby transmission line route allows vegetation to reach a maximum height of 9 metres. Therefore in areas of Banksia woodlands, which are typical of most of the proposed alignment, no permanent clearing will be required other than for access and tower sites.

Trees will need to be removed where they infringe the required clearance limits to live conductors for maximum conductor sag conditions.

Western Power will regularly maintain the cleared areas within the transmission line corridor to ensure that no vegetation encroaches into the clearance limit zone of the transmission line.

The vegetation clearing work will be carried out by external contractors and in accordance with the clearing profiles detailed in this document, requirements of the DEP, the Department of Conservation and Land Management (CALM) and the relevant Local Government Authorities.

Western Power will liaise with appropriate stakeholders regarding the disposal of vegetation and debris. Wherever possible, alternative uses for the cleared vegetation materials for firewood or milling will be encouraged.

2.5 Line Construction

The proposed transmission line will be constructed on lattice steel towers. The construction of the line is generally carried out in three distinct stages, namely:

- survey and vegetation clearing;
- tower erection; and
- the stringing of conductors

The clearing and tower erection stages require heavy vehicle access along the line route to each of the tower sites. Heavy equipment to be used for construction includes pile drivers, 20 tonne all-terrain cranes, trucks and semi-trailers. The conductor stringing process requires access along the route to play out and suspend draw wires and/or conductors.

The tower erection activities include the transport of materials to site, the installation of foundations and the erection of the towers.

The stringing phase will involve the installation of the line insulators and their associated hardware on the towers, followed by the running out, tensioning and clamping of the line conductors and earthwires onto the insulators and their fittings. Follow up work would involve fitting of tower accessories and a final inspection.

2.6 Line Maintenance

Once the transmission line is put into service, future maintenance activities on the line would generally involve the following:

- Periodic visual inspection of conductors, insulators and towers from the air and ground;
- Cleaning and replacement of line components as required;
- Maintenance of the vegetation profile; and
- Visual monitoring of easement condition to identify problems such as erosion and weed infestation.

Permanent access would be required to each of the tower sites to facilitate activities ranging from inspections and minor repairs to major work such as replacement of tower members or electrical components such as insulators. Maintenance access would be limited to:

- Two line patrols per year by four wheel drive vehicle along the line corridor during dry soil conditions between November and April (an additional patrol or patrols would be conducted from aircraft);
- Routine maintenance at selected locations along the line corridor requiring access by maintenance trucks and elevated work platforms (EWPs), once per year during dry soil conditions between November and April;
- A climbing inspection of towers requiring access by maintenance trucks and elevated work platforms (EWPs), during dry soil conditions between November and April once every 5 years;
- Emergency maintenance access by maintenance trucks and elevated work platforms (EWPs) to specific (usually single) locations once every 5 years on average.

The above access requirements represent worst case conditions. Generally access would be less than stated above. Vegetation control activities would be limited to ensuring access tracks remain free from large vegetation.

There would be little requirement for vegetation control within the transmission line corridor as the minimum conductor height above ground in areas of native vegetation is 15m, this means that vegetation can grow to a maximum height of 9m, enabling a 6m safety clearance between the vegetation and the conductor. Given that the majority of the proposed transmission line route is banksia woodlands which generally grows to a maximum height of 6m, there will be only a small number of areas along the route that will require vegetation control, for example the crossing of the Moore River.

2.7 Line Easements

The granting of a line easement by a landowner to Western Power, in general terms means the granting of certain rights to Western Power, including the right of entry to survey, clear, construct and maintain the transmission line. Western Power does not obtain title to the area of land affected by the line easement and ownership will always remain with the registered landowner.

There are two reasons for the registration of easements on a transmission line. The first is to do with the need to control and maintain public safety within the easement area and the second, concerns maintaining the operational security of the line.

The granting of a line easement by a landowner to Western Power precludes the construction of buildings, sheds, windmills, etc within the easement area. Should a landowner require to undertake works such as excavations, changes to ground levels, drains, etc within the easement, then prior approval must first be obtained from Western Power. For safety reasons, vegetation height will also need to be controlled within the easement area.

Normal farming operations such as grazing and cropping are permitted within the easement area. Similarly, normal farm fences, including electric fences are also permitted within the easement.

The width required for the easement is 60m. This figure is based on maintaining a controlled safe-zone where certain activities, obstacles and tall vegetation are excluded. Outside this zone, activities such as operation of heavy machinery and equipment, the construction of buildings and the growth of tall vegetation is considered safe.

The easement width should not be confused with the width of clearing required for the proposed transmission line. The clearing width is considerably

less than 60m because of the relatively low form of the native vegetation (see Section 2.4.1 and Section 5.2.1.1 for details on remnant native vegetation clearing requirements). However an easement width of 60m is required to prohibit unsafe land use close to the transmission line.

2.8 Compensation and Restoration

Compensation will be paid by Western Power to affected landowners who suffer any loss of production as a result of work on the transmission line on their property. The form and amount of compensation paid will be negotiated with the landowners, based, if necessary, on advice and recommendations from the relevant Authorities such as the Valuer General and Agriculture WA.

Affected landowners will also be offered seedlings to replace any trees removed from their properties. These seedlings should be planted in a new area remote from the line corridor.

It is inevitable that during the line survey, vegetation clearing and construction of the line, some damage may occur on some properties despite Western Power's best intentions to prevent them. All necessary actions will be taken by Western Power to either rectify/reinstate the damages or, if the affected landowner prefers, to negotiate and remunerate accordingly.

Upon completion of all the on-site work on the line, Western Power will liaise with landowners to arrange for any restoration work that may be required on their properties.

3.0 Transmission Line Route Selection Process

The selection of the transmission line route involved the following processes:

- Desktop analysis of available environmental planning information;
- Site visits to confirm planning information;
- Detailed discussion and involvement with potentially affected stakeholders;
- Selection of line route options;
- Evaluation of alternative options and selection of a preferred line route.

An initial desktop analysis determined constraints and potential transmission line corridors. Information used in this desktop analysis included, two line corridors identified for connection to the proposed Hill River Power Station (Dames & Moore, 1989) and digital geographic data layers comprising tenure, landuse, ecological and infrastructure layers and digital aerial photography of potential corridors.

The initial desktop study identified constraints to transmission line corridors and a preliminary line route option was selected. This preliminary line route was then used as the basis for stakeholder involvement in the refinement of the proposed transmission line route (the Western Option), and in the generation of alternative transmission line route options. Alternative line route options were identified to address concerns identified during the public involvement process. These alternative options were identified in general terms initially then refined through the processes discussed above, desktop assessment of constraints and issues and stakeholder involvement in detailed line route selection discussions.

The Eastern Option, was an alternative transmission line route investigated, in response to concerns raised by CALM regarding the amount of vegetation clearing potentially required along the Western Option, as well as concerns of landowners potentially affected by the Western Option.

The Common Corridor Option was also an alternative transmission line route option investigated and is located adjacent to an existing transmission line. This option was considered in response to questions and suggestions by stakeholders located along the Western and Eastern Options.

In selecting these route options a range of factors required consideration including:

- Absolute constraints such as National Parks and aircraft landing grounds;
- Land use issues, including potential urban development and/or subdivision, mining tenements/ mineralisation, agricultural activities;
- Impacts on conservation areas, wetlands, recreation areas and Natural Heritage sites;
- Impacts of vegetation clearing along the line corridor;
- Potential spread of the root pathogen *Phytophthora cinnamomi;*
- Potential spread of weeds;
- Potential soil erosion associated with the construction and maintenance of the transmission line;
- Effect of the transmission line on the visual amenity of the area;
- Concerns over perceived health risks from transmission lines;
- Bombing ranges – presence of unexploded ordinances;
- Aboriginal archaeological and ethnographic sites;
- Native Title claims;
- Bio-diversity issues including rare and endangered flora and fauna sites;
- The Australian International Gravitational Observatory site.

3.1 Consultation with the Local Community and Government Agencies

The stakeholders consulted during the line route selection process were: landowners potentially affected by having a transmission line located on their property, representatives of environmental agencies responsible for managing and protecting land and natural environments, including CALM, Water and Rivers Commission (WRC), and representatives of local government authorities traversed by the proposed transmission line.

Discussions between the proponent and stakeholders have been conducted wherever possible through face to face meetings.

A number of meetings were held by Western Power representatives with environmental agency representatives to establish issues for consideration in line route planning decisions and geographic locations

of environmental significance. Selection of the line routes relied on the use of geographic information systems and spatial information provided by environmental and land management agencies, to identify constraints to possible line route locations.

Discussions with local authorities affected by the project were limited to Council briefings and participation by local authority representatives in meetings between the proponent and landowner action groups.

Landowner consultation included one on one discussions and meetings between Western Power representatives and landowner groups attended by local authority representatives and members of State Parliament. Western Power representatives also addressed the Gingin Land Conservation District Committee (LCDC) in relation to the proposed transmission line.

All landowners were provided with information about the proposal. A period of negotiation then ensued where owners suggested alternative locations for the transmission line and possible relocation options were developed according to their wishes on an individual basis. At the end of that period of negotiation, a compromise line route alignment was selected.

Table 3.1 provides a list of the government agencies and community groups consulted throughout the corridor selection process.

Table 3.1: Government agencies and community groups consulted throughout the corridor selection process.

Agency	Issue
• Department of Environmental Protection	• Environmental issues associated with line route options.
• CALM Wanneroo	• State Forest 65 South • State Forest 65 North • Gingin Stock Route Nature Reserve
• CALM Woodvale Research Centre	• Threatened Ecological Communities.
• CALM Wildlife Branch	• Threatened Fauna, includes: 'rare or likely to become extinct'; 'birds protected under an international agreement' and 'other specially protected fauna.
• Water & Rivers Commission	• Management categories for wetlands.
• Australian International Gravitational Centre	• Avoiding potential for impact on Gravitational Observatory located in Gnangara Park
• Minter Ellison Consultants	• Areas subject to Native Title claims
• Heritage Council of Western Australia	• Areas of cultural heritage significance
• Shire of Gingin	• Effects on people living in the shire and associated issues
• Shire of Dandaragan	• Effects on people living in the shire and associated issues
• AgWest	• Remnant vegetation issues
• Dandaragan Landowner Action Group (Eastern Option)	• Effects on private land owners properties and associated issues
• Landowner Action Group (Western Option)	• Effects on private land owners properties and associated issues

3.2 Geographical Information System (GIS)

The identification and investigation process for transmission line route selection involved the use of a computer based geographical information system (GIS).

The digital data was assembled into layers to indicate areas unfavourable to the location of a transmission line. Such layers included Environmental Protection Policy (EPP) wetlands, conservation wetlands, threatened vegetation communities and populations of Declared Rare Flora (DRF), areas of high conservation value such as National Parks, System 5 & 6 reserves and natural heritage areas, mineralized areas and buildings including houses.

Contour and terrain data were also used to determine areas of high visibility from surrounding areas especially recreation sites and roads carrying high traffic volumes. Digital elevation data was also useful in locating the transmission line to avoid areas of high erosion potential. Digital data analysis was supplemented by site visits to verify the accuracy of various data layers.

Digital terrain data was also used to assess the implications of Department of Defence controlled low flying areas.

The digital data was useful in determining areas favourable to the location of a transmission line corridor such as existing tracks traversing areas of native vegetation, and private property boundaries. Remnant vegetation data was used to minimise the total area of remnant vegetation affected by the transmission line.

Digital aerial photographs were overlaid onto other digital data to assist in the determination of exact alignments to minimise local environmental and property effects.

3.3 Consideration of Alternatives

Several alternatives for a new transmission line between Pinjar and Cataby, either proposed by the proponent or suggested by stakeholders during the public participation process, are discussed below or in other sections of this PER.

The alternatives considered were:

1. **Construction of an additional new overhead transmission line on an alignment to the west of the existing Pinjar-Cataby transmission line.**

   This alignment is the Proponent's preferred option (the Western Option) and is the focus of this PER.

2. **Construction of an additional new overhead transmission line on an alignment adjacent to the existing Pinjar-Cataby transmission line.**

   This alternative is referred to as the Common Corridor Option and is discussed further in Section 3.4.2 of this PER. The relative merits and problems associated with the Common Corridor Option are considered in detail as part of the comparison of options in Section 3.5.

3. **Construction of an additional new overhead transmission line on an alignment to the east of the existing Pinjar-Cataby transmission line.**

   This alternative is referred to as the Eastern Option and is discussed further in Section 3.4.3 of this PER. The relative merits and problems associated with the Eastern Option are considered in detail as part of the comparison of options in Section 3.5.

4. **Replacement of the existing transmission line with a new transmission line on the same alignment as the existing Pinjar-Cataby transmission line.**

   This alternative, whilst proposed by most stakeholders, is not considered viable by the Proponent. Section 2.1 describes the necessity to construct an additional transmission line to ensure that the quality and reliability of the power supply in the North Country Region is adequately maintained beyond 2002. The Region is currently connected to Western Power's metropolitan transmission system by two 132 kV lines.

   Simply replacing the existing transmission line with a new transmission line would not provide sufficient capacity or security of supply. Thus in order to construct a new transmission line with two new circuits (comprising six live conductors and two earth wires) as well as the existing single transmission circuit (having three live wires) would require new structures capable of supporting three circuits (i.e, nine live wires and two earth wires).

   Such structures would need to be built on an alignment next to the existing transmission line. The existing transmission line would be de-commissioned following completion of the three-circuit transmission line.

   The problems with such an arrangement are:

   - Security of supply to the entire region would be jeopardised as a lighting strike or bush fire

would take out three of four transmission circuits supplying the region compared with two circuits if separate transmission line structures are employed;

- The cost of the three-circuit arrangement would be prohibitive (between 50% and 70% higher) compared with the cost of a new double circuit transmission line.
- A new three-circuit transmission line constructed adjacent to the existing Pinjar-Cataby transmission line would cause a range of environmental and social impacts almost identical to those described for the Common Corridor Option (Section 3.4.2).

5. Construction of a new transmission line incorporating sections of overhead conductor and underground cable.

This alternative is also not considered viable by the proponent but was proposed by several stakeholders. The preferred Western Option is 123km in length (75km through private land - the shortest distance through private land of the three options investigated). If Western Power were to underground a double circuit 330kV-transmission line over the entire 123km the cost would be $861M. If Western Power were to underground the sections through private land only, the cost would be $525M. Western Power could not fund either of these undergrounding options despite some obvious benefits. Selective undergrounding on some private properties would be possible if this was funded by the individual property owners or by a developer acting for the property owners. Individual property costs would be more than $7M per km of double circuit 330kV-transmission line.

In addition to prohibitive costs for an underground cable option, some environmental effects would not be reduced through the use of underground cable. Though there would be almost no visual impact from underground cable, construction impacts associated with clearing and soil disturbance would be greater than for an overhead transmission line. Also, electric and magnetic field effects would not be reduced and exposure levels may be higher because of the closer proximity of people to underground cables than overhead conductors (underground cable would be buried approximately 1m below ground).

3.4 Description of Alternative Transmission Line Route Options Investigated

3.4.1 Background

Three options were considered for the proposed Pinjar-Cataby transmission line. The proposed transmission line route option (the Western Option) has been briefly described in Section 2.2, and will be discussed in detail in Section 4 and Section 5 of this document. The alternative options that we investigated as part of the transmission line route selection process, i.e. the Common Corridor Option and the Eastern Option, are described below. Figures 2.2a and 2.2b illustrate the location of these alternative options.

3.4.2 Common Corridor Option

The Common Corridor Option would involve locating the new transmission line adjacent to and in a common corridor with the existing wood pole 132kV transmission line from Pinjar to Cataby. This would require the existing corridor increase in size from 40m to 90m. The Common Corridor Option is 109 kms in length, traverses approximately 38 private properties and 39km of remnant vegetation, including 14km in two Nature Reserves, 8.7km in Moore River National Park and 16km on private properties. The Common Corridor Option also traverses a series of 'Conservation' wetlands that run in a north-south direction between the Moore River National Park and the Yeal Nature Reserve. These wetland areas extend for approximately 23 kms and are generally seasonally inundated or waterlogged. Wetlands with high conservation values are also present within and north of the Moore River National Park.

The Common Corridor Option emanates from the Pinjar Power Station, then follows the same alignment as the existing Pinjar to Cataby wood pole transmission line through the Yeal Nature Reserve (approximately 12.5km) and private properties west of the Brand Highway before crossing the Highway and extending for approximately 3kms before recrossing it. It then traverses the Moore River National Park, the Namming Nature Reserve and approximately 37kms of private property.

Figures 2.2a and 2.2b illustrate some of the environmental factors associated with the Common Corridor Option including:

- Remnant Vegetation;
- Nature Reserves;
- National Park;
- Declared Rare Flora (DRF) and Priority Listed Flora (PLF);

- Threatened Ecological Communities (TEC);
- System 6 areas;
- Australian Heritage Listed areas;
- Conservation and Resource Enhancement Wetlands; and
- Environmental Protection Policy Lakes (EPP Lakes)

3.4.3 Eastern Option

The Eastern Option, approximately 119km in length, traverses approximately 51 private properties and 39km of remnant vegetation, including 13km in two Nature Reserves and 22km on private properties. The Eastern Option also traverses a series of 'Conservation' category wetlands north of Yeal Nature Reserve. This wetland area extends for approximately 18 kms and is generally seasonally inundated or waterlogged.

The Eastern Option emanates from the Pinjar Power Station then runs parallel to the existing Pinjar to Cataby transmission line through Yeal Nature Reserve (approximately 12.5km) and private properties west of the Brand Highway (approximately 13km). The new alignment and the existing Pinjar to Cataby transmission line diverge, 1km south west of the Brand Highway allowing the new alignment to avoid a number of conservation wetland areas and minimise the visual impact of the Brand Highway crossing.

The Eastern Option then traverses private property east of the Brand Highway, Gingin and Boonanaring Nature Reserve and Quins Hill and private properties (mainly broadacre farms) for the remaining 100km to Cataby. To minimise visual impact and effects on landuse and farming activities, the route avoids major ridges and is generally responsive to landform.

Note that most land owners contacted during discussion regarding the Eastern Option and other options requested Western Power to locate the transmission line on property boundaries to minimise social impacts including effects on livelihood and lifestyle. Western Power took the decision that where possible such requests would be accommodated to reduce individual and community concern and distress. As such, the Eastern Option followed property boundaries wherever possible and as a consequence, areas of remnant vegetation would need to be traversed. As the vegetation traversed by the Eastern Option is generally taller (including areas of Marri woodland) than that traversed on the Western and Common Corridor options (mainly Banksia woodland) a wider corridor would need to be cleared along some areas on the Eastern Option. Also, unlike the Western and Common Corridor options, it would generally not be possible to "span" across the top of existing remnant vegetation.

Significant environmental issues associated with the Eastern Option transmission line route are conservation wetland areas, significant vegetation, dieback infestation and visual impacts.

Figures 2.2a and 2.2b illustrate some of the environmental factors associated with the Eastern Option including:

- Remnant Vegetation;
- Nature Reserves;
- Declared Rare Flora and Priority Listed Flora;
- Threatened Ecological Communities;
- System 6 and System 5 areas;
- Australian Heritage Listed areas;
- Conservation and Resource Enhancement Wetland; and
- Environmental Protection Policy Lakes

3.5 Evaluation of Options

This section summarises the process and outcomes of the evaluation of the three options considered for the proposal, that is the Western Option (the proposed option), the Common Corridor Option and the Eastern Option. This process included the determination of significant environmental and social issues, the development of criteria for the assessment of these issues, the rating of risk for each issue based on the criteria and prediction of the severity and risk of impacts associated with each option.

3.5.1 Significant Environmental and Social Issues

The line route selection process avoided areas that present an absolute constraint to transmission lines, such as:

- Aircraft landing grounds;
- Residential areas; and
- Mining tenements

In addition, the following environmental, social and economic issues were identified and considered in the line selection process:

- Impacts on conservation areas, wetlands and recreation areas including National Parks, System 6 and Natural Heritage areas;
- Bio-diversity issues including rare and endangered flora and fauna sites and threatened plant communities;

- Aboriginal archaeological and ethnographic sites;
- Native Title claims;
- Impacts of vegetation clearing along the line corridor;
- Potential soil erosion associated with the construction and maintenance of the transmission line;
- Landuse issues, including potential development and / or subdivision; mining tenements / mineralisation, agricultural activities;
- Effects on landowners and local communities;
- Effect of the transmission line on the visual amenity of the area;
- Concerns over perceived health risks from transmission lines;
- Bombing ranges – presence of unexploded ordnances;
- Impacts on the Remote Instrument Landing System facilities;
- Impacts on low level flying, including crop dusting/ spraying;
- Potential impacts on the Australian International Gravitational Observatory site;
- Impacts on agricultural land uses;
- The effect on agricultural, local and domestic activities

These issues were identified through consultation with potentially affected stakeholders as described in Section 6.0. The following principles, also derived from stakeholder consultation, were used where possible to guide the line route selection process:

- Avoid entering National Parks;
- Avoid areas of Declared Rare Flora, Priority Species and threatened plant communities;
- Minimise distances of new alignments across conservation lands - ie: use existing roads/tracks;
- If crossing conservation lands, where possible, divide the land into large rather than small management segments (smaller segments reduce the potential for conservation management, increase ecological consequences and cause fragmentation);
- Minimise the overall extent of clearing;
- Minimise or avoid traversing wetlands;
- Minimise effects on landowners;
- Minimise visual impact;
- Avoid restrictions on future land use, such as mining, where possible;
- Minimise the overall cost by reducing the number of angles and the total transmission line length.

3.5.2 Assessment Criteria

In order to compare the relative overall impact associated with the three transmission line route options detailed above, it was necessary to develop criteria for assessing the relative importance of issues identified as significant. This enabled a risk weighting to be assigned to each factor so that the range of impacts for each option could be compared with impacts for other options. A multi-criteria evaluation technique was employed to determine the relative weighting of significant issues.

The risks associated with each issue were allocated scores using a scoring system used in the determination of environmental significance for environmental aspects and impacts associated with the Western Power Environmental Management System (EMS) (EMS Procedure No. 2). The risk associated with each issue was assessed on a 3, 4 or 5 point scale. Categories of risk considered were:

- scale (local, regional, and global);
- Regulations (nil, procedure, policy, legislation);
- duration (short term, moderate, ongoing); and
- effect on public image (positive, negligible, low, moderate, high).

The public image risk rating is associated with the potential effect each issue could have on Western Power's public image. Thus for example the potential effect on Western Power's image of not managing vegetation issues adequately by inappropriate or excessive clearing was assigned a risk rating in Table 3.2 of 3 on a four-point scale. Similarly inappropriate activities in national parks were assigned a public image risk rating of 4 on a four-point scale. The issues considered for rating by public image, although selected through stakeholder consultation, correspond closely to the environmental factors the EPA provided for consideration and assessment in the PER guidelines.

An overall risk rating was obtained by summing the component risk scores (Table 3.2).

Whilst the allocation of risk scores is somewhat subjective, scores were based on the best available information and results of the Community and Stakeholder Consultation (Section 6.0). Also, sensitivity analysis performed on the scores indicated that variations in rating scores did not influence the choice of the preferred option.

3.5.3 Options Comparison

Potential transmission line options were generated for detailed investigation after considering environmental constraint information (Figure 2.2a, 2.2b), social and economic constraint factors and after extensive consultation with affected stakeholders (see Sections 3.0-3.3). The three geographic alignments selected for detailed investigations (the Western Option, the Common Corridor Option and the Eastern Option) were each considered viable alternative options prior to detailed investigations. As can be seen from Figure 2.2a other possible areas considered for transmission line alignments were constrained because of extensive wet areas including Conservation Wetlands, the requirement for new clearing/access in National Parks and Nature Reserves and the requirement for new clearing/access in areas of remnant vegetation.

One area between SF65 North and the Moore River National Park was also considered as a potential alignment for the new transmission line. Discussions with potentially affected landowners, an assessment of the extent of remnant vegetation, dwelling locations and landuse in this area indicated that a line corridor through this area would be problematic. It was not possible to avoid dwellings and areas considered significant by landowners. Also the transmission line route would need to traverse extensive areas of remnant vegetation.

The three options selected were then investigated in detail and issues arising were analysed and used as a basis for options comparison.

The three transmission line route options were assessed using the risk ratings determined (see Table 3.2) and a detailed assessment of site specific issues for each option (see Table 3.3). The assessment of options (Table 3.4) indicated that the Western Option would have a lower overall environmental, social and economic impact than the other two options considered. The impact severity rating used in Table 3.4 was derived from the information on site specific issues contained in Table 3.3. The combined Severity/Risk rating used in Table 3.4 was derived by multiplying the issue specific risk rating (Table 3.2) by the impact severity.

Sensitivity analysis performed on the individual risk ratings and impact severity rating produced the same preferred transmission line route option.

Table 3.2: Comparison of Issues by Risk Rating

Issue	Scale (local/regional/global) (rating 1-3)	Regulations (nil/procedure/policy/ legislation) (rating 0-3)	Duration (short term/moderate/ ongoing) (rating 1-3)	Public Image (no effect/negligible/low/ moderate/high) (rating 0-4)	Risk Rating (sum of other ratings)
Vegetation	2	3	2	3	10
National Parks	2	3	3	4	12
State Forest	2	3	3	3	11
Nature Reserves	2	3	3	3	11
Weeds	1	3	2	1	7
Dieback Risk	2	3	3	2	10
DRF/Priority/Significant Flora	1	3	3	3	10
Threatened Ecological Communities	1	3	3	3	10
Threatened Fauna	1	3	3	3	10
EPP Lakes	1	3	3	3	10
Conservation Wetlands	1	2	3	3	9
Visual Amenity	2	1	3	3	9
Wilderness Quality	1	0	3	1	5
Aboriginal Heritage	1	3	3	3	10
Public Health & Safety - UXO	1	3	3	4	11
Public Health & Safety - Low Flight Zones	2	3	3	4	12
Landuse Existing	1	3	3	2	9
Landuse Potential	1	2	3	4	10
Landowners	1	2	3	3	9
Shires	2	3	3	1	9
Line Length	2	1	3	0	6
Number of Angles	2	1	3	0	6
Number of Structures	2	1	3	0	6
Construction Restrictions	1	1	1	0	3

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated.

Biophysical Factors

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Terrestrial Flora	Vegetation	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation.	**Remnant Vegetation** • 24km on private property • 2.15 km in Gingin Stock Route Nature Reserve • 8.2km in State Forest 65 South • 22km in State Forest 65 North • 4.9km Vacant Crown Land • Relatively uniform Banksia woodland, generally low numbers of DRF/Significant Species within 400m of the corridor (source: CALM digital data)	**Remnant Vegetation** • 16km on private property • 8.7km in Moore River National Park • 12.5km in Yeal Nature Reserve • 1.7km Namming Nature Reserve • 100metres in Nature Reserve • Significant areas of wetland vegetation and Banksia woodland • High numbers of DRF/Significant Species within 400m of the corridor (source: CALM digital data)	**Remnant vegetation** • 22km on private property • 12.5km in Yeal Nature Reserve • 2km Quins Hill area • 3km in Badgingarra Nature Reserve • Areas of Banksia woodland and wetland vegetation south of Brand Highway • Moderate numbers of DRF/ Significant Species within 400m of the corridor (source: CALM digital data) • Unique Marri woodlands exist to the north of this option, i.e. approximately 16kms north of Moore River National Park. These Marri woodlands are extremely significant (Griffin, 2000, pers. comm.). • Significant Marri woodlands exist to the north of this option, i.e. approximately 16kms north of Moore River National Park. (Griffin, 2000, pers. comm.).

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated continued...

Biophysical Factors continued

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Terrestrial Flora	National Parks	Ensure the conservation values and management of the National Park is not compromised.	No issues	**Moore River National Park** • Line traverses 8.7km • System 6 area • Australian Heritage Listed area • High conservation wetlands and dependant vegetation. • High presence of DRF and priority listed flora, e.g. Paracaleana dixonii (DRF) and Conostephium minus and Verticordia paludosa (PLF). • High presence of Lysinema elegans • Significant vegetation within the Park (Griffin, 2000, pers. comm.).	No issues
	State Forest	Ensure the conservation values and management of the State Forest is not compromised.	**State Forest 65 South** • Line traverses 27.5kms, of which 18kms is pine plantation. • Where possible the line will follow existing roads and tracks minimising effects on proposed Gnangarra Park. **State Forest 65 North** • Line traverses 22kms • The line would follow existing tracks wherever possible.	No issues	No issues

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated continued...

Biophysical Factors continued

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Terrestrial Flora	Nature Reserves	Ensure the conservation values and management of the Nature Reserve is not compromised. Ensure that Regionally significant flora and vegetation communities in the Reserve are adequately protected.	**Gingin Stock Route** • Line traverses 2.5km • Vegetation consists of low woodlands of *Banksia attenuata* and *B.menziesti.* • Vegetation survey conducted for the proposal indicates flora and vegetation communities are represented within other areas of the Swan Coastal Plain (Woodman Environmental Consulting 2000). • Tower structures would be stratrgically placed within existing cleared areas of the Reserve.	**Yeal Nature Reserve** • Line traverses 12.5km • System 6 area • Australian Heritage Listed area • Vegetation survey conducted for the proposal mapped a range of vegetation of which their Conservation Status is susceptible, i.e. could be modified or vulnerable to new threatening processes (Woodman Environmental Consulting 2000). **Namming Nature Reserve** • Lines traverses 1.7km • Vegetation consists of low woodlands of *Banksia attenuata* and *B.menziesii.* **Other Nature Reserve** • Line traverses 100 metres • Priority listed flora present within the Reserve – *Verticordia lindleyi subsp. lindleyi*	**Yeal Nature Reserve** • Line traverses 12.5km • System 6 area • Australian Heritage Listed area • Vegetation survey conducted for the proposal mapped a range of vegetation of which their Conservation Status is susceptible, i.e. could be modified or vulnerable to new threatening processes (Woodman Environmental Consulting 2000). **Badgingarra Nature Reserve** • System 5 area

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated continued...

Biophysical Factors continued

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Terrestrial Flora	Other Areas of Significance	Ensure that Regionally significant flora and vegetation communities are adequately protected.	No Issues	No Issues	**Quins Hill** • The high conservation value of the area should be protected (Department of Conservation and Environment, 1983).
	Weeds	Ensure that regionally significant flora and vegetation are adequately protected from the spread of weeds.	Ensure adequate management practices during construction and maintenance	Ensure adequate management practices during construction and maintenance	Ensure adequate management practices during construction and maintenance
	Dieback Risk	Ensure that regionally significant flora and vegetation are adequately protected from the spread of dieback.	Relatively low risk due to the soil type and minimal wet areas, i.e. this option is located almost primarily on Spearwood Dune system, with well drained soils with limestone a common feature as a basement material or present at the surface. Dieback survey conducted for the proposal identified the presence of dieback at the Moore River (Woodman Environmental Consulting, 2000).	Relatively high risk due to soil type and wet areas, i.e. this option is located entirely within the Bassendean system and is characterised by grey leached soils and extensive wetland systems. • Yeal Nature Reserve: survey conducted for the proposal identified a large infestation of dieback (Woodman Environmental Consulting 2000). • Conservation wetland areas running north-south between Yeal Nature Reserve and Moore River National Park • Moore River National Park: survey conducted for the proposal identified areas of disease expression within the National Park (Woodman Environmental Consulting 2000).	Relatively high risk due to soil type and wet areas, particularly: • Yeal Nature Reserve: urvey conducted for the proposal identified a large infestation of dieback (Woodman Environmental Consulting 2000). • Conservation wetland areas running north-south between Yeal Nature Reserve and Moore River National Park

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated continued...

Biophysical Factors continued

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Terrestrial Flora	DRF, Priority Flora and other significant flora	Protect DRF Protect other flora of conservation significance.	CALM digital data indicates that 3 areas have been identified within 400 metres from the line that contain Priority Flora. Flora surveys conducted for the proposal recorded one DRF population and one PLF species along the proposal transmission line corridor (Woodman Environmental Consulting 2000).	CALM digital data indicates that 17 areas have been identified within 400 metres from the line that contain either DRF or PLF. Flora surveys conducted in Yeal Nature Reserve for the proposal recorded two PLF species along the proposed transmission line corridor (Woodman Environmental Consulting 2000). Flora surveys conducted in Moore River National Park for the proposal recorded one plant of a Priority Three species and approx. five plants of a possible Priority One species along the proposed transmission line corridor (Woodman Environmental Consulting 2000).	CALM digital data indicates that 9 areas have been identified within 400 metres from the line that contain either DRF or PLF. Flora surveys conducted in Yeal Nature Reserve for the proposal recorded two PLF species along the proposed transmission line corridor (Woodman Environmental Consulting 2000).
Terrestrial Flora	Threatened Plant Community	Protect vegetation communities of conservation significance.	One area has been identified approx. 400 metres from the proposed transmission line that contains a threatened plant community, i.e. MYWABL05. This community will not be impacted by the proposal.	No Issues	No Issues

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated continued...

Biophysical Factors continued

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Terrestrial Fauna	Specially Protected (Threatened Fauna)	Protect Specially Protected (Threatened) Fauna and priority Fauna species and their habitats, consistent with the provisions of the	Vegetation clearing requirements for the proposal following the Western Option would minimise habitat disturbance, i.e. existing tracks will be utilised wherever possible and taller towers will enable native vegetation to grow to full maturity in most areas.	This option passes through a complex of wetlands which provides a large area of waterbird habitat. Given the location of these wetlands it will be difficult to avoid clearing some wetland dependent vegetation, therefore there is the potential to impact on these habitats (Bamford, 2001).	The fragmented areas of remnant native vegetation within the agricultural landscape is of high conservation value, therefore there is the potential to impact small but significant areas of fauna habitat (Bamford, 2001).
Wetlands	EPP Lakes	Maintain the integrity, functions and environmental values of wetlands consistent with the provisions of the *Environmental Protection Policy – Swan Coastal Plain Lakes.*	All EPP Lakes have been avoided.	Given the nature of the area it is extremely difficult to avoid some EPP Lakes. • 4 EPP Lakes are traversed.	Given the nature of the area it is extremely difficult to avoid some EPP Lakes. • 3 EPP Lakes are traversed.

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated continued...

Biophysical Factors continued

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Wetlands	Conservation and Resource Enhancement Wetlands.	Maintain the integrity, functions and environmental values of wetlands.	There is one "Conservation" wetland that will be traversed; which is 100 metres in width. Taking into account a 50 metre vegetation buffer, it would be possible to span this wetland, i.e. 400 metre span from structure to structure without removing any wetland dependent vegetation. There is also existing tracks located near the wetland that will be used for access for construction and maintenance activities.	• This option traverses a complex of "Conservation" wetlands and EPP Lakes. • WRC would strongly oppose this option. • The WRC generally oppose any construction activity within the area of conservation or resource protection wetlands including buffer zones. • The WRC have advised that a vegetation buffer zone of 50 metres around wetland dependent vegetation is required to minimise potential impacts on wetlands as a result of constrution activities. Given the nature of the area there are some cases where it is not physically possible or feasible to avoid impacting on some of the 'Conservation' wetlands through the removal of wetland dependant vegetation.	• This option traverses a complex of "Conservation" wetlands and EPP Lakes. • WRC would strongly oppose this option. • The WRC generally oppose any construction activity within the area of conservation or resource protection wetlands including buffer zones. • The WRC have advised that a vegetation buffer zone of 50 metres around wetland dependent vegetation is required to minimise potential impacts on wetlands as a result of constrution activities. Given the nature of the area there are some cases where it is not physically possible or feasible to avoid impacting on some of the 'Conservation' wetlands through the removal of wetland dependant vegetation.

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated continued...

Social Factors

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Aesthetic	Visual amenity	Ensure the visual amenity of the area is not significantly affected by implementation of the proposal.	Low number of landowners. Relatively low proportion of significant features. No Level 1 (high sensitivity) road crossings. Approximately 22km of pine plantation (good screening potential). High proportion of remnant vegetation compared to other options.	No steep slopes. One ridge crossing. Relatively high proportion of significant features. Relatively high proportion of A Zone (high public sensitivity). Two Level 1(high sensitivity) road crossings. High number of key views to the route. High proportion of route visible.	Low proportion of remnant vegetation compared to other options. Potential for landform screening of the route. Relatively high proportion of significant features. Relatively low proportion of C Zone (low public sensitivity). Two Level 1 (high sensitivity) road crossings. Relatively high proportion of steep slopes. Crosses a relatively high number of ridges.
Culture and Heritage	Aboriginal culture and heritage	Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Archaeological and ethnographic surveys will be conducted, effects managed, where necessary line relocated. Native Title Claims: • Combined Metro (Registered) • Ballaruks (Unregistered) • Yued (Registered)	Archaeological and ethnographic surveys will be conducted, effects managed, where necessary line relocated Native Title Claims: • Combined Metro (Registered) • Ballaruks (Unregistered) • Yued (Registered) • Bropho 1 (Unregistered)	Archaeological and ethnographic surveys will be conducted, effects managed, where necessary line relocated Native Title Claims: • Combined Metro (Registered) • Ballaruks (Unregistered) • Yued (Registered) • Bropho 1 (Unregistered)

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated continued...

Social Factors continued

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Public Health and safety	Risk & Hazard Unexploded ordinance (UXO)	Ensure transmission line does not jeopardise public safety	All areas of potential UXO contamination surveyed and made safe.	Several areas of potential UXO contamination would need to be surveyed and made safe	Several areas of potential UXO contamination would need to be surveyed and made safe
	Aeroplane Flying Zones, including: Remote Instrument Landing System (RILS) Aerial Spraying Low Flying Zones	Ensure transmission line does not jeopardise public safety	No issues	RILS within 1.5 km of corridor	RILS within 1.5 km of corridor Aerial spraying occurs in the area Low flying zones occur within the area
Landuse	Existing landuses	-	Intensive agriculture, grazing, horticulture, pine plantations, conservation	Grazing, horticulture, tree plantations, conservation	Cropping grazing, horticulture, tree plantations, conservation
	Potential landuses	-		Mineralisation	Mineralisation
Land Owners	Private landowners affected	-	18 private properties traversed	38 private properties traversed	51 private properties traversed
Shires	Shires affected	-	Wanneroo Shire Dandaragan Shire Gingin Shire (preference for maximum use of Crown Land)	Wanneroo Shire Dandaragan Shire Gingin Shire	Wanneroo Shire Dandaragan Shire Gingin Shire

Table 3.3: Site Specific Issues Associated with the Transmission Line Route Options Investigated continued...

Business Factors

Factor	Site Specific	EPA Objective	Western Option	Common Corridor Option	Easten Option
Costs	Line Length	Minimise overall length	123km	109km	119km
	Number of Angles	Minimise number angles	34 angles	10 angles	20 angles
	Number of Structures	Minimise number structures	Unknown	Unknown	Unknown
Operations	Timing restrictions (i.e.wet season)	Maximise construction time to meet construction program	Access restrictions in one wet area near TiWest Mine and Moore River crossing	Major access restrictions to construction due to wetland areas and dieback risks	Major access restrictions to construction due to wetland areas and dieback risks

Table 3.4: Comparison of the Transmission Line Options Investigated

Issue	Western Option		Common Corridor Option		Eastern Option	
	Impact Severity (0-4)	**Combined Severity/Risk Rating** (Severity*Risk)	**Impact** Severity (0-4)	**Combined Severity/Risk Rating** (Severity*Risk)	**Impact** Severity (0-$4)	**Combined Severity/Risk Rating** (Severity*Risk)
Vegetation	2	20	2	20	3	30
National Parks	0	0	2	24	0	0
State Forest	2	22	0	0	0	0
Nature Reserves	1	11	2	22	2	22
Weeds	1	7	1	7	1	7
Dieback Risk	1	10	2	20	2	20
DRF/Priority/Significant Flora	1	10	2	20	1	10
Threatened Ecological Communities	2	20	0	0	0	0
Threatened Fauna	0	0	1	10	1	10
EPP Lakes	0	0	2	20	2	20
Conservation Wetlands	0	0	4	36	4	36
Visual Amenity	2	18	3	27	3	27
Wilderness Quality	2	10	1	5	2	10
Aboriginal Heritage	1	10	1	10	1	10
Public Health & Safety - UXO	2	22	2	22	2	22
Public Health & Safety - Low Flight Zones	1	12	4	48	4	48
Landuse Existing	2	18	2	18	2	18
Landuse Potential	3	30	4	40	2	20
Landowners	2	18	3	27	3	27
Shires	1	9	1	9	1	9
Line Length	1	6	1	6	1	6
Number of Angles	1	6	1	6	1	6
Number of Structures	1	6	1	6	1	6
Construction Restrictions	1	3	3	9	3	9
All Factors	30	268	45	412	42	373

3.5.3.1 Significant Issues Associated with the Three Options Investigated

A detailed comparison of the significant issues for the three options is given below. This indicated that in addition to the Western Option being selected as the preferred option on the basis of risk and impact ratings, certain constraints applying to the Common Corridor and Eastern Options would make these options not viable without significant modification.

- **Aircraft Low Flight Areas**

The Common Corridor and Eastern Option alignments would not be viable without significant modification as they encroach on two low flying areas controlled by the Department of Defence. The Department of Defence has advised that both these options constitute an obstruction and are hazardous to flying safety at RAAF Base at Gingin and the Remote ILS/TACAN Site at Beermullah. Areas hatched on Figure 3.1 are of prime concern to the Department of Defence as transmission towers located within the hatched area would affect aircraft safety during circling, take off and approach procedures. The Department of Defence have advised that they could not support the Common Corridor or Eastern Option alignments without significant re-routing and reduction in tower height.

Analysis of Figure 3.1 indicates that a deviation of at least 3km to the west of the Common Corridor Option alignment would be required in the vicinity of the Remote ILS/TACAN Site at Beermullah. Such a diversion would place the alignment within a large area of conservation wetlands. A diversion to the east would not be practical as structures would be limited to a height of no more than 15m.

The Western Option is generally acceptable to the Department of Defence provided that the maximum elevation of the structures does not exceed the elevations (RL) given in Figure 3.1. This is achievable with minor adjustments to tower heights and locations.

The existing Pinjar-Cataby transmission line predates the Remote ILS/TACAN and other Department of Defence facilities. This existing transmission line is acceptable to the Department of Defence because the three pole support structures have a height of 20m compared with a standard design height of 50m for the structures of proposed new transmission line. Design calculations indicate that the minimum height of a double circuit 330kV-transmission line structure would be approximately 31m. This height is necessary to ensure safe clearances between live conductors and the ground using the most compact configuration available. This minimum height is greater than that permissible within the Department of Defence Control Area (Figure 3.1). Even using minimum height 330kV transmission towers it would be necessary to significantly realign the transmission line route away from the existing Pinjar to Cataby transmission line to comply with Department of Defence requirements. The project would not be viable with extensive use of low height transmission structures.

- **Mineralised Areas**

Advice from the Department of Minerals and Energy (DME) indicates that the Common Corridor Option would traverse significant areas of mineralization located on private and Crown land, particularly north of Brand Highway crossing near Beermullah Road West. A deviation of the Common Corridor Option alignment to avoid these mineralized areas would locate the alignment in areas of Conservation Wetlands and in the Moore River National Park in areas populated by species of Declared Rare Flora (DRF) and Priority Listed Flora.

- **Conservation Wetlands**

Both the Eastern Option and the Common Corridor Option traverse an extensive area of wetlands, which include Environmental Protection Policy Lakes (EPP Lakes), *damplands, palusplains, sumplands, floodplains* and *holes* (Figure 3.2). The management categories of the wetlands affected by these route options include 'Conservation', 'Resource Enhancement' and 'Multiple Use' as defined by Hill *et al* (1996). The Common Corridor Option also traverses 'Conservation' wetlands to the south and north of the Moore River National Park as well as within the Park.

The proposed transmission line route option (Western Option) avoids the damplands and EPP Lakes located near the eastern boundary of SF65-South and the Yeal Nature Reserve. Further to the north, the line avoids a chain of swamplands, which include Three Mile Swamp, Imbat Swamp, Nilgen Swamp and Carba Garba Swamp. One 'Conservation Wetland' will be traversed along the Western Option however it would be possible to span this dampland without removing wetland dependant vegetation. The WRC have advised that they would not support either the Common Corridor Option or the Eastern Option.

Western Power have been advised by the WRC that a large number of the wetland areas that would need to be traversed along the Common Corridor and Eastern Options are of 'conservation' and 'resource

enhancement' value and therefore require a buffer zone of 50 metres around wetland dependent vegetation in order to minimise potential impacts as a result of construction activities. Given the nature of the area there are some cases where it is not physically possible or feasible to avoid impacting on some of the 'conservation' wetlands through the removal of wetland dependent vegetation.

- **Flora and Vegetation**

Experienced Botanists undertook flora and vegetation surveys along the length of the proposed transmission line route (Western Option) and sections of the Eastern Option and Common Corridor Option. The findings of these surveys are presented in detail in Woodman Environmental Consulting Pty Ltd (2000). The following provides a summary of the main findings of these surveys for the purposes of comparing the three options.

The flora and vegetation along the three options is of variable condition, composition and quantity. The Eastern Option traverses the smallest area of native vegetation of the three options. The southern end passes through several vegetated wetland areas and there are several small remnant vegetation blocks along the remaining length of this option. There are very few conservation reserves in the area adjacent to the Eastern Option and those that are present are very small. The Common Corridor Option follows the existing transmission line through the Yeal Swamp Nature Reserve, conservation wetlands, the Moore River National Park and several unnamed reserves along the Brand Highway. The Western Option passes through areas of native vegetation in SF65-South, SF65-North, the Gingin Stock Route Reserve, VCL and remnant vegetation on private property.

South of the Moore River, vegetation has been mapped at the complex level by Heddle *et al.* (1980). The Eastern and Central Options pass through the Karrakatta Complex–North, Karrakatta Complex-North-Transition Complex, Bassendean Complex-North, Bassendean Complex-North-Transition Complex and Yanga Complex before splitting. These complexes consist of low forests, woodlands and sedgelands on deep sands. The Yanga Complex occurs on moister low-lying areas. The Eastern Option then crosses the Coonambidgee, Moondah, Karamal South, Karamal North and Mogumber North vegetation complexes. The Coonambidgee Complex is located on the Swan Coastal Plain, while the other complexes are all unique to the Dandaragan Plateau. These complexes on the Dandaragan Plateau are floristically unique and dominated by heath vegetation and low forests and woodlands (Heddle *et al.* 1980).

After the Common Corridor Option and Eastern Option diverge from each other, the Common Corridor Option then crosses the Bootine, Coonambidgee, Bassendean North and Moore River Complexes. These complexes all occur on the Swan Coastal Plain and consist of low forests, woodlands and sedgelands. The Moore River Complex is restricted to the banks of the Moore River, while the Coonambidgee Complex is restricted to a narrow band adjacent to the Brand Highway.

The Western Option crosses the Cottesloe North and Karrakatta North Complexes, both components of the Spearwood dune system. The vegetation structure within these complexes is determined by the depth of sand over limestone and varies between woodlands and heaths. North of the Moore River, the Western Option passes into the Bassendean Dune system, characterised by deep grey sands.

The Common Corridor and Eastern Options both pass through the Yeal Swamp Nature Reserve, which has been surveyed in detail by Woodman Environmental Consulting (2000). This conservation area was dominated by Banksia woodland vegetation, the majority of which was in very good condition. No Declared Rare flora species were recorded during the survey of the reserve. However one Priority 4 species, *Stachystemon axillaris*, was recorded approximately 6.5km north of the southern reserve boundary. The species *Schoenus* affin. *laevigatus* was also recorded. If the identification could be confirmed when this species was flowering it would represent a significant range extension for this taxon, which is common to the far south of the state, with only one previous recording from the Perth metropolitan area. The Gingin Wanneroo Branch Drain was in a generally poor condition due to weed invasion and the impact of *Phytophthora cinnamomi* (dieback). A significant area on the north side of the drain was infested with dieback, with the area so heavily impacted as to be impossible to map as a plant community. Several of the plant communities mapped within the Nature Reserve are unrepresented elsewhere within the conservation reserve system (Gibson *et al.* 1994).

Vegetation along the northern section of the Eastern Option has been largely cleared for agriculture, with very few intact remnants remaining. Any areas of uncleared vegetation therefore have high conservation significance and contain vegetation associations not represented within the reserve system. These include Marri (*Corymbia calophylla*) woodlands, which are very

restricted locally (Griffin, 2000 pers. comm.) There are very few conservation areas within this region. The Eastern Option also passes through several conservation wetlands.

North of Yeal Swamp Nature Reserve the Common Corridor Option also crosses several Conservation wetlands, before traversing extensive areas of agricultural land and the Moore River National Park. Woodman Environmental Consulting (2000) surveyed vegetation along the Central Option corridor within the park in detail. This survey found vegetation within the National Park to be dominated by Banksia woodland in very good condition. Several dampland areas were also mapped. Red Gully Creek crosses the proposed route near the southern end of the park. The vegetation within the creek was in poor condition due to the impact of dieback caused by *Phytophthora cinnamomi*. All of the plant communities mapped within the park are well represented within the reserve system, with the exception of those communities influenced by the soil of the Dandaragan Plateau.

No DRF taxa were recorded within the National Park during the survey. One plant, a Priority Three species *Stylidium nonscandens*, was recorded at one location. A possible Priority One species *Stylidium carlquistii*, was also recorded although the identification could not be confirmed due to a lack of flowering material. Several other interesting flora species were recorded during the survey. A collection of a possible new subspecies of *Philotheca spicata* was made on the north side of Red Gully Creek. This was named *Philotheca spicata* subsp. Moore River National Park and a specimen has been retained by the Western Australian Herbarium for further study. Another collection named as Cyperaceae/Liliaceae sp. could not be identified to a family level by staff at the Herbarium and it may therefore be a new species. However, a lack of flowering material prevented any further study of the collected specimen. *Leucopogon sp.* Moore River (M.Hislop 1695) was also recorded. This species has a restricted distribution and has not yet been fully described. A possible range extension was recorded for *Melaleuca subtrigona*. This taxon has not previously been recorded from the coastal plain, being common on the Dandaragan Plateau.

The Western Option does not pass through any conservation wetlands or reserves, although it crosses areas of native vegetation within SF65-South, SF65-North and the Gingin Stock Route. The northern section of the Western Option also passes through native vegetation on VCL. A range of plant communities has been mapped along this proposed route alignment, including woodlands, shrublands and heaths. Unlike the Common Corridor and Eastern Option, this route crosses through extensive areas of limestone and its associated heath vegetation. The condition of native vegetation along this option varies, with the majority of vegetation on private property in very poor condition (Woodman Environmental Consulting 2000). The Banksia woodland communities mapped along the Western Option are well represented within the reserve system, as are the majority of heath and shrublands. One Threatened Ecological Community is present within SF65-North, as is a DRF taxon and a Priority 4 species. The northern section of the Western Option passes through areas largely typical of the Kwongan vegetation of the region, all of which are well represented within the reserve system (Mattiske Consulting 1997). Three Priority flora species were recorded in the northern area.

In summary, very little remnant vegetation is present along the Eastern Option, with the existing remnants largely unrepresented within the conservation reserve system. The conservation significance of these remnants is therefore very high. Both the Eastern and Common Corridor Options also pass through conservation wetlands, which are also poorly represented within the reserve system. Further north, the Common Corridor Option passes through several conservation reserves and a National Park. These areas contain plant communities poorly represented within the reserve system, as well as restricted and unusual flora species. The Western Option passes through larger areas of vegetation but will require clearing of less vegetation known to be poorly represented within the reserve system.

- **Phytophthora (Dieback)**

Experienced dieback interpreters undertook dieback surveys along the length of the proposed transmission line route (Western Option) and sections of the Eastern Option and Common Corridor Option. The findings of these surveys are presented in detail in Woodman Environmental Consulting Pty Ltd 2000. The following provides a summary of the main findings of these surveys for the purposes of comparing the three Options.

The Eastern Option traverses primarily uncleared native vegetation on the Bassendean Dune system from Pinjar north through the Yeal Swamp Nature Reserve until it turns to the east and crosses the Regan Scarp onto the Dandaragan Plateau. The majority of the route on the Dandaragan Plateau is through cleared agricultural land with only a few scattered remnants of native vegetation encountered. The route then crosses back into the Bassendean Dune system at the Cooljarloo Mine Access Road where the Cataby substation is situated.

The vegetation of the Bassendean Dune system is primarily composed of Banksia woodlands of varying composition with understoreys dominated by plants from the following families; Myrtaceae, Dilleniaceae, Epacridaceae, Proteaceae and Papilionaceae (Heddle *et al.* 1980). The vegetation is highly susceptible to infestation by dieback and disease impacts in this vegetation are usually high resulting in severe modification to both the tree and understorey strata (Hill *et al.* 1994). Surveys by Woodman Environmental Consulting (2000) have identified that the southern section of this route through the Yeal Swamp Nature Reserve has a single large infestation associated with the Yeal Lake and Gingin Wanneroo Branch Drain. This infestation has a high disease impact with total removal of the tree stratum and extreme modification of the understorey.

The vegetation of the Dandaragan Plateau includes a variety of complexes as described by Heddle *et al.* (1980). The soils are primarily well drained sands and gravels over lateritic gravels and clays, and apart from the Wandoo woodlands of the Karamal Complex - North that are associated with clay soils, the vegetation is dominated by the highly susceptible plant families Myrtaceae, Dilleniaceae, Epacridaceae, Proteaceae and Papilionaceae. No surveys of this portion of the route were undertaken, and no regional surveys covering this area have been conducted to provide a regional context for discussion. The Dandaragan Plateau section of this route however is probably less susceptible to the effects of dieback than the more westerly sections because rainfall reduces dramatically east of the coast resulting in the soils being drier than on the coastal plain for longer each year. In addition, the well-drained soils are not conducive to the establishment and spread of dieback.

The Common Corridor Option traverses the Bassendean Dune system from Pinjar, roughly parallel to the Brand Highway to the Cataby substation. This route encounters significant areas of uncleared native vegetation on both Crown land and private property. The southern section of this route is common to both the Common Corridor Option and the Eastern Option, traversing the Yeal Swamp Nature Reserve.

The Common Corridor Option is characterised by vegetation types associated with various types of wetlands and drainage lines. Woodman Environmental Consulting (2000) assessed both the vegetation and dieback distribution for two sections of this route. These areas were the Yeal Swamp Nature Reserve and the Moore River National Park, both of which contained active dieback infestations. The dominant vegetation types present along this route are various different Banksia Woodlands with some Myrtaceous and Epacridaceous heaths present in wet areas. The Common Corridor Option is extremely vulnerable to the effects of dieback due to the wet nature of the topography and the Bassendean soils. The vegetation types present along the Common Corridor Option are also highly susceptible to dieback, resulting in a generally high risk of introduced inoculum establishing and causing severe disease symptoms.

The Western Route option, being located primarily on the Spearwood Dune system is dominated by well-drained soils, with limestone a common feature as a basement material or present at the surface. Disease risk increases with moisture status of the soils and is greatest in low, wet areas such as swamps, drains and creeks (Hill *et al.* 1994). The vegetation of this route however, is dominated by Banksia woodlands and flora assemblages highly susceptible to the effects of dieback.

Apart from the Moore River area (known to be infested) and a few wetter sites closer to Cataby, the Western Route Option contains few wet areas and therefore is less vulnerable to the effects of dieback than the routes traversing the Bassendean Dune system.

In summary, the potential risk imposed on the environment of the possible introduction of dieback is assessed in terms of the vulnerability of the site and the susceptibility of the receiving vegetation. Site vulnerability is a function of the factors that the pathogen requires for survival and reproduction, and these include:

- Moisture (annual rainfall approximately 600 mm or greater).
- Nutrient deficient neutral or slightly acidic soils.
- Host plants as dieback is as obligate parasite/pathogen (these do not need to be susceptible species as dieback can survive and reproduce on non-susceptible species).

All three route options discussed contain moderately to highly susceptible vegetation types and floral assemblages, however the relative risk to the environment posed by the introduction of the pathogen to each of them varies according to the relative vulnerability of each option as discussed above. Following this reasoning, the Common Corridor Option poses the greatest risk while the Eastern Option and Western Option would probably pose the least risk in terms of dieback introduction.

The relative risk of the introduction of dieback is also related to the type of activities undertaken and more

specifically to the potential for soil movement along the proposed transmission line corridor. As indicated in Section 2.5 and Section 2.6, the overwhelming majority of Western Power vehicle movements (including heavy vehicle movements) along the transmission line corridor will occur during the construction phase of the project. Vehicle movement for transmission line maintenance and vegetation control will be infrequent and at a low absolute level. All transmission line construction, maintenance and vegetation control activities will be undertaken during dry summer months between November and April, except where emergency maintenance requires access at other times (an extremely rare, localised and short duration event). Thus the greatest potential risk of soil movement related to transmission line activities is from transmission line construction activities carried out in permanently wet areas or poorly drained areas subject to long periods of inundation. The Common Corridor and Eastern options contain large vegetated areas subject to inundation whereas the vegetated sections of the Western Option traverse areas of predominantly well-drained soils.

It could be argued that non-Western Power vehicle movements could increase if the proposed transmission line corridor requires the creation of new through access to off road or other vehicle users. Such vehicle movements would be largely uncontrolled and could increase the potential for soil movement especially during wet conditions. None of the proposed options, including the Western Option, requires the installation of new through access. The Eastern and Common Corridor options use tracks adjacent to an existing transmission line on CALM managed lands and existing or new access on private property. The Western Option also utilises existing tracks on CALM managed lands, and other areas of remnant vegetation, but will require the installation of spurs from existing tracks to tower sites. These spurs are no longer than 200m in length and will not create new through access in areas of remnant vegetation. Thus, neither the proposal (the Western Option) nor either of the other options would open up areas for public access that are not already accessible to the public.

- **Fauna**

Ecologist, Dr Mike Bamford, assessed the fauna of the project area, which was based upon a review of available information and his personal knowledge of the general region, having worked extensively in the region since the early 1980s. The findings of his assessment of the three options are presented in detail in Bamford (2000). The following provides a summary of the main findings of the assessment for the purposes of comparing the three options. Section 4.8 of this PER provides further details of the findings of the assessment for the proposed transmission line route option (the Western Option).

The general region of the three transmission line route options is rich in fauna, with the coastal plain north of Perth recognised as being a centre of high biodiversity. The fauna includes species with very restricted distributions on the coastal sandplain, species confined to the South-West that are at the northern limit of their distribution in the region, species that occur primarily to the north and inland and are at the southern or eastern limit of their distribution in the region, and species that are widespread. The fauna is particularly rich because the general region encompasses the transition from the mesic South-West to the more arid north, and also takes in a range of landforms from the coastal sandplain to the heavier soils of the escarpment.

Within the region, the proposed transmission line route (Western Option) crosses a more limited range of vegetation types and landforms, and therefore is likely to affect slightly fewer species than either the Common Corridor Option or the Eastern Option. It also avoids natural habitats except in SF65-North and in the vicinity of Mimagarra Road and Tiwest's Cooljarloo minesite.

The Common Corridor Option traverses the eastern edge of the coastal sandplain and although it lies on agricultural land in many areas, it also crosses a major wetland area west and north-west of Gingin, part of Moore River National Park and a chain of wetlands north of the national park. The Eastern Option follows the same route as the Common Corridor Option through wetlands to the west and north-west of Gingin, but then diverts east to pass through areas that are extensively cleared for agriculture. The very extent of this clearing raises the issue of the importance of remnant vegetation for fauna conservation in the region, and the potential impacts on this critical remnant vegetation.

4.0 Existing Environment

4.1 Introduction

This section provides a description of the existing biophysical and socio-cultural environment within the project area of the proposed transmission line route.

4.2 Climate

The climate of the project area is characterised by a temperate, Mediterranean climate of hot, dry summers and cool, wet winters. Many climatic factors indicate a south-west to north-east variation due to the change in latitude and coastal influences (Smolinski & Scholz 1997). There is also a topographical effect imposed by the Dandaragan Plateau.

The mean annual rainfall varies from 759mm near Gingin to 611mm in Lancelin. Approximately 90 per cent of rainfall occurs between May and October. The mean maximum temperature of the hottest months ranges from 29oC to 32oC. The mean minimum temperatures in winter are between 9oC and 18oC. Annual pan evaporation is 1,700mm near the coast and 2,200 mm at Gingin.

4.3 Geology and Soils

4.3.1 Geology and Physiograohy

The proposed transmission line traverses two geomorphic units that are common within the Swan Coastal Plain, the Bassendean dunes and Spearwood dune system, one geomorphic element of the Coastal Belt dunes. The proposed transmission line does not traverse the other element of the Coastal Belt dunes, the Quindalup Dunes. The Swan Coastal Plain is generally flat to gently undulating and covered by sediments that have been deposited by aeolian, fluvial and marine activity.

Bassendean Dunes

The Bassendean Dunes extend east from the Coastal Belt to the Gingin Scarp. This dune system, considered the oldest of the three dune systems along the Swan Coastal Plain, has swampy areas and small lakes common in the internal swales. The Bassendean sand is the geological unit associated with dune system, of which the deposits are predominantly bleached quartz sand, however coloured sands also occur.

Coastal Belt

The Coastal belt, which lies west of the Bassendean Dunes, consists of a series of compound and complex dune bodies of variable age deposited since the Pleistocene. The Belt consists of two geomorphic elements: the Spearwood and the Quindalup dune systems.

The Spearwood Dune Systems is a gently undulating landscape, varying from 30 to 130 m above sea level, and consists of fixed dunes that are characterised by the presence of Tamala limestone and weakly coherent brown to yellowish brown siliceous sands. Weathering of the limestone has produced karst features such as underground caverns and solution holes.

The Quindalup Dune System, which in many cases overlies the Spearwood Dune System, is dominated by dunes of Holocene age and are partly fixed, however mobile parabolic dunes and blowouts are common. The very pale brown calcareous sand of the Safety Bay Sand is the geological formation.

4.3.2 Soils

The proposed transmission line traverses the Bassendean, Karrakatta and Cottesloe Soil Units. A short section of the Moore River Soil Unit will be affected where the transmission line crosses the Moore River.

The Bassendean Soil Unit consists of sand plains with low dunes and occasional swamps; iron or humus podzols and areas of complex/steep dunes. Karrakatta soils consist of deep yellow sands over limestone in an undulating landscape. Cottesloe soils are shallow brown sands over limestone in a low hilly landscape. The Moore Soil Unit consists of sandy terraces and slopes of the Moore River as it traverse the coastal plain and adjacent Dandaragan Plateau.

4.4 Wetlands and Water Courses

Wetlands in the general region of the proposed transmission line route can be divided into two broad categories: rivers and other watercourses such as Moore River; and sumplands, damplands and palusplains where seasonal inundation may be short but large areas may become waterlogged or flooded.

The proposed transmission line route follows high, stabilised sand dunes of the western coastal plain for much of its length and therefore largely avoids wetlands. It does cross the Moore River between SF65-South and SF65-North, but mostly avoids the river and associated wetlands, see Figure 4.1.

The proposed transmission line route avoids the damplands and EPP Lakes located near the eastern boundary of SF 65-South and the Yeal Nature Reserve. Further to the north, the line avoids a chain of swamplands, which include Three Mile Swamp, Imbat Swamp, Nilgen Swamp and Carba Garba Swamp. The

proposed transmission line route does however traverse one dampland located approximately 2km north west of the intersection of Mimegarra Rd and Dingo Rd in Dandaragan and passes through a complex of sumplands and damplands in the vicinity of Mimagarra Road up to the Tiwest Minesite, see Figure 4.2. These wetlands have not been assessed by the Water & Rivers Commission therefore a conservation status has not been determined.

4.5 Flora and Vegetation

4.5.1 Background

A separate, stand-alone biological survey report has been prepared for the proposed alignment which provides detailed accounts of the methodology, findings, field data and regional assessments of flora and vegetation values of the site (Woodman Environmental Consulting, 2000). Key information from Woodman Environmental Consulting (2000) has been summarised for inclusion in the following sections of this PER.

The proposed transmission line route passes through blocks of native vegetation in SF65-South and SF65-North, the Gingin Stock Route Reserve and areas of remnant vegetation on private property and Vacant Crown Land (VCL). The majority of this route lies within the Swan Coastal Plain subregion of the South-West Botanical Province, as defined by Beard (1990). The southern part of the route lies within the Drummond Botanical Subdistrict, characterised by *Banksia* low woodland on leached sands, interspersed by swamps and Tuart, Jarrah and Marri woodlands. The northern part of the route lies within the Irwin Botanical District of the Northern Sandplains Region. This District is characterised by scrub heaths on sandplains.

SF65-South is situated inland from Yanchep and Two Rocks, on the eastern side of the Wanneroo-Lancelin Road. The vegetation in this State Forest consists of a mosaic of pine plantations and discrete blocks of native vegetation.

SF65-North is located north of the Moore River, inland from Seabird, and is surrounded by grazing land and pivot irrigation systems, with some housing to the west of the western boundary. Two proposed transmission line route alignments within SF65-North were investigated and surveyed in detail; the eastern alignment and the western alignment. The eastern corridor follows Pickpocket Road and McCormicks Road for the majority of its length, while the western alignment is located between 300m and 900m east of Brockway Road, which is the western boundary of the State Forest. Both alignments total approximately 32.5km in length, with the eastern alignment the longer of the two.

The Gingin Stock Route Reserve is situated west of Gingin off Chitna Road and is 5.2 kilometres in length, of which approximately 2km will be impacted by the proposed transmission line (an earlier proposed route alignment would have impacted approximately 4.2 km). Prior to vegetation, flora and dieback surveys conducted for the purposes of this proposal, there was no existing information on flora and vegetation within the reserve, which acts as a corridor between SF65-South and remnant vegetation north of Chitna Road.

North of SF65-North there are several blocks of remnant vegetation on private property. These vary in size and in the condition of the vegetation. Other large areas of native vegetation are also present in the northern section of the proposed route alignment. These areas consist of private property and VCL, the majority of which is covered by the Tiwest Joint Venture Cooljarloo mining lease. Another area of VCL is located south of the Tiwest lease area, bordering the Department of Defence Lancelin Training Area.

The southern section of the route alignment is located within the Bassendean unit of the Bassendean geomorphological system as defined by McArthur and Bettenay (1960) and Churchward and McArthur (1980). This unit is defined as sand plains with low dunes and occasional swamps on predominantly grey sands. North of Two Rocks, the route passes into the Spearwood Dune geomorphological system as defined by McArthur and Bettenay (1960). A subdivision of these geomorphological systems into units by Churchward and McArthur (1980) places the study area within both the Cottesloe and Karrakatta geomorphological units. The Cottesloe unit, covering the south-western half of SF65-North, is defined as a low hilly landscape with shallow sands over much exposed limestone. The Karrakatta unit, covering parts of SF65-South and SF65-North, as well as the Gingin Stock Route Reserve, is described as an undulating landscape of deep yellow sands over limestone. Further north, the alignment passes back into the Bassendean Dune System.

The vegetation of the Swan Coastal Plain has been mapped at the complex level by Heddle *et al.* (1980). Heddle et al (1980) mapped vegetation on the Swan Coastal Plain at the complex level. This was done at a very large scale, with a complex defined as a series of

vegetation communities forming regularly repeating vegetation complexes, based on geomorphology. These complexes can be divided into many floristic/plant communities based on differences in species composition. Heddle et al (1980) mapped vegetation of SF65-South, the eastern section of SF65-North and the Gingin Stock Route Reserve as Karrakatta Complex – North. This complex is predominantly a low open forest and low woodland of banksia – *Eucalyptus todtiana*, with minor occurrences of *Eucalyptus gomphocephala* (tuart). The common banksia species are *Banksia attenuata* and *Banksia menziesii*, with *Banksia ilicifolia* on the lower slopes. Common shrub species in this complex, as listed by Havel (1968), include *Conospermum triplinervium*, *Hakea trifurcata*, *Mesomelaena stygia*, *Eremaea pauciflora* and *Stirlingia latifolia*.

Vegetation of the south-western section of SF65-North was mapped as Cottesloe Complex – North. Closed heaths on limestone outcroppings, with a mixture of banksia woodlands and low forests on deeper sands, dominate this complex. Common species associated with the limestone outcrops include *Melaleuca huegelii*, *Trymalium ledifolium*, *Grevillea preissii*, *Jacksonia hakeoides* and *Conospermum canaliculatum* (Havel 1968).

North of the Moore River, an attempt has been made to define floristic bioregions as part of the West Midlands project (Griffin 1998). The proposed line route option passes through the Spearwood and Bassendean bioregions, with the Cataby substation near the boundary of the Yerramullah bioregion.

4.5.2 Flora and Vegetation Survey Methodology

With the exception of the Tiwest Lease area, Woodman Environmental Consulting Pty Ltd conducted a detailed survey of the native vegetation along the proposed transmission line route in successive seasons during late winter and spring 2000. The timing of the survey was chosen to coincide with the appropriate flowering periods for annual species and all Declared Rare Flora (DRF) and Priority Listed Flora (PLF) species known from the region. The Tiwest Lease area did not require surveying by Woodman Environmental Consulting as it had been previously surveyed in detail by Mattiske Consulting Pty Ltd (1997).

All areas of native vegetation, 30m either side of the centreline, were traversed by vehicle and on foot to map vegetation boundaries and search for restricted flora species. These surveys were carried out between June and November 2000. Detailed site recordings were taken at each community boundary change and at regular intervals along the routes. At each site a standard recording sheet was used to ensure the consistent collection of flora and site data. The data collected is largely consistent with that collected by Gibson *et al.* (1994). Statistical analysis was not used to define plant communities due to the narrow width of the study area and therefore quantitative plots were not established. At each site the following information was collected within a 10m radius:

- Site location
- Soil type and colour
- Slope (based on 1 to 3 scale used by Gibson *et al.* (1994)
- Vegetation condition (Trudgen 1991)
- Vegetation structure (Muir 1977)
- All vascular plant species present, and the foliage cover of the dominant species.

Gibson *et al* (1994) conducted a vegetation study within the Swan Coastal Plain (SCP) over several seasons and classified vegetation communities within the SCP based on the species composition. Where possible the sites were classified into the community types defined by Gibson *et al.* (1994). This was difficult in some cases as the Swan Coastal Plain study was carried out over several seasons, rather than one sampling occasion as for this project. In addition numerous changes in species nomenclature have occurred since the report was produced in 1994, leading to difficulties in determining the current names of key indicator species in the Gibson *et al.* report. This classification was not carried out for the vegetation north of State Forest 65 - North, as these areas are located outside the boundary of the Gibson *et al.* study area (ie. north of Seabird). Where possible, the conservation status of each plant community was determined by reference to available regional studies. This was limited by the different scales of mapping used in the various regional studies.

A search of CALM's Rare and Priority flora database was carried out prior to the field-work. This provided a list of all restricted species known to occur in the area. All native vegetation within the proposed transmission line corridor was traversed on foot by experienced botanists to search for these species and any others not recorded in the vegetation mapping sites. Where unknown species were encountered specimens were collected for identification at the West Australian Herbarium. The location of all Rare and Priority flora recorded was noted, and marked on the appropriate vegetation maps. With the exception of the Gingin Stock Route Reserve, all surveys were carried out during the spring flowering season to allow identification of all known Declared Rare and Priority Flora. The Gingin Stock Route was re-visited in spring

to confirm the presence or absence of any annual restricted flora species.

All specimens of restricted and significant flora species recorded were submitted to the West Australian Herbarium for incorporation into the collections. Report forms for all Declared Rare and Priority flora were also submitted to CALM.

Plant species nomenclature follows Green (1985). All names were checked using the Max Database to ensure they are current. The conservation status of all species collected was checked using the current CALM list (Department of Conservation and Land Management 1999a).

4.5.3 Flora

A total of 355 vascular plant taxa belonging to 59 plant families were recorded from the proposed line route (see Woodman Environmental Consulting Pty Ltd 2000). Of these, 32 were introduced (weed) species. This is a relatively low number of weeds and reflects the very good condition of vegetation within State Forest 65 – North and the VCL at the northern end of the proposed route. Weed invasion was generally restricted to tracks and block edges. Pasture areas and areas mapped as disturbed were not surveyed for weeds during this study. The only block of vegetation not surveyed at the height of the spring flowering season was the Gingin Stock Route Reserve, and it is estimated that only 85% of the plant taxa present in the Reserve were recorded during this survey. The Reserve was re-surveyed for Declared Rare and Priority flora in spring as several annual restricted flora species are known to occur in the area. Detailed results of the flora and vegetation survey are given in Woodman Environmental Consulting (2000).

The dominant plant families recorded during the flora survey are listed Table 4.1.

The dominance of the Myrtaceae, Proteaceae and Papilionaceae is typical of the region and has been recorded during other studies (Griffin 1994).

Two DRF species, as defined under the *Wildlife Conservation Act 1950*, were recorded either on or close to the proposed alignment. *Anigozanthos humilis* subsp. chrysanthus was recorded in SF65-North. Three plants of this taxon were recorded on the proposed centreline. Surveys by Mattiske Consulting Pty Ltd (1997, 1998) and Landcare Services Pty Ltd (1998) recorded the DRF taxon *Anigozanthos viridis* subsp. *terraspectans* within the Tiwest Joint Venture Cooljarloo mining lease. Two populations of this taxon are located to the east and west of the proposed transmission line. These

Table 4.1: Dominant Plant Families Recorded along the Proposed Transmission Line Route

Family	No. of Taxa
Myrtaceae	45
Proteaceae	35
Papilionaceae	28
Epacridaceae	20
Asteraceae	18
Cyperaceae	17
Haemodoraceae	17

populations have been fenced by Tiwest Joint Venture and will not be disturbed during construction or maintenance of the transmission line. Both of these DRF taxa have been previously recorded from the region.

Four PLF taxa were recorded within the survey corridor during the field studies. *Comesperma acerosum* (Priority 3) was recorded from one location within VCL south of the Tiwest Joint Venture lease. *Platysace ramossisima* (Priority 3) was also recorded from one location within VCL south of the Tiwest Joint Venture lease. Both of these species have been recorded from several locations within the adjoining Department of Defence Lancelin Training Area (ecologia 2000).

The Priority 4 species, *Georgeantha hexandra* ms, was recorded on the western corridor within SF65-North. Approximately 5 plants were located along an unnamed track near the northern end of this alignment within SF65-North. This represents a significant range extension for this taxon, which has not previously been recorded south of Jurien. It should be noted that this particular alignment along the proposed transmission line route within SF65-North is ***not*** Western Power's preferred alignment. The eastern alignment within SF65-North is Western Power's preferred alignment within SF65-North.

The Priority 4 species *Conostephium minus* was recorded at several locations within the Tiwest Joint Venture lease area, and the VCL to the south of the lease. However, this species will not be disturbed as a result of this proposal.

Several other species of interest were recorded during the survey. *Thysanotus multiflorus* was recorded on private property, south of the Tiwest lease area. This represents a small range extension for this species, which has not previously been recorded as far north.

The *Allocasuarina fraseriana* mapped within SF65-South is at the northern limit of its range.

Griffin *et al.* (1990) lists 259 taxa known to be endemic to the northern kwongan between the Moore and Irwin Rivers. Only five of these, *Anigozanthos humilis* subsp. *chrysanthus, Comesperma acerosum, Conostylis angustifolia, Dasypogon obliquifolius* and *Hypocalymma xanthopetalum* were recorded along the proposed line route. This low number reflects the position of the route alignment along the coastal belt and Bassendean dunes, known to be low in regional endemics (Griffin *et al.* 1990).

4.5.4 Vegetation

The condition of vegetation along the proposed line route was variable between areas. Native vegetation within SF65-South varied in condition from block to block, with some areas heavily infested with weeds and recently burnt. Several areas appeared to have been very regularly burnt, resulting in a loss of diversity and increase in weed cover. This was particularly evident in the blocks closer to the Wanneroo-Lancelin Road.

Native vegetation within SF65-North was in very good condition, with weed invasion restricted to tracks and

Table 4.2: Representation of Plant Communities along the Proposed Line Route

Community	SF65 - Sth	SF65 - Nth	Gingin SR	VCL	Private
F4					+
F5				+	
F6				+	
W1	+				
W3					+
W5				+	
W5b				+	
W6		+	+		+
W9	+				
W10	+				
W11		+			
W12		+			
W13		+			
W14	+	+			
W16	+	+	+		+
W17		+			
W18					+
W19					+
W20		+			
W21	+				
S1		+			
S2		+			
S4					+
S5				+	
S1/H1					+
H1	+	+			
H2		+			
H4				+	
H5				+	
D3					+

block edges. The only exceptions were several recently burnt areas, which had high weed invasion. This was particularly evident in limestone heath areas and is likely to be temporary.

Vegetation within the Gingin Stock Route Reserve was found to vary in width between 50m and approximately 90m depending on the width of firebreaks either side of the corridor. Overall, the vegetation through the reserve was in good condition. The number of weed species was low, with those present concentrated on the boundaries of the reserve. Fire history through the reserve varied, with areas of very recent (1-2 years) and recent (<3 years) burns recorded. Weed species were more abundant in the recently burnt areas and on the western boundary of the Reserve.

The proposed line route also passes through several areas mapped as remnant vegetation on private property, between the Gingin Stock Route Reserve and the Tiwest lease area. The field survey found the majority of these to be in poor to very poor condition. Most were not fenced and had been impacted on from grazing and other farming activities. Weed invasion was high in these areas, resulting in low species richness. The vegetation within VCL and the Tiwest lease area was in very good condition, although active mining has impacted the northern and southeastern sections of the Tiwest lease.

A total of 29 plant communities and 1 disturbance community were described and mapped along the proposed line route by Woodman Environmental Consulting (2000). Woodman Environmental Consulting (2000) conducted a vegetation study of all areas of native vegetation, 30m either side of the proposed transmission line centreline, between June and November 2000. The vegetation identified during this survey was mapped and classified into vegetation communities based on the species composition.

As a requirement of the EPA, where possible and appropriate, the regional vegetation community data set as defined by Gibson et al (1994) was referred to when classifying the vegetation communities mapped by Woodman Environmental Consulting (2000) during the flora and vegetation survey for this proposal. Essentially, the vegetation communities described by Woodman Environmental Consulting (2000) in this PER are the same as the 'Gibson Communities' (defined by Gibson et al, 1994), although Woodman Environmental Consulting (2000) have further subdivided the Gibson communities in some cases, based on the presence of specific dominant understorey species. Additional disturbed units were also mapped, although species lists for these were not produced. This vegetation mapping is illustrated in Figures 4.3. to 4.7. A summary of the plant communities mapped in each block of vegetation is given in the Table 4.2. The plant communities consisted of Forests, Woodlands, Shrublands and Heaths.

• Forests

F4: Dense Forest of *Eucalyptus rudis, Melaleuca rhaphiophylla* and *Banksia prionotes* over weed species, along the Moore River.

The vegetation at the proposed Moore River crossing was in very poor condition as it is unfenced and actively grazed by cattle. Very few understorey species were present, with a total of only six native species recorded in this community.

F5: Low Forest of *Eucalyptus decipiens, Melaleuca preissiana* and *Banksia spp.* over tall shrubs on grey sand.

Plant community F5 was mapped along three low-lying areas within the VCL south of the Tiwest lease. It was generally only present in a narrow band, with *Eucalyptus decipiens* dominant on the outer edges. The diversity of these areas was low, with a total of 33 plant taxa recorded. The shrub layer was dominated by *Kunzea ericifolia* and *Adenanthos cygnorum*.

F6: Dense Low Forest of *Eucalyptus rudis, Melaleuca preissiana, Melaleuca rhaphiophylla* and *Banksia prionotes* on brown sand.

Dense Low Forest F6 was only recorded at one location within the VCL and was in a poor condition when compared to other plant communities within the area. Only 19 plant taxa were recorded, six of which were weed species. Very few shrub species were recorded, with the understorey layer dominated by herbs.

• Woodlands on grey sand

W1: Open Tall Woodland of *Melaleuca preissiana, Eucalyptus rudis* and *Banksia littoralis* over *Kunzea ericifolia* and *Adenanthos cygnorum* on grey sand in low-lying areas.

Plant community W1 was recorded in a drainage line near the southern end of State Forest 65 - South. The vegetation had been disturbed by heavy machinery, with a resulting low number of species recorded (15).

W3: Low Woodland of *Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia* over *Eremaea pauciflora, Xanthorrhoea preissii, Phlebocarya ciliata* and *Verticordia nitens* on grey sand.

Plant community W3 was mapped at the southern end of the proposed alignment, adjacent to SF65-South. Eighty-nine plant taxa were recorded in this community.

W5: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over mixed low shrubs dominated by *Eremaea pauciflora* on grey sand.

Plant community W5 was the dominant community mapped within the VCL. It is a very uniform community both in species composition and height, with a total of 68 plant taxa recorded during this survey.

W5b: Low Woodland of similar understorey species composition to W5, but dominated by *Banksia prionotes*. These areas appeared to have been disturbed.

Woodland W5b was recorded along a property boundary near the southern end of the VCL. It appeared to have been disturbed as the shrub layer was very open and species richness was low (30 taxa recorded). The shrub layer in areas mapped as W5b was dominated by *Kunzea ericifolia*, which is often recorded at high density in disturbed areas.

W6: Open Low Woodland of *Banksia menziesii* and *Banksia attenuata* over a tall shrub layer dominated by *Adenanthos cygnorum* over *Hibbertia hypericoides* and *Eremaea pauciflora* on grey sand.

Plant community W6 was recorded in the Gingin Stock Route Reserve, SF65-North and on private property. A total of 131 plant taxa were recorded in this community. Other common understorey species included *Stirlingia latifolia, Petrophile linearis, Alexgeorgea nitens, Patersonia occidentalis, Xanthorrhoea preissii* and *Lyginia barbata*.

- **Woodlands on yellow sand**

W9: Low Woodland of *Allocasuarina fraseriana, Banksia attenuata* and *Eucalyptus todtiana* over open low shrubs on yellow sand.

Plant community W9 was mapped in a small section of the route alignment in SF65-South. A total of 47 plant species were recorded in this community, with common understorey species including *Stirlingia latifolia* and *Xanthorrhoea preissii*. The amount of bare ground present was high, which is a common occurrence under she-oaks (*A. fraseriana*).

W10: Low Woodland of *Banksia attenuata, Banksia menziesii* and *Allocasuarina fraseriana* over *Hibbertia hypericoides, Xanthorrhoea preissii* and *Adenanthos cygnorum* on yellow sand.

W10 was mapped at two locations in the northern part of SF65-South, with a total of 44 species recorded. Other common species included *Conospermum canaliculatum* and *Thryptomene prolifera*.

W11: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over mixed shrubs dominated by *Xanthorrhoea preissii, Hibbertia hypericoides, Eremaea pauciflora, Stirlingia latifolia* and *Mesomelaena pseudostygia* on yellow sand.

Plant community W11 was mapped along the eastern alignment within SF65-North, with a large proportion of its area burnt within the last 3 years. Fifty-one plant taxa were recorded in this community which was similar in composition to W16. It was mapped as a separate unit as the recent fire had changed the abundance of many of the dominant species.

W12: Low Woodland of *Eucalyptus todtiana, Banksia attenuata* and *Banksia grandis* over *Jacksonia sternbergiana, Hibbertia hypericoides* and *Xanthorrhoea preissii* on yellow sand.

Forty-three plant taxa were recorded in plant community W12 during this survey. This community was mapped at one location on the western alignment of SF65-North. It differed from surrounding woodlands in the dominance of tall shrubs such as *Jacksonia sternbergiana* and *Hakea prostrata*.

W13: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over *Jacksonia sternbergiana, Hibbertia hypericoides* and *Xanthorrhoea preissii* on yellow sand.

Plant community W13 was also only recorded along one section of the western alignment in SF65-North. It differed from W12 in the absence of *Eucalyptus todtiana* and *Banksia grandis* in the tree layer, and the absence of *Eremaea pauciflora* in the shrub layer. A total of 58 plant species were recorded.

W14: Low Woodland of *Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* over *Xanthorrhoea preissii, Calytrix ?fraseri, Thryptomene prolifera* and *Stirlingia latifolia* on yellow sand in low-lying areas.

A total of 114 vascular plant species were recorded in plant community W14 in SF65-South and SF65-North. This plant community was mapped in low-lying areas. The density of *Calytrix ?fraseri* varied between sites, with higher cover recorded in disturbed areas, such as the edges of tracks. Other common understorey species included *Eremaea pauciflora, Mesomelaena pseudostygia* and *Schoenus brevisetis*.

W16: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over a low shrub layer dominated by *Hibbertia hypericoides, Eremaea pauciflora, Leucopogon polymorphus, Mesomelaena pseudostygia* and *Calothamnus sanguineus* on yellow sand.

Plant community W16 was the most common plant community mapped along the Western Option and was dominant on mid to upper slope areas. It was characterised by a very low, diverse shrub layer, with

dominant species varying depending on fire history. A total of 164 vascular plant taxa were recorded in this community. Common understorey species included *Xanthorrhoea preissii, Patersonia occidentalis, Conostephium pendulum* and *Alexgeorgea nitens*.

W17: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over *Hibbertia hypericoides, Hakea costata, Hakea trifurcata* and *Mesomelaena pseudostygia* on yellow sand.

Plant community W17 was recorded along the western corridor in SF65-North, and although no limestone was visible at the surface, the species composition indicated limestone was closer to the surface than in other woodland communities. A total of 68 vascular plant taxa were recorded, with other common species including *Stirlingia latifolia, Eremaea pauciflora, Jacksonia hakeoides, Leucopogon polymorphus* and *Conospermum canaliculatum*.

W18: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over low shrubs dominated by *Eremaea pauciflora, Stirlingia latifolia, Xanthorrhoea preissii* and *Conospermum canaliculatum* on yellow sand.

Plant community W18 was the dominant plant community mapped on a large remnant north of Sappers Road. A total of 88 vascular plant species were recorded. The vegetation in this community was in very good condition, with only a few weed species present along the edge of an existing track inside the property boundary. Fire history within the property varied, resulting in slight changes in vegetation composition, with *Hibbertia hypericoides* more abundant in recently burnt areas. The route alignment has been moved to the east in this area to minimise clearing in this community.

W19: Open Low Woodland of Banksia ilicifolia over low shrubs dominated by *Xanthorrhoea preissii* on yellow sand in low-lying areas.

This plant community was mapped in a low-lying area near the southern boundary of remnant vegetation north of Sappers Road. It was also in very good condition, although the open nature of the understorey layer has allowed weeds to invade further from the track edge than observed in other communities. A total of 32 plant taxa were recorded, with common species including *Schoenus brevisetis, Acacia pulchella* var. *glaberrima* and *Conospermum canaliculatum* subsp. *canaliculatum*. No clearing will occur in this plant community following re-alignment of the route.

- **Woodlands on limestone**

W20: Open Low Woodland of *Banksia attenuata* and *Banksia menziesii* over *Jacksonia hakeoides, Melaleuca systena, Acacia lasiocarpa, Calothamnus quadrifidus* and *Conospermum canaliculatum* on yellow sand with occasional limestone outcropping.

Woodland W20 was recorded along both the western and eastern alignments in SF65-North in areas where soils were shallow. Species richness was very high, with 108 taxa recorded. Much of the area mapped on the eastern alignment had been burnt in the past three to four years. The amount of surface limestone varied between sites, although some outcropping was always present.

W21: Low Woodland of *Banksia attenuata, Banksia menziesii* and *Banksia grandis* over *Hibbertia hypericoides, Xanthorrhoea preissii, Conospermum canaliculatum* and *Stirlingia latifolia* on yellow sand over limestone.

Plant community W21 was mapped in SF65-South and occurs where limestone, normally at depth within the Karrakatta complex, comes closer to the surface, with very occasional surface outcropping present. Species diversity was relatively high, with 72 plant taxa recorded. Other common species present were *Acacia lasiocarpa, Petrophile macrostachya* and *Jacksonia hakeoides*.

- **Shrublands**

S1: Shrubland of *Melaleuca systena* and *Melaleuca huegelii* subsp. *huegelii* on limestone ridges.

Plant community S1 was only recorded in two locations along the proposed western alignment in SF65-North, and just off this alignment in a third location. It occurred on the highest points in the landscape, where the limestone outcropping was very heavy. A high proportion of bare ground was present which annual weed species and native herbs had invaded. Fifty-nine plant species were recorded. This community is listed by CALM as a Threatened Ecological Community (floristic community 26a as described by *Gibson et al.* 1994). It should be noted that this particular alignment along the proposed transmission line route within SF65-North is ***not*** Western Power's preferred alignment. The eastern alignment within SF65-North is Western Power's preferred alignment within SF65-North.

S2: Shrubland of *Dryandra sessilis, Melaleuca systena, Baeckea ?robusta* and *Diplolaena angustifolia* on yellow sand with limestone outcropping.

Plant community S2 was recorded immediately downslope of S1 and was also characterised by heavy

limestone outcropping. The cover of annual species was not as high as in plant community S1. A total of 38 taxa were recorded, many of which were unique to this community.

S4: Dense Shrubland of *Hakea trifurcata* over low shrubs and weeds on yellow sand with limestone outcropping.

This plant community was mapped at the northern end of the Gingin Stock Route Reserve. This area was in very poor condition, with a high weed cover and only 12 native species recorded.

S5: Dense Shrubland of *Leptospermum erubescens, Calothamnus sanguineus* and *Banksia telmatiaea*, with occasional emergent *Banksia littoralis* and *Melaleuca rhaphiophylla*, on grey sandy-loam.

Plant community S5 was recorded in a narrow band at one location near the northern boundary of the VCL. The shrub layer in this community was very dense, except in areas where some surface water was present. Twenty vascular plant species were recorded in this community.

S1/H1: Shrubland of *Hakea trifurcata, Melaleuca systena, Dryandra sessilis, Calothamnus quadrifidus* and *Melaleuca huegelii* subsp. *huegelii* on yellow sand with limestone outcropping.

This plant community was mapped in one small pocket on the south side of Dingo Road. It was in fair condition, with some weed invasion from the road and adjoining grazing properties. It was named S1/H1 as it contained many of the dominants from both of these previously described plant communities. Thirty-three plant taxa were recorded from this community during the survey.

- **Heaths**

H1: Dense Heath dominated by *Hibbertia hypericoides, Dryandra sessilis, Calothamnus quadrifidus, Melaleuca systena, Jacksonia hakeoides* and, *Conospermum canaliculatum* on yellow sand with heavy limestone outcropping.

Community H1 was recorded in SF65-South and SF65-North and occurs where soils become very shallow with much limestone at the surface. The blocks covered by this community in SF65-South had been recently burnt, with a resulting low diversity and high weed cover. It was the most common heath mapped along both corridors in SF65-North. A total of 85 plant species were recorded, with other common species including *Desmocladus* spp., *Conostylis candicans, Hakea trifurcata, Banksia leptophylla* and *Acacia lasiocarpa*.

H2: Dense Heath dominated by *Jacksonia hakeoides* on yellow sand.

Plant community H2 was recorded on the western alignment within SF65-FNorth. It was much denser than H1, with lower species richness (51 taxa). No limestone was visible at the surface. Other common species included *Acacia sessilis, Melaleuca systena, Conospermum canaliculatum, Hibbertia hypericoides* and *Xanthorrhoea preissii*.

H4: Dense Heath of mixed low shrubs on grey sandy-clay.

The plant community mapped as H4 was the most diverse community recorded in the VCL south of the Tiwest lease, with 80 plant taxa recorded in a relatively small area. It bordered Shrubland S5 on both sides and was dominated by proteaceous and myrtaceous shrubs over sedges such as *Mesomelaena pseudostygia*.

H5: Low Heath dominated by *Xanthorrhoea preissii* and *Melaleuca ?trichophylla* on grey sand.

Plant community H5 was only present in one small area in the VCL, with a resulting low number of species recorded (33). Other common understorey species included *Alexgeorgea nitens, Dasypogon obliquifolius, Caustis dioica* and *Dryandra lindleyana*.

- **Disturbed**

D3: Banksia Woodland – areas so disturbed by clearing, grazing or burning that little or none of the original understorey layer is remaining.

The majority of the remnants on private property were mapped as D3. In these areas the tree layer was generally intact, but grazing pressures have severely impacted the understorey layer. Remaining understorey species included *Mesomelaena pseudostygia, Hibbertia hypericoides, Hakea prostrata, Alexgeorgea nitens, Desmocladus fasciculatus, Macrozamia riedlei* and *Xanthorrhoea preissii*.

Other areas were also mapped as disturbed. At the northern end of the Gingin Stock Route Reserve the transmission line route passes close to Chitna Road, through an old borrow area (D2). Some attempt has been made to rehabilitate this borrow pit but only some trees seedlings have survived. The route then crosses into private property mapped as plant community W6. The southern several hundred metres of this remnant were in good condition, but degenerated closer to Gingin Brook Road. The remaining area south of Gingin Brook Road was mapped as W6d, defined as areas originally community W6 but disturbed by clearing, grazing or burning and in very poor condition.

North of Chitna Road was a mosaic of completely cleared areas and mapping unit W6d, until the proposed route crosses the Moore River. Between the Moore River and SF65-North, the route passes through areas mapped as remnant vegetation from aerial photography. Site inspections found these to be areas of remnant trees, such as *Corymbia calophylla, Banksia* spp. and *Nuytsia floribunda*, over pasture. The understorey layer had been completely removed. Only one very small remnant was located between SF65-North and Sappers Road. This remnant was unfenced and had been historically grazed. It should be noted that the entire length of the Garbanup Road reserve in this area is vegetated. The proposed alignment does not impact on this road reserve vegetation as it is located entirely on cleared private property on the eastern side of the road reserve.

Between Sappers Road and Dingo Road a large area of remnant vegetation in very good condition was recorded. The transmission line route has been moved to the east in this section to prevent clearing in this remnant. A small remnant further north was also surveyed and mapped with the plant community recorded as W16, a community present in several other areas. The vegetation within this area was in good condition, although weeds have invaded the edges. Extensive areas between Dingo Road and Mimegarra Road have been mapped as remnant vegetation by various sources. A field inspection of the route alignment in these areas found the majority to be a dense *Banksia* Woodland over a very disturbed understorey, too modified by fire, clearing or grazing to be described and mapped. All of the remnants on private property north of Dingo Road were in very poor condition, with the understorey layer varying between scattered shrubs and weeds and no native shrubs. None of the remnants were fully fenced from adjacent grazing land and as such as been disturbed over a period of time.

A further seven plant communities were described and mapped along the proposed route within the Tiwest Joint Venture lease area. Mattiske Consulting Pty Ltd (1997) surveyed the flora and vegetation within the Tiwest Joint Venture lease area. Since this survey, extensive areas at the northern end of the proposed transmission line route have been cleared for mining. The communities are described below:

- **Woodlands**

1a.1: Open Woodland of *Banksia attenuata* and *Banksia menziesii* over mixed Proteaceous and Myrtaceous shrubs in upper slope areas on yellow-brown sand.

And

1a.2: Woodland of *Banksia prionotes* and *Eucalyptus todtiana* over mixed Proteaceous and Myrtaceous shrubs in upper slope areas on yellow sand.

These plant communities were mapped at several locations along the route and are widespread throughout the Tiwest lease areas. Plant community 1a.1 is dominant in dune areas, with plant community 1a.2 only recorded on dune crests.

1b: Woodland of *Eucalyptus todtiana, Banksia menziesii* and *Banksia attenuata* over mixed Proteaceous and Myrtaceous shrubs on lower slopes on grey sand.

Plant community 1b was the dominant community mapped by Mattiske Consulting (1997) in the Tiwest Joint Venture southern lease area. It is present at several locations along the proposed transmission line, with dominant understorey species including *Adenanthos cygnorum* and *Eremaea pauciflora*. This community was also mapped to the north of the Cataby sub-station (Mattiske Consulting 1996).

1e: Woodland of *Banksia attenuata, Banksia menziesii* and *Nuytsia floribunda* over *Banksia telmatiaea, Beaufortia squarrosa* and *Adenanthos cygnorum* on lower slopes on grey-brown sand.

Plant community 1e was mapped in a very small section at the southern end of the proposed route. This community is similar to 1a.1 but is lower in the landscape and therefore dominated by species common to damper soils. It is well represented locally in the north-western section of the Tiwest lease area (Mattiske Consulting Pty Ltd 1997).

1f: Woodland of *Melaleuca preissiana, Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana* over *Adenanthos cygnorum, Eremaea pauciflora* and *Calytrix fraseri* over *Dasypogon obliquifolius*, on mid to lower slopes on grey-brown sand.

This community was mapped in the northern section of the proposed route alignment. It is similar in composition to 1b, but its position lower in the landscape is reflected by the presence of species such as *Melaleuca preissiana* which preferentially grow in damper soils.

- **Heaths on sand**

3a: Heath of occasional *Nuytsia floribunda, Banksia* spp. and *Eucalyptus todtiana* over *Beaufortia elegans, Petrophile macrostachya* and *Allocasuarina* spp. on grey sand.

Plant community 3a was the most widespread community mapped along the proposed transmission

line, and was common throughout the Tiwest lease area (Mattiske Consulting 1997). Other common understorey species present within this community were *Hakea costata* and *Mesomelaena pseudostygia*.

3k: Low heath dominated by *Banksia telmatiaea*, with occasional emergent *Nuytsia floribunda* and *Eucalyptus todtiana*, on brown sandy-loam.

This plant community was mapped in a very small area at the southern boundary of the Tiwest lease and is the preferred habitat of the DRF species *Anigozanthos viridis* subsp. *terraspectans*.

4.5.5 Regional Significance and Conservation Status of Plant Communities

The regional significance and conservation status of the plant communities mapped along the proposed transmission line route was determined by reference to available regional studies. No one regional study covers the entire length of the proposed alignment with adequate discussion of the conservation status of vegetation types. Therefore, for ease of presentation, the following information is discussed in terms of whether the plant communities were mapped South or North of Seabird along the proposed transmission line corridor.

Regional Significance and Conservation Status of Plant Communities South of Seabird

South of Seabird, the conservation status of the plant communities was determined by reference to Gibson et al. (1994). This definitive study of the southern Swan Coastal Plain describes floristic communities within the region and their distribution. Where possible, the plant communities mapped during this project were matched to floristic communities described by Gibson et al. (1994). This was difficult in some cases as the Swan Coastal Plain study was carried out over several seasons, rather than one sampling occasion as for this project. In addition, numerous changes in species nomenclature have occurred since the report was produced in 1994, leading to difficulties in determining the current names of key indicator species in Gibson et al. (1994). Where the communities along the route could be matched to these floristic communities, each was assigned a conservation code as defined below.

Table 4.3 provides the definitions of community conservation status as used by Gibson *et al.* (1994)

The area south of Seabird includes SF65-South, the Gingin Stock Route Reserve, the majority of SF65-North and any remnants on private property. Within these areas, the plant communities mapped were matched to floristic communities described by Gibson et al. (1994). In many cases, several plant communities were included in one floristic community due to the broader scale of the Gibson et al. (1994) study.

Plant community W1 is a component of floristic community 14, deeper wetlands on sandy soils. This community is described in Gibson et al. (1994) as not being represented in the reserve system and a conservation status was not assigned, as it is insufficiently

Table 4.3: Definition of Community Conservation Status as used by Gibson et al. (1994)

Conservation Status	Definition
Presumed destroyed	A community that is totally destroyed or so extensively modified that it is unlikely to re-establish ecosystem processes in the foreseeable future
Critical	A community with most or all of its known occurrences facing severe modification or destruction in the immediate future
Endangered	A community in danger of severe modification or destruction throughout its range, if causal factors continue operating
Vulnerable	A community likely to move into the endangered category in the near future if the causal factors continue operating
Susceptible	A community of concern because there is evidence that it can be modified or destroyed by human activities, or would be vulnerable to new threatening processes
Low risk	A community that does not qualify for one of the above categories
Insufficiently known	A community for which there is inadequate data to assign to one of the above categories

known. However, this floristic community has been mapped within the Yeal Swamp Nature Reserve, although it only occurred in a narrow strip along the Gingin Wanneroo Branch Drain and was in a poor condition in parts (Woodman Environmental Consulting, 2000). Plant community W3 is a component of floristic community 22, Banksia ilicifolia woodlands, as defined by Gibson et al. (1994). This floristic community is poorly reserved and susceptible to human activities. It was also mapped in Yeal Swamp Nature Reserve (Woodman Environmental Consulting, 2000).

Heath communities H1 and H2 are components of floristic community 24, northern Spearwood shrublands and woodlands. This floristic community type is well reserved but has been identified as susceptible to human activity. The shrubland mapped as S1 is floristic community 26a as described by Gibson et al (1994). This community is unreserved and susceptible to human activities. CALM also list it as a Threatened Ecological Community. It was recorded at two locations on the western alignment within SF65-North, one of which is the highest point within the State Forest. Shrubland S2 was mapped adjacent to S1 within SF65– North and corresponds to community 26b, woodlands and mallees on limestone, described by Gibson *et al.* (1994). This community is well reserved and at low risk from human activities.

Woodlands W6, W9, W10, W11, W12, W13, W14, W16 and W17 all appear to be components of community type 28, Spearwood Banksia attenuata or Banksia attenuata – Eucalyptus woodlands. This community type is widespread north of Perth; it is well represented within the reserve system, and therefore has a low risk conservation status.

Several plant communities south of Seabird could not be assigned to a floristic community type. These were F4, W20 and W21. Plant community F4, vegetation along the Moore River, was in a very degraded condition with no native understorey remaining. This prevented it being correlated to a floristic community. The degraded condition of the vegetation in this area reduces its conservation significance, although the Moore River may act as a fauna corridor in some sections. The woodlands on limestone mapped as W20 and W21 did not appear to fit into any of the floristic communities. They were most similar to 26b but do not appear to be described in the Gibson et al. (1994) study. These areas were mapped at the northern limit of the Southern Swan Coastal Plain study and therefore may have not been included in any survey sites. These

Table 4.4: Conservation Status of Plant Communities south of Seabird (from the floristic community types of Gibson et al. (1994)

Plant Community	Floristic Community Type	Reservation Status	Conservation Status
F4	unknown		
W1	14	Unreserved	Insufficiently known
W3	22	Poorly reserved	Susceptible
W6	28	Well reserved	Low risk
W9	28	Well reserved	Low risk
W10	28	Well reserved	Low risk
W11	28	Well reserved	Low risk
W12	28	Well reserved	Low risk
W13	28	Well reserved	Low risk
W14	28	Well reserved	Low risk
W16	28	Well reserved	Low risk
W17	28	Well reserved	Low risk
W20	unknown		
W21	unknown		
S1	26a	Unreserved	Susceptible
S2	26b	Well reserved	Low risk
H1	24	Well reserved	Susceptible
H2	24	Well reserved	Susceptible

woodlands on limestone are very well represented in areas of SF65-North that will not be disturbed during this project, however, their representation within the reserve system is unknown. A summary of the conservation status of the plant communities mapped south of Seabird is provided in the Table 4.4. status was not assigned, as it is insufficiently known. However, this floristic community has been mapped within the Yeal Swamp Nature Reserve, although it only occurred in a narrow strip along the Gingin Wanneroo Branch Drain and was in a poor condition in parts (Woodman Environmental Consulting Pty Ltd 2000). Plant community W3 is a component of floristic community 22, *Banksia ilicifolia* woodlands, as defined by Gibson *et al.* (1994). This floristic community is poorly reserved and susceptible to human activities. It was also mapped in Yeal Swamp Nature Reserve (Woodman Environmental Consulting Pty Ltd 2000).

Heath communities H1 and H2 are components of floristic community 24, northern Spearwood shrublands and woodlands. This floristic community type is well reserved but has been identified as susceptible to human activity. The shrubland mapped as S1 is floristic community 26a as described by Gibson et al (1994). This community is unreserved and susceptible to human activities. The Department of Conservation and Land Management also list it as a Threatened Ecological Community. It was recorded at two locations on the western corridor within State Forest 65 - North, one of which is the highest point within the State Forest. Shrubland S2 was mapped adjacent to S1 within State Forest 65 – North and corresponds to community 26b, woodlands and mallees on limestone, described by Gibson *et al.* (1994). This community is well reserved and at low risk from human activities.

Woodlands W6, W9, W10, W11, W12, W13, W14, W16 and W17 all appear to be components of community type 28, Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands. This community type is widespread north of Perth; it is well represented within the reserve system, and therefore has a low risk conservation status.

Several plant communities south of Seabird could not be assigned to a floristic community type. These were F4, W20 and W21. Plant community F4, vegetation along the Moore River, was in a very degraded condition with no native understorey remaining. This prevented it being correlated to a floristic community. The degraded condition of the vegetation in this area reduces its conservation significance, although the Moore River may act as a fauna corridor in some sections. The woodlands on limestone mapped as W20 and W21 did not appear to fit into any of the floristic communities. They were most similar to 26b but do not appear to be described in the Gibson *et al.* (1994) study. These areas were mapped at the northern limit of the Southern Swan Coastal Plain study and therefore may have not been included in any survey sites. These woodlands on limestone are very well represented in areas of SF65-North that will not be disturbed during this project, however, their representation within the reserve system is unknown. A summary of the conservation status of the plant communities mapped south of Seabird is provided in the Table 4.4.

Regional Significance and Conservation Status of Plant Communities North of Seabird

Determining the regional significance of the plant communities mapped north of Seabird was more difficult as no single study is currently available that details the conservation status of plant communities in this region. The West Midlands Study will allow this in the future but is incomplete and could not be used in preparation of this document. In addition, the available studies all discuss vegetation at different levels of detail, making specific comparisons to plant communities mapped along the proposed transmission line not possible in all cases. Regional studies referenced for the route north of Seabird included Griffin and Keighery (1989), Crook et al. (1984), Halpern Glick Maunsell (2000) and ecologia (2000). Griffin (1994) describes in detail the floristics of the Perth to Geraldton region. However, it does not discuss the representation of these floristic groups within the reserve system, or the area (hectares) covered by each

Table 4.5: Proportion of Bioregion and Soil-landscape systems Vegetated and in Conservation Reserves

Interim bioregion	Soil-landscape system	Proportion Vegetated	Proportion NPNCA
Spearwood	Spearwood	0.64	0.16
	Tamala	0.92	0.66
Bassendean	Bassendean	0.70	0.09

group within the region. Therefore it could not be used to discuss the conservation significance of the plant communities mapped along the proposed transmission line route. Each plant community was also cross-referenced against CALM's Threatened Ecological Communities list (English and Blyth 1997), as well as Keighery and Keighery (1992).

Areas surveyed north of Seabird consisted of native vegetation remnants on private property, VCL and the Tiwest Joint Venture lease area. The proposed line route passes through the Spearwood and Bassendean bioregions, with the Cataby substation near the boundary of the Yerramullah bioregion (Griffin 1998). The Spearwood bioregion is well represented in the conservation estate though the southern portion is less represented. The Bassendean bioregion contains much uncleared land but is poorly represented in the conservation estate. Table 4.5 provides an analysis of the proportion of these bioregions remaining uncleared, and represented in conservation reserves. This was taken from Griffin (1998).

The plant communities north of Seabird were mapped within private property or on VCL south of the Tiwest Joint Venture lease area. Forests F5 and F6 were mapped in drainage lines and depressions on VCL. Plant community F5 was also mapped by Halpern Glick Maunsell (2000), on Vacant Crown Land in several areas to the east and west of the proposed transmission line. *Eucalyptus decipiens* is common near Jurien and north-west of Eneabba, with restricted distribution within the vicinity of the transmission line (Brooker and Kleinig 1990). Its distribution within the reserve system is unknown, and it is likely to be poorly conserved. A small pocket has been mapped within the Southern Beekeepers Reserve (Burbidge and Boscacci 1989), although the composition of the understorey in this area would be different to that mapped along the transmission line route. The *Eucalyptus rudis* Woodland of F6 is locally and regionally restricted due to its narrow linear nature. Woodlands of these types in drainage lines and swamps have been recorded in Reserve #27993 (Halpern Glick Maunsell (2000), and Reserve #27216 and Wongonderrah Nature Reserve (Crook *et al.* 1984).

Four *Banksia* Woodland communities, W5, W5b, W18 and W19 were also mapped north of the Moore River. The conservation status and regional representation of these is difficult to determine as the available regional studies generally map these areas at a vegetation association, rather than a plant community, level. Plant community W5 has been mapped in the Moore River National Park (Woodman Environmental Consulting 2000) and is also present in the Namming Nature Reserve and reserve #23934 (Crook *et al.* 1984). Halpern Glick Maunsell (2000) mapped the vegetation in the area as '*Banksia* woodland over heath' and described this association as being very widespread in the region. It has also been mapped extensively in the Department of Defence training area west of the proposed transmission line (ecologia 2000). *Banksia* woodland is also present within the majority of nature reserves in the area, although the composition of the understorey layer can vary significantly between locations (Griffin and Keighery 1989). All of the *Banksia* woodland communities mapped along the proposed route are present in extensive areas along the route that will not be disturbed during construction and maintenance of the transmission line.

Several shrublands and wet heaths were also mapped. S4 and S1/H1, both associated with limestone were only present in very small pockets and were in poor condition. As a result, their conservation significance is low, with similar vegetation in good condition present in nearby reserves (Halpern Glick Maunsell 2000). Heaths on grey sand (H4 and H5) are poorly represented in the reserve system within the Moore River – Namming area, but very well represented within Badgingarra National Park and Mullering and Wongonderrah Reserves (Griffin and Keighery 1989). Shrubland S5 is a component of Wet Heath Super Group III as described by Griffin and Keighery (1989). These wet heaths are widespread in the Moore River National Park and Namming Nature Reserve.

Mattiske Consulting (1997) discussed the conservation significance of the plant communities in the Tiwest lease area. This report states that all are well represented locally and regionally within the reserve system.

4.6 Weeds

A total of thirty-two weed species from 14 plant families were recorded in the native vegetation surveyed along the proposed transmission line route (see Woodman Environmental Consulting 2000). Pasture and other disturbed areas were not surveyed for weed species. None of the species recorded were Declared Weeds, as listed by Agriculture WA, although several of the species can be aggressive colonisers of disturbed areas. These include *Pelargonium capitatum* (Rose pelargonium), *Asphodelus fistulosus* (Onion weed), *Trachyandra divaricata* (Dune onion weed) and *Ehrharta calycina* (Veld grass). These species are currently restricted to roads and tracks, but may spread if adequate weed hygiene procedures are not followed.

The majority of weed species, most of which are common and non-aggressive, were recorded in unfenced remnants on private property and along existing tracks and firebreaks. Within the Gingin Stock Route Reserve and SF65-South and SF65-North weeds had also invaded into recently burnt areas, as burning creates open ground into which weed spores can germinate. The limestone communities mapped (S1, S2, S4, S1/H1) appear to be the most susceptible to weed invasion as all of these areas contained some annual weeds. The high cover of bare ground around limestone outcropping in these communities provides suitable habitat for weed spores. The northern end of SF65-South, SF65-North and the VCL towards the northern end of the proposed line route all contained large blocks of vegetation relatively unaffected by weeds.

4.7 Plant Diseases

4.7.1 Background

Plant diseases known to impact significantly on native vegetation in Western Australia include *Phytophthora* root and collar rots, Rusts, *Armillaria* root rot and Stem Cankers (Shearer 1994).

Armillaria luteobubalina, Rusts and Stem Canker fungi such as *Diplodina* sp, *Botryosphaeria ribis* and *Cryptodiaporthe* sp. are most commonly spread as aerial spores and as such are extremely difficult to manage. These pathogens are most likely native organisms that have co-evolved with the native vegetation and therefore cause epidemic only sporadically in response to changing environmental conditions. *Phytophthora* pathogens however are not all native to Australia, with *P. cinnamomi* (Dieback) known to be introduced during human settlement (Shearer 1994).

Pathogens in the genus *Phytophthora* are soil-borne oomycete like organisms that require moist conditions in which to sporulate. These organisms are readily spread in water, soil and infected plant material. There are several species of *Phytophthora* present in the native vegetation communities of the south west of the State, including *P. cinnamomi, P. citricola, P. megasperma,* and *P. cryptogea* to name the most common. *P. cinnamomi* has been identified as the single most destructive plant pathogen in native plant communities in Western Australia. It is therefore the focus of the following review.

Several species of *Phytophthora* have been identified in the native vegetation communities in Western Australia. These species range from being largely non pathogenic (eg. *P. cryptogea*) through to extremely pathogenic (*P. cinnamomi*) in native vegetation. Species other than *P. cinnamomi* have been largely discounted as potential epidemic causing organisms as a result of many years of study. Management focus has recently concentrated on *P. cinnamomi* (Department of Conservation and Land Management 1999b).

The proposed Pinjar to Cataby Transmission line route is located on the Swan Coastal Plain within the area bounded by the 600mm isohyet. It is therefore within the portion of the State known to be vulnerable to the effects of *P. cinnamomi*. The proposed transmission line route traverses the Spearwood Dune system for the majority of its length, with the northern end entering the Bassendean Dune system as the route approaches Cataby. The Spearwood Dune system is recognised as being less vulnerable to the effects of *P. cinnamomi* than the Bassendean Dune system due primarily to soil properties associated with the presence of limestone (Hill *et al.* 1994; Shearer and Dillon 1996; Department of Conservation and Land Management 1999).

The proposed transmission line corridor has been interpreted for the presence of *P. cinnamomi* and a description of that study follows.

4.7.2 Survey Methodology

Experienced dieback interpreters carried out surveys for *P. cinnamomi* between June and November 2000 (Woodman Environmental Consulting, 2000). A 60m wide strip was surveyed along the proposed line route, with the exception of the Gingin Stock Route Reserve where the entire width of remnant vegetation was surveyed. During the course of the interpretation, CALM's Disease Standards Officer, responsible for maintaining the quality of disease interpretation by CALM accredited interpreters, inspected portions of the interpreted area. The interpretation was conducted both from a vehicle and on foot along the full length of the proposed route.

Samples of soil and vegetation material from dead or dying indicator plant species were collected and analysed for the presence of *P. cinnamomi*. Any obvious disease boundaries along the route were marked in the field using day-glo pink (*P. cinnamomi* infested) or white (uninterpretable) flagging tape. The sampling regime employed during the surveys also included the collection of 'control' samples of soil from locations approximately 20m away from identified infestation boundaries, in uninfested vegetation. Following receipt

of the sample analysis results and an assessment of the significance and potential for management of each *P. cinnamomi* free area (uninfested), field boundaries were amended as required.

4.7.3 Disease Interpretation and Mapping Terminology

P. cinnamomi free (Uninfested areas) - Areas of native vegetation that an accredited interpreter has determined to be free of plant disease symptoms which would indicate the presence of the pathogen *P. cinnamomi*.

These areas need not be sampled for the presence of P. cinnamomi, however if samples are collected, analysis results must not show the presence of P. cinnamomi.

P. cinnamomi infested (Infested areas) - Areas of native vegetation that an accredited interpreter has determined have plant disease symptoms consistent with the presence of the pathogen *P. cinnamomi*.

Samples of plant tissue and/or soil should be collected within these areas to confirm the presence of the pathogen. Sample analysis results should provide a recovery of the pathogen from within each area to confirm the interpretation.

Uninterpretable - Areas in which indicator plants are absent or too few to determine the presence or absence of disease caused by *P. cinnamomi*.

Areas that have suffered significant disturbance to reduce the number of indicator plants or mask disease symptoms may be included in this category. Fire is a common factor that will cause normally interpretable areas to become uninterpretable. Cleared land is placed in the uninterpretable category, however these areas will never regain their status as interpretable.

Areas of vegetation that do not include indicator plants such as wetlands and some swamps should be placed in this category unless sampling confirms the presence of *P. cinnamomi*. These areas must then be placed in the infested category.

4.7.4 The distribution of *P. cinnamoni*

P. cinnamomi distribution maps showing areas of *P. cinnamomi* infestation (Infested), areas free of *P. cinnamomi* infestation (Uninfested) and areas uninterpretable for the presence of *P. cinnamomi* (Uninterpretable) are presented in Figures 4.8 to 4.12. A single infestation on the proposed transmission line route was identified at the proposed Moore River crossing as shown in Figure 4.9. The remainder of the preferred route was found to be either uninfested or uninterpretable. The uninterpretable areas were primarily cleared agricultural land or degraded or cleared areas associated with roads and agriculture.

The proposed line route contained several large areas of high quality native vegetation separated by disturbances such as roads and agricultural properties. The line route option primarily traverses Spearwood Dune system soils and limestone outcrops. These sites typically are less vulnerable to the effects of *P. cinnamomi* than sites in the Bassendean system due to soil chemistry. However, the predominantly Proteaceous vegetation consisting of various Banksia Woodlands is highly susceptible to *P. cinnamomi*, and infestations causing significant impact were observed in vegetation on these soil types during the spring 2000 survey.

There have been relatively few surveys for the presence of *P. cinnamomi* in this mid-west region of Western Australia to provide a wider context for discussion of the results of this survey. Regional surveys along roads in the Northern Sandplains area north of the Moore River (Hart, Simpson and Associates for the Northern Sandplains Dieback Working Party) in the early 1990s showed that P. cinnamomi infestations were rare in the region. The other Phytophthora species such as *P. citricola* and *P. megasperma* were more common, especially associated with wet areas such as drains, but did not produce symptoms of epidemic similar to *P. cinnamomi*. These other pathogens were generally found associated with minor spot infestations that killed small patches of *Banksia* in some years (Hart, Simpson and Associates 1992).

As a general rule, proteaceous vegetation on sites with high soil moisture associated with drainage systems and wetlands are more susceptible to the effects of *P. cinnamomi* than upland areas.

4.8 Fauna

4.8.1 Sources of Information on Fauna

Ecologist, Dr Mike Bamford, having worked extensively in the region since the early 1980s, assessed the fauna of the project area. The assessment was based upon a review of available information and his personal knowledge of the general region. His work has included detailed fauna studies near Gingin and in the Moore River National Park over the period 1983 to 1986 (Bamford 1986) and for Tiwest Joint Venture just north of Cataby over the period 1986 to 2000 (eg. see Bamford and Bamford 2000), and reviews of the fauna and fauna conservation of the Wheatbelt (Bamford 1995 and Safstrom 1999). Other published and unpublished reports that provided information for this study included: Storr *et al.* (1978), Storr and Johnstone (1988), Bush et al. (1995), Blakers *et al.* (1984), Johnstone and Storr

(1998), Morgan *et al.* (1998) the database of birds of Western Australia (maintained by the WA Group of Birds Australia) and the threatened fauna database maintained by CALM. Information from this database was taken from the area bounded by 30 15' to 31 30'S, and 115 30' to 116 00'E.

The literature available on fauna of the region that encompasses the project area, and Dr Bamford's personal experience in the region, made it possible to prepare detailed species lists. In addition, the level of information prepared by Woodman Environmental Consulting in relation to the distribution of vegetation types and the identification of significant habitats in the area allowed for comments to be made on the distribution of the fauna.

Note that most of the information available on the fauna of the region relates to vertebrates, but the CALM threatened fauna database contains some information on invertebrate fauna of conservation significance. Therefore, general species lists were prepared for vertebrate fauna, and only invertebrate fauna classed as threatened can be considered.

Taxonomic orders and names used in this document generally follow Tyler *et al.* (1984) for amphibians, Storr et al. (1983, 1986, 1990 and 1999) for reptiles (common names for amphibians and reptiles from Bush *et al.* 1995), Strahan (1983) for mammals and Christidis and Boles (1994) for birds. Where recent taxonomic revisions have occurred, earlier names are given in parenthesis. This is particularly the case with reptiles, for which several recent revisions have been carried out but some new names have not been widely published or accepted.

The scope of work for this project required the identification of fauna listed as threatened and species otherwise considered to be significant. In Western Australia, fauna species are listed as threatened under the *WA Wildlife Conservation Act 1950*, while CALM also has a priority list. In addition, ANZECC (1999) has prepared a list of threatened fauna for Australia, while Garnett (2000) has recently reviewed the conservation status of all Australian bird species and sub-species. Earlier reviews that have been superseded by these reports but still provide some useful information include Cogger *et al.* (1993) on threatened Australian reptiles, Garnett (1992) on threatened Australian birds and Kennedy (1992) on threatened Australian marsupials. Details of the categories used in these lists are given in Appendix 3.

For the purposes of this document, species are considered to be of national conservation significance if they are listed under the *WA Wildlife Conservation Act 1950*, CALM's priority list, ANZECC (1999) or Garnett (2000). Species are considered to be of regional conservation significance if they are poorly represented in the general area or are at the limit of the species distribution in the region, but are not listed as being of national conservation significance.

4.8.2 Fauna of the Project Area

Species lists have been prepared that indicate each species that may occur within the project area. Some of the lists also indicate the principle habitat of each species. In relation to the proposed transmission line route, 10 freshwater fish (one introduced), 12 frog, 64 reptile, 166 bird (3 introduced) and 32 mammal (5 introduced) species may be present. In addition, 5 bird and 16 mammal species are locally extinct. Six species of invertebrates recorded from the region are included under the WA Wildlife conservation Act 1950 or are in CALM's priority list.

- **Freshwater Fish**

The general region of the proposed line route supports 7 native and 1 introduced species of freshwater fish (see Appendix 2: Table A2.1), although several other introduced species may be present. The majority of these freshwater fish rely on permanent water and are therefore confined to rivers and other permanent wetlands, although several species disperse widely when water levels are high and breeding occurs in seasonal wetlands adjacent to permanent sites. Species such as the Freshwater Cobbler, Nightfish, Western Minnow and Pygmy Perch are therefore likely to occur principally in the Moore River and its tributaries, but disperse into adjacent wetlands in late winter and early spring. Note that all the native freshwater fish with the exception of the Western Minnow and the Swan River Goby, are at the northern limit of their range in the Moore River region, so can be considered of regional conservation significance.

- **Frogs**

Twelve species of frogs are known from the general region of the proposed line route (see Appendix 2: Table A2.2). Because of the north-to-south extent of the project area, there are several species whose distribution boundaries are crossed. The Glauert's Froglet and Sandplain Froglet are southerly in distribution, Glauert's Froglet occurring as far north

as the Moore River, but the other species occurring only as far north as Gingin. In addition, the Slender Tree-Frog occurs only as far north as Tiwest Joint Venture's Cooljarloo minesite. In contrast, the Spotted Burrowing Frog and Humming Frog are northerly and easterly in distribution, apparently being absent from the coastal plain in the Gingin area and south. All five of these species can be considered to be of Regional Conservation Significance because of their distribution in relation to the proposed line route option, although this is to be expected given the area covered by the line route. No frog species of the region is of National Conservation Significance.

With the exception of the Turtle Frog that breeds terrestrially and lives in woodland or heathland with sandy soil (Roberts 1981), all frog species rely on wetlands for breeding. In general, seasonal swamps and watercourses are utilised rather than permanent rivers and lakes, although seasonal flooding of permanent wetlands creates suitable breeding habitat. Some of the frog species remain around wetlands as adults, but several are known to move long distances into terrestrial habitats outside the breeding season. For example, the Moaning Frog and Pobblebonk occupy woodland several kilometres from the wetlands where they breed (Bamford 1992).

The most significant area for frogs along the proposed line route may be at the northern end, in the vicinity of Mimegarra Road and Tiwest's South Mine, which is a complex of woodlands and seasonal wetlands.

- **Reptiles**

The proposed line route is located in a region of high reptile diversity, with a total of 52 species in the general region (see Appendix 2:Table A2.3). This high species richness is due to a number of species endemic or largely restricted to the coastal plain (*Aclys concinna, Pletholax gracilis, Lerista christinae, Neelaps calonotos*).

The size of and habitat diversity within the overall study area mean that many species are at the limit of their distribution in the region. If this parameter is taken as an indicator of Regional Conservation Significance, then approximately half the reptile species would be considered of regional significance. As noted above, however, this is a function of the vast distance covered by the proposed line route. Of more significance is a consideration of the proposed line route in relation to distribution patterns. The proposed line route passes through the west and centre of the coastal plain, so therefore largely avoids distributional transitions.

Regional Conservation Significance can also be considered from the perspective of species with small distributions or with outlying populations. The proposed line route does traverse areas for species confined or largely confined to the coastal plain (eg *Aclys concinna, Pletholax gracilis, Lerista christinae, Neelaps calonotos*), with the main areas of habitat being in SSF65-South and SF65-North, and towards the northern end of the option. There are also a number of species with outlying populations on the coastal plain. For example, the geckoes *Crenadactylus ocellatus* and *Diplodactylus polyopthalmus* occur in scattered locations on the coastal plain often in association with limestone, being more widespread amongst rocks and on the heavier soils east of the escarpment. Isolated populations of these species could be present in SF65-North.

Only two reptile species from the general region are currently recognised as having National Conservation Significance: the South-West Carpet Python and the South-West population of the Woma (both listed under Schedule 4 of the *Wildlife Conservation Act 1950* but not by ANZECC 1999). The Carpet Python tends to be associated with rocky areas of both the escarpment and the coastal plain, and is noted as being moderately common in these regions north of Perth by Bush *et al.* (1995). It has been recorded several times in the area of Tiwest's Cooljarloo mine (Bamford and Bamford 2000 and unpub. records). In the South-West, the Woma has declined in abundance dramatically but in the past was associated with sandy soils of the northern coastal plain and the Wheatbelt. There are recent records of the species at Watheroo and Badgingarra, so if still present in the region, is most likely to persist in the large tracts of native vegetation on sandy soils north of Cataby. However, over 10 years of fauna studies for Tiwest have failed to locate this species (Bamford and Bamford 2000).

Two additional reptile species are listed by Cogger *et al.* (1993) but are not included in more recent reviews of threatened reptile fauna. These are the skink *Lerista christinae* and the Black-striped Snake *Neelaps calonotos*. Both the skink and the snake have restricted distributions on the coastal plain and have been discussed above.

- **Birds**

Birds expected in the general region of the proposed line route are listed in Tables A2.4A and A2.4B in Appendix 2 (waterbirds and landbirds respectively). Because of the mobility of birds, only those that are likely to use the region regularly have been included. Therefore, vagrant species and seabirds have generally

not been listed, except for those seabirds that regularly visit lakes and rivers. The division between waterbirds and landbirds is used because it is distinctive and important both taxonomically and ecologically. Waterbirds also pose a special issue because they concentrate on small areas of habitat and many nest colonially. A third of the 161 species of birds that may occur in the general region of the proposed line route are waterbirds.

Waterbirds

The waterbird species listed for the area are primarily birds of freshwater lakes, swamps and river pools, although several estuarine species, such as the Australian Pelican, have been included as they also visit lakes regularly.

Wetlands in the general region can be divided into three broad categories: rivers and other watercourses such as the Moore River; discrete lakes, whether seasonal or permanent, such as Garagan Lake; and sumplands and damplands where periods of inundation may be short but very large areas may become waterlogged or flooded. These three wetland types can grade into each other, but the distinction is useful when comparing potential impacts on waterbirds. For example, the different general wetland types support different sorts of waterbirds, may be important at different times of the year and may also be used by different species for breeding.

The proposed line route follows high, stabilised sand dunes of the western coastal plain for much of its length and therefore largely avoids wetlands. It does cross the Moore River between SF65-South and SF65-North, but it mostly avoids the river and associated wetlands. At the northern end of the proposed line route, however, it passes near, and in some areas, traveres, a complex of sumplands and damplands in the vicinity of Mimagarra Road and up to the Cooljarloo minesite. At least one of these wetlands, Emu Lake, is permanent and appears to be used by large numbers of waterbirds for breeding, but nests observed in the paperbark trees around the lake were not in use when the site was visited in early September 2000.

Waterbirds in Australia are often very mobile because of the seasonal nature of their habitat, and therefore there are few patterns of distribution of waterbirds across the general region that aren't simply related to this availability of wetland habitat. Some species do have a generally southerly distribution, but even these species will opportunistically utilise wetlands outside their normal range following heavy rain. Because waterbirds tend to be widespread and mobile, regional conservation significance is related not so much to the presence of birds but their activity at a site. In particular, breeding by colonies of waterbirds can be of regional significance, as can the use of wetlands as drought refuges. Several breeding colonies are known in the region, while the larger lakes, and pools of the Moore River, may be important drought refuges.

As noted above, Emu Lake just to the south-west of Tiwest's South Mine appears to be used by a colony of waterbirds, possibly one of the ibis. In addition, the Purple Swamphen was breeding at this lake in early September 2000, which was unexpected as this is one of those waterbirds with a primarily southerly distribution, Johnstone and Storr (1998) recording the northern limit of its range as Moora.

One waterbird is considered to be locally extinct by Johnstone and Storr (1998). This is the Black Bittern and it once occurred along the Moore River, being primarily a species of overhanging, riverine vegetation. As this species is widespread in northern Australia, is it not listed as of conservation significance by Garnett (2000), but the South-West population is classed as Priority 2 by CALM.

Landbirds

Landbirds in the general region have better defined local patterns of distribution than waterbirds, due to habitat differences from north to south and west to east, and in general reflecting the position of the region in the transition from the high rainfall Bassian to the low rainfall Eremaean Zones. There are species that are confined or largely confined to the south of the region, some that are similarly restricted to the north, a few that are confined to the coastal plain and some that are essentially birds of the Wheatbelt.

As noted in the section on reptiles, species with distributional boundaries within the general region of the project area can be considered of Regional Conservation Significance, but this would include almost a third of the landbird species. Therefore, better resolution is obtained by considering the distribution of species, with emphasis on species with small distributions or outlying/fragmented populations.

The only landbird species with a very restricted range within the project area is the White-breasted Robin, which is actually widespread in the forest of the South-West but occurs as an isolated population on the coastal plain from Yanchep to Geraldton (Ford 1971, Blakers *et al.* 1984). In this region, it occurs mainly in the west in dense vegetation of gullies and around wetlands, and it is present in the Cataby area (Bamford and Bamford 2000).

Seven landbird species are of National Conservation Significance, although recognition of threatened species varies between different sources of information. For example, the Square-tailed Kite is classed as Priority 4 by CALM, the Peregrine Falcon is listed as Schedule 4 under the *WA Wildlife Conservation Act 1950*, the Short-billed Black-Cockatoo is classed as Endangered under the *WA Wildlife Conservation Act 1950*, by ANZECC (1999) and by Garnett (2000). The Barking Owl (South-West population) and Masked Owl are classed as near-Threatened by Garnett (2000) and as Priority 2 and Priority 4 respectively by CALM, while South-West races of the Rufous Fieldwren and Crested Bellbird are all classed as near-Threatened by Garnett (2000).

The two species that are listed only as near-Threatened have lost habitat due to clearing for agriculture, but the Fieldwren and Bellbird are common in the region, the former in heathland and the latter in *Banksia* woodland. Of the remaining five species, the Masked and Barking Owls may occur in eucalypt woodland, such as an area of tuart woodland in SF56-North. Both species nest in hollows of large trees. The Square-tailed Kite and Peregrine Falcon have both been recorded at several locations in the region, including around Tiwest's Cooljarloo Minesite (Bamford and Bamford 2000), where the Kite typically forages over heathland. If either of these raptors breeds in the region, they would do so in large trees.

The Short-billed Black-Cockatoo is the most critical of the Threatened species, and in the provision of information on Threatened fauna, CALM requested that Western Power should consult directly with CALM regarding the conservation of this species. This is a species that has declined badly due to loss of breeding habitat in the Wheatbelt, but it is known to breed in the east of the region and to forage in large flocks in the Banksia woodlands on the coastal plain. It could be affected by habitat loss and particularly by loss of nest trees.

Several landbirds are considered to be extinct in the region (see Appendix 2: Table A2.4b). Factors that have affected them include habitat loss, altered fire regimes and introduced predators.

- **Mammals**

The extant mammal fauna of the general region of the proposed line route consists of 21 native and 5 introduced species (Appendix 2: Table A2.5), with a further 16 native species that are regionally extinct (Appendix 2: Table A2.5). This massive loss of mammal species has occurred across much of mainland Australia and has been attributed to changes in fire regime, habitat loss and predation by foxes and cats (Burbidge and McKenzie 1989, Paton 1991). Note that the past presence of some mammal species can only be guessed at, as there are few records of extinct species in the region. In some cases, these records include recent remains in caves, such as skeletal material of the Woylie and Boodie in caves at Yanchep (Glauert 1948).

The distribution patterns of several mammal species in the region make them regionally significant, in some cases because urban and rural development on the coastal plain around Perth has resulted in a local contraction of a species' range. For example, several of the dunnarts (*Sminthopsis dolichura, S. griseoventer* and *S. granulipes*), the Honey Possum and the Noodji or Ashy-grey Mouse are largely coastal plain species that have disappeared or almost disappeared from the southern coastal plain, including the Perth area. The proposed line route therefore passes through what is effectively an artificial southern limit to the range of these species.

There are also species that are close to the northern limit of their distribution in the region, with the result that urban and rural development around Perth has created what may be isolated populations of the Chuditch, Brush-tailed Phascogale, Quenda, Western Pygmy Possum and several species of bats north of Perth.

Six of the mammal species known or expected from the region are of National Conservation Significance, but four of these are listed only as Priority 4 by CALM: Brush-tailed Phascogale, Brush Wallaby, the bat *Falsistrellus mackenziei* and the Rakali or Water Rat. Of these, the Phascogale and the bat are of unknown distribution in the region but may be present in southern areas, the Brush Wallaby is widespread in *Banksia* woodlands and the Rakali probably occurs along several of the rivers and around permanent lakes. The Quenda, also listed as Priority 4 by CALM, is additionally classed as Conservation Dependent. It has been recorded only as far north as the mouth of the Moore River (CALM's Threatened Fauna Database) and just to the east of Gingin (M. Bamford, pers. obs.), but may occur in dense vegetation around damplands and wetlands to the west and north-west of Gingin. It may also occur along the Moore River where suitable vegetation is present.

The Chuditch is listed in Schedule 1 (and as Vulnerable) under the *WA Wildlife Conservation Act 1950*, and as Vulnerable by ANZECC (1999). It has been reported from Lennard's Brook near Gingin and from just south of Cataby in the last 15 years (CALM's Threatened Fauna Database), so is still present in the area. It is probably surviving at low population densities in large

tracts of native vegetation, but may increase in numbers if planned fox control is undertaken in the region. This Fox control can also be expected to benefit some other native species, such as the Brush-tailed Phascogale and Quenda, and the Fox control may be followed by the release of some locally extinct species. The Fox control is planned for native vegetation on the coastal plain, including to the south-west of Tiwest's Cooljarloo mine.

- **Invertebrate Fauna**

In general, the invertebrate fauna of a region is too species rich and poorly understood for a review to be carried out in the same manner that can be conducted for vertebrates. However, the following provides a list from CALM's Threatened Fauna Database of threatened invertebrates of the general region of the proposed line route:

Schedule 1. A native bee *Leioproctus contrarius* recorded from Moore River National Park.

Priority 1. A native land snail *Bothriembryon perobesus* known only from near the mouth of the Moore River.

Priority 2. A native cricket *Phasmodes jeeba* reported from Cockleshell Gully.

Priority 3. Two crickets, *Austrosaga spinifer* from near Cervantes and *Hemisaga vepreculae* from Jurien Bay, and a bee Hyaleus globuliferus from Moore River National Park and 17 km ESE of Jurien.

Priority 4. The South-West Freshwater Mussel *Westralunio carteri* that is considered to be common in freshwater rivers and streams, and permanent, freshwater lakes, in the region.

With the exception of the Freshwater Mussel, all these species have been recorded from native vegetation of the western coastal plain, but only *L. contrarius* and *H. globuliferus* have been reported from sites close to the proposed line route.

4.9 Social Surroundings

4.9.1 Land Use

Land development in the Gingin area commenced in the mid 19th century, primarily for grazing along the Gingin Brook and its tributaries on the floodplain of the Moore River (Smolinski and Scholz, 1997). About 60% of the Gingin area has now been cleared for agriculture and the area has long been recognised as a pastoral district. Sheep and cattle grazing is still the major land use with some cropping of coarse-grained cereals and fodder crops. Irrigated Horticulture is also practised and the proximity to the metropolitan area and the availability of groundwater are making the area attractive for major horticulture developments, including intensive horticulture using pivot irrigation to produce vegetables for local, interstate and overseas markets.

Other enterprises in the area include orchards producing citrus and stone fruit, and wildflower farms. Some properties are cultivated to produce products such as tagasaste and cereal crops for stock feed.

Development in the area is typically rural in character and mainly associated with agricultural pursuits. In addition Lancelin and Ledge Point are popular holiday/recreation destinations. There has been some subdivision of the land in the area to the west of the proposed alignment for 'recreational' living.

The proposed alignment is approximately 123km in length, affects 15 private properties and traverses SF65-South and SF65-North and the edge of Gingin Stock Route Reserve. Approximately 60km of the route traverses native vegetation, of which approximately 25km is within State Forest and approximately 35km on private properties.

Private land traversed by the proposed alignment is used for cattle and sheep grazing, small areas of planted pine trees, small areas of tagasaste, unused land adjacent to remnant vegetation and sand mining. One area of private land traversed is currently subject to a subdivision application. If successful this land parcel would be divided into smaller rural lots. However the proposed alignment is outside the actual area subject to the subdivision application. The proposed alignment has been selected to avoid any existing residential or subdivided rural land. The alignment was also selected to avoid any areas identified for future subdivision in local authority planning schemes or other Local or State Government planning documents.

Crown land traversed by the proposed alignment includes SF65-South and SF65-North, the Wabling Management Priority Area, Gingin Stock Route Nature Reserve and Un-allocated Crown land.

The majority of the area within SF65-South that will be traversed by the proposal is presently used for pine plantation, with small areas of remnant vegetation being managed for nature conservation. The areas of pine plantation will be transformed into re-vegetated conservation lands under CALM's Gnangara Park Concept Plan (see Department of Conservation and Land Management, 1999c). The Concept Plan provides a broad statement of intent with suggestions for future land uses such as nature conservation, resource, recreation and heritage values.

For safety requirements, timber resources such as pines in SF 65-South would have to be removed from within

the transmission line corridor and from within falling height distance of the transmission line. As such, the presence of the proposed transmission line will slightly reduce the area available for the reintroduction of native vegetation in SF65-South for the Gnangarra Park.

SF65-North, north of the Moore River, also referred to as State Forest 65 North and the Gingin Stock Route Nature Reserve are, and will continue to be, managed for nature conservation. CALM has advised that SF 65-North and the Gingin Stock Route are regarded as important nature conservation areas with recreation potential.

The Unallocated Crown land is not presently managed for any specific land use except Lancelin Defence Training Area to the north of Mimegarra Road, however areas of uncleared remnant vegetation would have nature conservation value. The alignment borders the Lancelin Defence Training Area but will not affect any military operations.

Extensive consultation with potentially affected landowners and government agencies indicate that the most significant landuse concerns associated with the proposal are:

- potential conflicts with intensive agriculture;
- effects on the conservation estate and Natural Heritage values;
- loss of public timber resources in SF65-South and;
- effects on future subdivision potential of private land holdings.

The height of the Pivot irrigation equipment used on some of the properties along the line route may conflict with the standard designed electrical clearances on the line and provisions will have to be made on the line design to accommodate this.

It is unclear which areas in the vicinity of the proposed corridor have subdivision potential. However, the Gingin Coast Structure Plan draft working papers prepared in 2000 for the Western Australian Planning Commission and the Ministry for Planning have indicated that the proposal would not conflict with areas being considered for future subdivision.

The line route will traverse the TiWest mine site on an alignment negotiated to ensure that the presence of the transmission line would not conflict with TiWest's operations.

4.9.2 Visual Resources

Western Power engaged a consultant Landscape Architect to investigate the visual resources of the area traversed by the proposed corridor and the alternative alignments investigated, the likely visual impacts of the project and possible management strategies to reduce visual impact. Findings of this landscape study related to visual resources are summarised briefly below. See Cleary (2001) for the full landscape study conducted for the project.

The proposed transmission line corridor and alternative alignments corridors investigated are located mainly on the Swan Coastal Plain, which extends approximately 30km inland from the coastline. This area is within the Swan Bioregion (Thackway & Cresswell 1995). It generally has an elevation of 0-80m AHD but also contains a number of prominent ridges that lie in a north-west/south-east direction and which rise up to approximately 160m AHD. The Moore River dissects the plain in the middle of the landscape study area, heading west after it enters the plain from the east, then a south-easterly direction through a prominent valley before swinging to the west again and eventually reaching the ocean at Guilderton.

The remnant vegetation traversed by the proposed transmission line corridor is dominated by Banksia woodland and shrubland. Major watercourses (such as Moore River) are lined with trees (eg. marri, river gum) that usually contrast in height and density with surrounding vegetation. Over half the study area has been cleared for agriculture, mainly grazing. A substantial area in the south has been developed as plantations.

The Natural Landscape Character Units traversed by the proposed transmission line include the Coastal Plain, Coastal Ridges and a short section of Valleys. The majority of the proposed transmission line corridor traverses the Coastal Plain Unit. A substantial part of the corridor traverses the Coastal Ridges Unit (potentially high visibility) and a short section of traverses the Valleys Unit (potentially high visibility depending on vantage points and siting in relation to ridges).

Significant visual and aesthetic features affected include a short section of the Moore River valley and a longer section of high ridges in the Coastal Ridges Unit, including a number of ridge crossings.

The proposal affects approximately equal areas of low, moderate and high public sensitivity zones, including two road crossings of moderate-high sensitivity.

The vegetation structure in the area of the proposal includes approximately 22km of pine plantation

(medium-tall forest) and remnant vegetation of mainly low woodland or shrubland except for a short section of medium woodland near the Moore River.

4.9.3 Landowner/Community Attitudes

The Local Authorities affected by the proposed transmission line option, that is the City of Wanneroo, Shire of Gingin and the Shire of Dandaragan, have to date expressed qualified support for the proposal subject to Western Power making satisfactory efforts to minimise effects on the local communities.

Extensive consultation with landowners potentially affected by the Western Option indicate that a number choose to live in the area for lifestyle reasons rather than, or in addition to, earning an income from some commercial pursuit on the property. Some of these landowners and some members of local communities are concerned about the lines impact upon the existing character of the area and are generally opposed to such facilities being located close to their place of residence.

A group of landowners opposed to the proposed transmission line route has formed and held several meetings to discuss their concerns. Western Power representatives attended one of the groups meetings in March 2000 to address landowners questions and concerns.

4.10 Heritage

4.10.1 Aboriginal Culture and Heritage

Aboriginal Culture and Heritage includes objects and places in which Aboriginal people hold special significance and which reflect a deep and lasting relationship with the land. Traces of the past, which include former camp sites, rock paintings, initiation grounds, burial or massacre sites and artefacts, all retain deep meaning today to Aboriginal People who guard and protect them to maintain their links with their ancestors.

These traces, along with current sites and objects of significance, are important parts of the living culture of Aboriginal people. Western Power respects the importance of the protection of this Culture and understands their obligations to determine if any sites exist in the proposed transmission line route corridor. Therefore, Western Power will engage appropriately qualified consultants to conduct archaeological and ethnographic surveys of the proposed transmission line alignment. The consultancy brief for these surveys will require the consultants to make recommendations on any modifications to the location, construction and operation of the transmission line necessary to ensure that no heritage values are adversely affected.

4.10.2 Native Title

Native title describes the rights and interests of Aboriginal and Torres Strait Islander people in land and waters according to their traditional laws and customs that are recognised under Australian law.

Native title claimants can negotiate about some proposed developments over land and waters if they have the right to negotiate. Claimants gain the right to negotiate if their native title claimant application satisfies the registration test conditions.

The right to negotiate applies over some proposed developments or activities that may affect native title. Such developments or activities are known as 'future facts' under the *Native Title Act 1993*. The right to negotiate is triggered when a government agency issues a notice to say that it intends to allow certain things to happen on land. This notice is called a 'section 29 notice', because section 29 of the Native Title Act 1993 sets out what must be done.

The proposal traverses two Registered Native Title Claims, the Combined Metropolitan Claim WC 99/66 and the Yued Claim WC 97/71. The Combined Metropolitan Claim includes six Registered Claimants, and the representatives for the Combined Metropolitan Claim are Dwyer Durack and the Noongar Land Council. The Representative for the Yued Claim is the Noongar Land Council.

On the 14th June 2000 Western Power sent a Notice of Entry under provisions of the *Energy Corporations (Powers) Act 1979* and the *Native Title Act 1993* to the Native Title Claimants and their representatives. This Notice of Entry included a map showing the proposed transmission line alignment and an offer to provide further information on request. The Notice of Entry also stated that if required Western Power representatives would be willing to meet with Claimants or their representatives. Western Power also advised that it had engaged an Aboriginal Heritage consultant to undertake archaeological and ethnographic studies for areas traversed by the proposal.

To date no response to the Notice of Entry has been received by Western Power.

4.10.3 Historic Heritage

The Heritage Council of Western Australia conducted a search for Western Power of the State Register of Heritage Places within the three shires that the proposed transmission line will traverse, i.e. the Shire

of Gingin, the Shire of Dandaragan and the Shire of Wanneroo. The Register, which includes places listed on the Register of the National Estate and the local Council's Municipal Inventories, identified places within these Shires that have cultural heritage significance. Whilst the search of the databases did identify places of cultural significance within the region of the project area, there are no places in which the proposed transmission line route will impact on these places or the values associated with them.

5.0 Environmental Factors and Management Strategies

5.1 Introduction

Table 5.1 lists the environmental factors that the EPA have identified as relevant to the proposed transmission line route. Appendix 1 provides a copy of the EPA Guidelines for the proposal which detail the issues presented in Table 5.1.

The following section discusses Western Power's Environmental Management System, the management strategies proposed to address the above-mentioned environmental factors and states Western Power's environmental commitments for the project.

Table 5.2 presented over provides a summary of the environmental issues associated with the proposal and the management strategies proposed to manage these issues.

Table 5.1 Environmental Factors associated with the proposed Pinjar to Cataby Transmission Line Route

Factor	Issue	Specific
Biophysical	Terrestrial Flora	Remnant Native Vegetation
		Conservation Reserves
		Declared Rare and Priority Listed Flora
		Weeds
		Dieback (Phytophthora)
	Terrestrial Fauna	Fauna/Specially Protected (Threatened) Fauna.
	Wetlands	Lakes/protected lakes
		Water Courses
	Land	Land Degradation
Pollution	Non-Chemical Emissions	Noise
		Dust
		Electro-magnetic fields
Social	Aesthetic	Visual Amenity
	Culture & Heritage	Aboriginal Culture & Heritage
		National Estate
	Public Health & Safety	Unexploded Ordinance

Table 5.2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Stategies	Predicted Outcome
Terrestrial Flora including: • Remnant Vegetation; • State Forest 65 South, State Forest 65 North and Gingin Stock Route Nature Reserve • Weeds and disease, including dieback (Phytophthora) and; • Declared Rare Flora, Priority Flora and other significant flora.	The EPA's objectives for this proposal in relation to terrestrial flora are to: • Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities. • Ensure that the conservation values and management of existing and proposed reserves are not compromised. • Ensure that regionally significant flora and vegetation communities in these reserves are protected. • Ensure that regionally significant flora and vegetation are adequately protected from the spread of weeds and diseases, including Dieback. • Protect Declared Rare (DRF) and Priority Listed Flora (PLF), consistent with the provisions of the *Wildlife Conservation Act 1950* and the Commonwealth *Environmental Protection and Biodiversity Act 1999*	Detailed flora, vegetation and dieback surveys undertaken for the project provided the following description of the existing environment: • 29 plant communities and 1 disturbance community were described and mapped along the proposed line route. • 335 taxa of vascular flora belonging to 59 plant families were recorded from the proposed line route. • 32 weed species from 14 plant communities were recorded in the native vegetation along the proposed line route. • A single infestation of Dieback was identified at the proposed crossing of Moore River. • 2 declared rare flora and 4 priority listed species were recorded within close proximity of the proposed transmission line route corridor • The proposed transmission line corridor traverses State Forest 65 South, State Forest 65 North and Gingin Stock Route Nature Reserve.	The key potential impacts on terrestrial flora, vegetation and conservation estates resulting from the proposed Pinjar to Cataby transmission line may include: • Fragmentation and severance of State Forest 65 North, State Forest 65 South and Gingin Stock Route Nature Reserve. • Clearing of remnant native vegetation. • Loss or disturbance of significant flora species populations. • Introduction or spread of weeds. • Introduction or spread of soil borne diseases. • Increased risk of fires. • Generation of dust and waste. • Disturbances associated with increased access. • Positive impacts such as rehabilitation and controlled vehicle access	The following environmental management strategies have been identified that will enable the project to meet the objectives of the EPA: • Existing access tracks will be utilised whereever possible. See Section 2.4.1 and Section 5.2.1.1 for details. • Vegetation control methods and transmission tower structure design and location will result in minimal vegetation clearing and temporary vegetation disturbance. See Section 2.4.1 and Section 5.2.1.1 for details. • An Environmental Management Plan (EMP) for both the construction and maintenance phase of the project will be implemented that will address issues of vegetation clearing controls, DRF & PLF, weed & dieback hygiene, fire management, dust suppression and waste management. • With the exception of one area, all areas of identified DRF, PLF and Threatened Ecological Communities have been avoided. See Section 5.2.1.2 for details on proposed management of affected DRF.	EPA Objectives can be met.

Table 5.2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Fauna including: • Specially Protected (Threatened) Fauna	The EPA's objectives for this proposal in relation to fauna are to: • Maintain the species abundance, diversity and geographical distribution of fauna. • Protect Specially Protected, Threatened and Priority Fauna and their habitats, consistent with the provisions of the *Wildlife Conservation Act 1950* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*	An assessment of the fauna within the project area provided the following description of the existing environment: • 7 fresh water fish species, 1 of which is introduced. • 12 frog species. • 52 reptile species, 2 of which are of national conservation significance and another 2 of which are listed by Cogger et al (1993). • 53 wetland bird species, 3 of which are of national conservation significance. • 108 dryland bird species, 7 of which are of national conservation significance and another 2 of which are introduced. • 28 mammal species, 6 of which are of national conservation significance and 5 of which are introduced.	Potential impacts on fauna resulting from the proposed Pinjar to Cataby transmission line may include: • Fauna loss due to habitat removal and fragmentation. • Habitat loss as a result of increased access and the introduction of weeds, dieback and/or fire. • Direct fauna kills during the construction phase of the project. • Removal of habitat suitable for threatened species. • Creating a barrier to fauna movement.	The following environmental management stratrgies have been identified that will enable the project to meet the objectives of the EPA: • The potential for habitat fragmentation has been minimised by avoiding where-ever possible native remnant vegetation, e.g. traversing pine plantations and aligning the transmission line route near existing access tracks. • Vegetation control methods and transmission tower structure design and location will result in minimal vegetation clearing and temporary vegetation disturbance. See Section 2.4.1 and Section 5.2.1.1. • Habitat suitable for threatened fauna has been avoided. • An Environmental Management Plan (EMP) for both the construction and maintenance phase of the project will be implemented that will address issues of vegetation clearing controls, weed & dieback hygiene and fire management.	EPA Objectives can be met.

Table 5.2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Wetlands including: Lakes Watercourses	The EPA's objectives for this proposal in relation to wetlands are to: Maintain the integrity, functions and environmental values of wetlands. Ensure Environmental Protection Policy Lakes (EPP Lakes) are protected and their key ecological functions are maintained. Maintain the integrity, function and environmental values of rivers, creeks and ephemeral streams.	An assessment of the wetlands within the project area provided the following description of the existing environment: The proposed transmission line route traverses the Moore River at one location. The southern portion of the proposed line route avoids damplands and EPP Lakes located near the eastern boundary of State Forest 65 South. The northern portion of the proposed line route does pass through a complex of sumplands and damplands. The proposed line route does not traverse any EPP Lakes.	Potential impacts on wetlands resulting from the proposed Pinjar to Cataby transmission line may include: Alteration to existing hydrological processes through the removal of wetland dependent vegetation. Degradation of wetland vegetation and impacts on wetland fauna.	The following environmental management strategies have been identified that will enable the project to meet the objectives of the EPA: Utilise existing access tracks located near wetland areas for construction and maintenance activities. All tower structures will be placed outside a 50m vegetation buffer surrounding each wetlands. All construction and maintenance activities will occur in dry conditions. All towers located near wetland areas will be placed in already cleared areas	EPA Objectives can be met.

Table 5.2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Land Degradation	The EPA's objectives for this proposal in relation to soil is to: Ensure that vegetation clearing does not result in land degradation.	A review of the soils associated within the project area provided the following description of the existing environment: • The proposed line traverses Bassendean, Karrakatta, Cottesloe and Moore River soil units	Construction works have the potential to cause land degradation through soil erosion resulting from the removal of vegetation.	Where ever possible, existing access tracks will be utilised thereby minimising the removal of vegetation Construction Specifications will include the following: • Low vegetation to be retained where possible in drainage lines; • In vegetated areas, drainage to be directed into undisturbed bush; • No tree, soil, rock or debris to be pushed into drainage channels; • Drainage paths under/ through bridges, culverts shall not be blocked; • Existing road or track drainage lines to be maintained as required. • See Section 5.2.4 of this document for further details.	EPA Objectives can be met.

Table 5.2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Noise	The EPA's objective for this proposal in relation to noise is to: • Protect the amenity of residents from noise impact during construction, ensuring that noise levels meet statutory requirements and acceptable standards	The proposed transmission line corridor is generally located away from areas of human settlement and traverses no townships or rural residential subdivisions. The closest rural residence is at least 200m from the proposed transmission line.	Transmission line construction activities having the potential to create noise emissions include the general movement of construction vehicles and the use of heavy materials. Post construction noise emissions is the use of helicopters for patrols and maintenance activities.	Construction activities will comply with the conditions set out for special cases in the Environmental Protection (Noise) Regulations 1997. See Section 5.3.1 of this document for further details.	EPA Objectives can be met.
Dust	The EPA's objective for this proposal in relation to dust is to: • Ensure that dust and particulate emission levels generated by the proposal, both individually and cumulatively, meet appropriate criteria and do not cause environmental or human health problems	The proposed transmission line corridor is generally located away from areas of human settlement and traverses no townships or rural residential subdivisions. The closest rural residence is at least 200m from the proposed transmission line.	Transmission line construction activities having the potential to generate dust emissions include the general movement of construction vehicles and the use of heavy materials.	Special measures for dust control will be employed if an assessment of the corridor during construction activities indicates that there is a risk of a nuisance arising due to dust. Rehabilitation of rural land following construction (Section 2.8) will ensure that there will be no post construction dust impacts.	EPA Objectives can be met.

Table 5.2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Electro - magnetic Fields	The EPA's objective for this proposal in relation to Electro-magnetic fields is to: • Protect the amenity and health of residents from potential impacts of electro-magnetic fields, ensuring that levels meet statutory requirements and acceptable standards.	Electro-magnetic fields (EMFs) can occur over a wide range of frequencies and are found whereever electricity is used. They are a natural by-product of the use of electricity and occur around all electric wires and electrical appliances. Hence, they are present in domestic and workplace environments as well as near ordinary street distribution lights and high voltage transmission lines such as the proposed transmission line from Pinjar to Cataby.	For most people the greatest exposure to power frequency EMFs arises from distribution lines in the street, household wiring and domestic electrical appliances. Based on field profiles (see Section 5.3.3), living near the proposed transmission line would not substantially increase this exposure.	Western Power is committed to the concept of prudent avoidance as a means of controlling exposures to EMFs if there is any doubt that they are harmless; it designs, constructs and operates all it's plants and facilities prudently within the guidelines recommended by the NH&MRC of Australia. See Section 5.3.3 for further details.	EPA Objectives can be met.
Effects of Electric Fields on Honeybees	The EPA Guidelines for the proposal also state that Western Power must identify the potential impact of EMFs on mating, navigation and physiology of honey bees, specifically Queen Bees.	An apiary site is located in the northwestern boundary of State Forest 65 North within the vicinity of the proposed transmission line route.	All the research studies undertaken to date have shown that there is no detrimental effects to commercial apiary operations such as queen bee breeding and honeybee production if the apiary sites are located in areas where the electric field exposure is less than 2kV/m.	The maximum electric field produced by the proposed Pinjar to Cataby 330kV transmission line is less than 2kV/m. Based on the studies identified in Section 5.3.3.1, it can be concluded that the proposal would not have a detrimental effect upon any commercial apiary operations such as queen bee breeding and honey production in the area.	EPA Objectives can be met.

Table 5.2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Visual amenity	The EPA's objective for this proposal in relation to the visual amenity of the area is to: • Ensure that the visual amenity of the area is not significantly affected by the proposal.	A consultant Landscape Architect was engaged to investigate the visual resources of the project area. The Natural Landscape Character Units traversed by the proposed line route include the Coastal Plain, Coastal Ridges and a short section of valleys.	Potential impacts on visual amenity resulting from the proposed Pinjar to Cataby transmission line may include: • Impacts of views and small areas of significance and wilderness. • Impacts on the natural character in the vicinity of the proposed transmission line route.	The landscape studyconducted for this proposal identified that the proposal had a moderate or high compliance with management objectives related to landscape character, visual aesthetic significance and wilderness quality. See Section 5.4.1 of this document for further details of study. The study also found that the proposal had a low to moderate compliance with objectives related to views. As a result the study recommended modifications to the proposed line route, of which Western Power has investigated and intends to adopt three of the four proposed changes. Social issues related to impacts on small private holdings and existing landuse make the adoption of the fourth proposed modification problematic.	EPA Objectives can be met.

Table 5.2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
Aboriginal culture and heritage	The EPA's objective for this proposal in relation to aboriginal culture & heritage is to: • Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act 1972*. • Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Western Power will engage appropriately qualified consults to conduct archaeological and ethnographic surveys of the proposed transmission line alignment. The proposal traverses two Registered Native Title Claims. A Notice of Entry has been sent to the Representatives for the Claims stating Western Power's willingness to meet with Claimants or their representatives.	Potential impacts on Aboriginal Culture and Heritage resulting from the proposed Pinjar to Cataby transmission line may include: • The physical presence of the transmission line • Ground disturbing activities such as vegetation clearing, the preparation of tower foundations and constructing access roads. • Indirect impacts may be due to increased erosion or to improved access to vulnerable sites.	The consultancy brief for the archaeological and ethnographic surveys will require the consultants to make recommendations on any modifications to the location, construction and operation of the transmission line necessary to ensure no heritage values are adversely affected. Western Power commits to the modification of the location of the transmission line to ensure that no Aboriginal Heritage values are adversely affected by the proposal.	EPA Objectives can be met.

Table 5.2: Summary of potential environmental impacts and management strategies associated with the proposed transmission line route continued...

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Issues and Impacts	Management Strategies	Predicted Outcome
National Estate	The EPA's objective for this proposal in relation to the National Estate is to: • Ensure that the proposal complies with the requirements of the Western Australian *Heritage Act 1972* and the *Australian Heritage Commission Act 1975* and protects the identified values of places listed in the register of the National Estate and places listed on the Interim List of the Register of the National Estate.	The Heritage Council of Western Australia conducted a search of the Register of the National Estate, the State Register of Heritage Places and the State Places database. The search of the databases identify places of cultural significance within the region of the project area.	Construction activities have the potential to adversely affect National Estate Places. Activities include: • The physical presence of the transmission line • Ground disturbing activities such as vegetation clearing, the preparation of tower foundations and constructing access roads. • Indirect impacts may be due to increased erosion or to improved access to vulnerable sites.	Whilst the search of the databases identified places of cultural significance within the region of the project area, there are no places in which the proposed transmission line route will impact on these places or the values associated with them.	EPA Objectives can be met.
Risk and hazard – Unexploded ordinance	The EPA's objective for this proposal in relation to Unexploded ordinances is to: • Establish the area potentially affected by unexploded ordinances in the vicinity of the proposed route	The proposed line route traverse three WW2 era gazetted live firing areas and portions of the Defence Training area north of Lancelin. Therefore an assessment of the extent of unexploded ordinances (UXO) present within the proposed line route was undertaken.	Activities associated with the construction of the proposed transmission line presents a risk to human health if UXOs are detonated.	The UXO Unit of the Fire and Emergency Services Authority (FESA) of Western Australia was commissioned by Western Power to conduct detailed search and remediation of the impact areas identified in the UXO assessment. Should any additional changes to the proposed Pinjar to Cataby transmission line arise from the environmental planning or EIA process, these changed alignments would be assessed for UXO contamination and where necessary remediated to eliminate UXO hazards.	EPA Objectives can be met.

5.1.1 Western Power's Environmental Management System

Detailed strategies for managing the potential impacts of the proposed transmission line are contained in Sections 5.2 to 5.5. These strategies will form the basis for Western Power's project Environmental Management Plan (EMP) containing detailed procedures that will be used for specifying and auditing construction and maintenance activities. This EMP will be incorporated into Western Power's Environmental Management System (EMS) and information will be stored in the Environmental Management Information System (EMIS).

Commitment 1:

Develop and implement an Environmental Management Program (EMP) that:

1. *Includes specific plans and procedures developed in consultation with concerned stakeholders through ongoing stakeholder liaison and discussion by the proponent's officers, which address construction impacts and stakeholder concerns.*
2. *Includes monitoring procedures and control of the activities of employees, agents and contractors to ensure the adherence to environmental requirements identified in the EMP.*
3. *Is integrated into the existing Western Power Corporate Environmental Management System and documented in the Environmental Management Information System (EMIS).*

Commitment 2:

Implement the approved Environmental Management Program referred to in Committment 1.

Western Power's EMS is a structured process for achieving continual improvement in environmental performance. It is a system set in place to manage environmental impacts, both current and future.

The EMS addresses all activities, processes and products within Western Power, and assists in integrating environmental management into it's daily operations, long term planning and other quality management systems. All operating sites and locations that have the potential to impact the environment are covered by Western Power's EMS.

The development of Western Power's EMS has required the Corporation to:

- establish an environmental policy applicable to Western Power activities, processes and services;
- identify the environmental risks associated with the Western Power's activities, processes and services;
- identify relevant legislative and regulatory requirements associated with the Organisations activities, processes and services;
- identify priorities and set environmental objectives and targets;
- establish a structure and program to implement the environmental policy and achieve environmental objectives and targets;
- plan for, control, and monitor: corrective actions, audits and review to ensure planned arrangements are followed through; and
- continually adapt changing circumstances.

5.1.2 Western Power's Environmental Management Information System

Western Power has also developed an internet based environmental management information system, known as EMIS, which is used for tracking Western Power's environmental activities and legal compliance as well as supporting the documentation needs of the EMS.

The EMIS contains the following databases:

- Environmental Responsibilities
- Legal and other requirements
- Issues and Impacts
- Management Programs
- Environmentally Sensitive Areas: includes information on declared rare flora, dieback, invasive weeds, livestock disease, Environmental Protection Policy lakes;
- Emergency Response
- Training Programs and Records
- Monitoring
- Incidents
- Auditing and Reporting
- Procedures
- Non-comformance
- Communications

The EMIS is used to:

- communicate and track legal compliance issues;
- manage Western Power's environmental issues;
- promote environmental awareness;
- encourage environmental leadership;
- draw attention to environmental protection;
- communicate practical environmental programs; and
- track and record environmental performance

The EMIS provides Western Power's workforce with:

- information on declared rare flora, threatened ecological communities and other environmentally sensitive areas;
- access to important environmental legislation;
- environmental procedures and guidelines (government approvals and assessments);
- a forum to submit environmental queries; and
- a resource for the identification of areas of environmental risk requiring management and special precautions.

5.2 Biophysical Factors

5.2.1 Terrestrial Flora

Experienced botanists and dieback interpreters carried out vegetation, flora and dieback surveys for the project between June and November 2000. Woodman Environmental Consulting (2000) provide a detailed and comprehensive discussion of the survey findings and methodology employed. The findings of these surveys have been used to address the following section on the potential impacts on terrestrial flora in relation to the proposed transmission line route.

The EPA guidelines for Terrestrial Flora require the following environmental objectives are met in relation to proposed transmission line route:

- *'Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities';*
- *'Ensure that the conservation values and management of existing and proposed reserves are not compromised';*
- *'Ensure that regionally significant flora and vegetation communities in these reserves are protected';*
- *'Protect Declared Rare and Priority Flora consistent with the provisions of the Wildlife Conservation Act 1950, and the Commonwealth Endangered Species Act'; and*
- *'Ensure that regionally significant flora and vegetation are adequately protected from the spread of weeds and diseases, including Dieback'.*

Section 5.2.1.1 to Section 5.2.1.4 address the above terrestrial flora objectives and management strategies that Western Power will employ to ensure these objectives are met.

5.2.1.1 Remnant Native Vegetation and Management Strategies

EPA Objectives:

- *'Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities';*
- *'Ensure that the conservation values and management of existing and proposed reserves are not compromised'; and*
- *'Ensure that regionally significant vegetation communities in these reserves are protected'.*

The following lists the areas of remnant native vegetation that the proposed transmission line route will traverse:

- Gingin Stock Route Nature Reserve
- SF65-South
- SF65-North
- East of SF65-South
- Between Gingin Stock Route Reserve and SSF65-North
- Between SF65-North and Sappers Road
- Between Sappers Road and Dingo Road
- Between Dingo Road and Mimegarra Road
- Between Tiwest Joint Venture and Properties Ajacent to Mimegarra Road
- Tiwest Joint Venture Lease

Information on the above-mentioned areas of remnant native vegetation will be presented separately below, and will include discussion on the conservation values and regional significance identified from the vegetation surveys as well as the specific vegetation clearing requirements and methods that will be employed to meet the EPA objectives. For further details on generic vegetation clearing scenarios and methods, refer to Section 2.4 of this document.

Section 4.5 of this document and Woodman Environmental Consulting (2000) provide further details on vegetation communities mapped and their conservation status.

Management strategies to address the protection of Declared Rare and Priority Listed Flora and the control of weeds and dieback infestation are discussed separately in Sections 5.2.1.2 to 5.2.1.4 respectively.

Table 5.3a summarises the quantity of remnant native vegetation by land tenure that will be permanently cleared or temporarily disturbed by the proposal. Table 5.3b and 5.3c summarise the Vegetation Complexes, as defined by Heddle et al (1980), that will be permanently cleared and temporarily disturbed as a result of the proposal.

The total area of remnant native vegetation within **secure conservation reserves** affected by the proposal is 24.9ha, including **23ha of temporary vegetation disturbance** and **1.9 ha of permanent clearing**.

Commitment 3:

Prepare a vegetation management plan that addresses:

1. *a system of environmental offsets;*
2. *procedures to ensure that the transmission line does not reduce the overall area of remnant vegetation within the State's secure conservation estate; and*
3. *the protection of declared rare and priority species.*

Commitment 4:

Implement the approved vegetation management plan required by Committment 3.

The exact nature and extent of the environmental offset will be determined to ensure a net environmental benefit to the conservation estate. This may be achieved by Western Power adding an area of private land having significant conservation value to the conservation estate or by contributing to the State's nature conservation effort in some way.

Table 5.4 provides information on generic management strategies that will be employed in relation to minimising the clearing of remnant vegetation. For further details on generic vegetation clearing scenarios and methods, refer to Section 2.4 of this document.

Table 5.3a: Quantity of remnant native vegetation (defined by Heddle et al, 1980) by land tenure that will be permanently cleared or temporarily disturbed by the proposal.

Land Classification	Area Permanently Cleared (HA)	Area Temporarily Disturbed (HA)
Gingin Stock Route Nature Reserve	0.025	0.697
State Forest 65 South	0.66	7.82
State Forest 65 North	1.249	14.483
Total CALM Managed Estate	**1.934**	**23**
Crown Land other than CALM	0.607	9.283
Private Land	0.359	6.097
Total All Land Classifications	**2.9ha**	**38.4ha**

Table 5.3b: Area of Heddle Vegetation Complexes to be **Permanently Cleared** as a Result of the Proposal

Heddle Complex	Original Area of Complex (ha)	Total Remnant Vegetation of Complex Remaining (ha)	% of Complex Remaining	Total Area of Complex to be Permanently Cleared as a result of the Proposal (ha^2)	% of Total Remnant Vegetation to be Permanently Cleared as a result of the Proposal	Area (ha) of Remnant Vegetation on CALM Managed Land (1) to be Permanently Cleared as a result of the Proposal i.e. GINGIN STOCK ROUTE NATURE RESERVE	Area (ha) of Remnant Vegetation on CALM Managed Land (2) to be Permanently Cleared as a result of the Proposal i.e STATE FOREST 65-SOUTH	Area (ha) of Remnant Vegetation on CALM Managed Land (2) to be Permanently Cleared as a result of the Proposal i.e STATE FOREST 65-NORTH	Area (ha) of Remnant Vegetation on Crown Land other than CALM Managed Land to be Permanently Cleared as a result of the Proposal	Area (ha) of Remnant Vegetation on Private Land to be Permanently Cleared as a result of the Proposal
Bassendean Complex North	79056.466	58671.67	74	0.036	0.00006	0.000	0.0358	0.000	0.000	0.000
Cottesloe Complex North	43473.772	19520.70	45	0.933	0.0048	0.019	0.2791	0.563	0.008	0.064
Karrakatta Complex North	44272.515	22818.31	52	1.653	0.00723	0.006	0.345	0.686	0.341	0.275
Karrakatta Complex North/ Transition Vegetation Complex	5260.325	5004.27	95	0.278	0.00555	0.000	0.000	0.000	0.258	0.020
Moore River Complex	8461.832	3479.311	41	0.000	0.00000	0.000	0.000	0.000	0.000	0.000

(1) This CALM Managed Land category includes Nature Reserves, National Parks, Conservation Parks and 5(g) Reserves.

(2) This CALM Managed Land category includes State Forests and Timber Reserves.

Note:

- Digital remnant vegetation data used for outside the Perth Metropolitan Area was 'Woody Perenial 2000', the custodian of the data is LandMonitor Project.
- Digital remnant vegetation data used for inside the Perth Metropolitan Area was 'Bush Forever', the custodian of the data is DEP.

Table 5.3c: Area of Heddle Vegetation Complexes to be **Temporarily Disturbed** as a Result of the Proposal

Heddle Complex	Original Area of Complex (ha)	Total Remnant Vegetation of Complex Remaining (ha)	% of Complex Remaining	Total Area of Complex to be Temporarily Disturbed as a result of the Proposal (ha)	% of Total Remnant Vegetation to be Temporarily Disturbed as a result of the Proposal	Area (ha) of Remnant Vegetation on CALM Managed Land (1) to be Temporarily Disturbed as a result of the Proposal i.e. GINGIN STOCK ROUTE NATURE RESERVE	Area (ha) of Remnant Vegetation on CALM Managed Land (2) to be Temporarily Disturbed as a result of the Proposal i.e STATE FOREST 65-SOUTH	Area (ha) of Remnant Vegetation on CALM Managed Land (2) to be Temporarily Disturbed as a result of the Proposal i.e STATE FOREST 65-NORTH	Area (ha) of Remnant Vegetation on Crown Land other than CALM Managed Land to be Temporarily Disturbed as a result of the Proposal	Area (ha) of Remnant Vegetation on Private Land to be Temporarily Disturbed as a result of the Proposal
Bassendean Complex North	79056.466	58671.67	74	0.6009	0.00069	0.000	0.6009	0.000	0.000	0.000
Cottesloe Complex – North	43473.772	19520.70	45	10.63	0.05403	0.104	3.2134	6.493	0.203	0.616
Karrakatta Complex - North	44272.515	22818.31	52	22.82	0.10728	0.593	4.0043	7.990	5.093	5.144
Karrakatta Complex – North/ Transition Vegetation Complex	5260.325	5004.27	95	3.869	0.07731	0.000	0.000	0.000	3.869	0.000
Moore River Complex	8461.832	3479.311	41	0.455	0.01307	0.000	0.000	0.000	0.118	0.337

(1) This CALM Managed Land category includes Nature Reserves, National Parks, Conservation Parks and 5(g) Reserves.

(2) This CALM Managed Land category includes State Forests and Timber Reserves.

Note:

- Digital remnant vegetation data used for outside the Perth Metropolitan Area was 'Woody Perenial 2000', the custodian of the data is LandMonitor Project.
- Digital remnant vegetation data used for inside the Perth Metropolitan Area was 'Bush Forever', the custodian of the data is DEP.

Table 5.4 Generic management strategies to minimise clearing of remnant native vegetation

Minimising Vegetation Clearing	Description
Using existing access tracks	Wherever possible the transmission line route has been aligned alongside existing access tracks, which thereby reduces the necessity to remove remnant vegetation to create access tracks.
Tower Height	Transmission towers will be 50-60m in height, which thereby enables vegetation growth up to 9m under the conductor (wire). This means that in areas of Banksia woodlands typical of most of the proposed alignment, no clearing will be required other than for access and tower sites.
Tower placement	Wherever possible transmission towers will be placed in areas where remnant vegetation has already been removed or degraded.

Gingin Stock Route Nature Reserve

Gingin Stock Route Nature Reserve is situated west off Chitna Road Gingin and is 5.2km in length. Heddle et al. (1980) have mapped the vegetation within Gingin Stock Route Nature Reserve as Karrakatta Complex – North. This complex is predominantly a low open woodland and low woodland of banksia.

Vegetation communities mapped within the Reserve, i.e. W6 and W16, appear to be components of community type 28, 'Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands', as described by Gibson et al (1994). **This community type is widespread north of Perth; it is well represented within the reserve system, and therefore has a low risk conservation status** (Woodman Environmental Consulting 2000).

A tall shrubland dominated by *Hakea trifucata*, S4, was also mapped within Gingin Stock Route Nature Reserve but was only present in small pockets and was in poor condition. There was a high weed cover and only 12 species recorded. As a result, **their significance is low, with similar vegetation in good condition present in nearby reserves** (Halpern Glick Maunsell 2000).

At the northern end of the Reserve there is an old borrow area (D2), some attempt has been made to rehabilitate this borrow pit but only some tree seedlings have survived.

The survey of the Gingin Stock Route Reserve found that the vegetation was in good condition although there was extensive weed invasion in some areas from the farmland on both edges of the reserve. This weed invasion was particularly high in several pockets that had been recently burnt, and was also greater on the western side of the reserve where significant areas had been cleared. The vegetation was uniform in composition along the reserve, with only two plant communities mapped. No Declared Rare or Priority flora or other species of significance were recorded during the survey, and none of the plant communities mapped are threatened or restricted. The stock route acts as a vegetation corridor in an otherwise cleared area and is likely to be used by fauna.

Vegetation Clearing Requirements in Gingin Stock Route Nature Reserve

The proposed transmission line route traverses approximately 2.5 km of the Gingin Stock Route Nature Reserve. Figure 5.1 illustrates an example of the vegetation clearing that will occur alongside or within the Reserve. As the figure indicates, wherever possible the transmission towers will be placed in areas that are already cleared or degraded; or on private property adjacent to the Reserve.

Figure 5.4a provides an overview of the vegetation clearing scenario that will occur within the Gingin Stock Route Nature Reserve. See Section 2.4 for further details on vegetation clearing scenarios and methods.

Existing access tracks running alongside the Reserve will be utilised during the construction and post construction phases thereby reducing the amount of vegetation clearing within the Reserve.

Transmission towers will be 50-60m in height, which enables vegetation up to 9m to remain under the conductor (wire). Given that the vegetation within the Reserve is predominantly Banksia woodlands, no clearing will be required other than for tower sites and tower construction. Table 5.5a and 5.5b summarises the conservation status and quantity of vegetation that

will be permanently cleared and temporarily disturbed with the Gingin Stock Route Nature Reserve as a result of the proposal.

State Forest 65-South

SF65-South, also known as Moore River State Forest, is situated inland from Yanchep and Two Rocks, on the eastern side of the Wanneroo-Lancelin Road. The vegetation consists of a mosaic of pine plantations and discrete blocks of native vegetation of woodlands and heath. Heddle *et al.* (1980) have mapped the vegetation complexes within SF65-South as Bassendean Complex, Cottesloe Complex and Karrakatta Complex – North.

Seven plant communities were mapped along the proposed line transmission line corridor within SF65-South. Four of the seven plant communities mapped, i.e. W9, W10, W14 and W16, are of the community type 28 as described by Gibson *et al* (1994), which is Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands. **This community type is widespread north of Perth; it is also well represented within the reserve system and therefore has a low risk conservation status** (Woodman Environmental Consulting 2000).

The plant community W1 mapped along the proposed transmission line corridor within SF65-South is a component of the floristic community 14, deeper wetlands on sandy soils as described in Gibson *et al* (1994). **This community is described as not being represented in the reserve system and a conservation status was not assigned as it is sufficiently unknown.**

The woodlands on limestone mapped as W21 along the proposed transmission line corridor with SF65-South did not appear to fit into any of the floristic communities as defined by Gibson et al (1994) and so therefore could not be assigned to a floristic community type. However **the woodlands on limestone are very well represented in areas of SF65-North that will not be disturbed during this project.**

The plant community H1 mapped along the proposed transmission line corridor is a component of the floristic community 24, northern Spearwood shrublands and woodlands. **This floristic community type is well reserved but has been identified as susceptible to human activity.**

Survey results indicate that overall the vegetation within SF65-South is not in good condition due to disturbances from many access tracks servicing the pine plantations in the Forest, as well as regular burning which has led to a reduction in the number of plant species expected.

SF65-South was a mosaic of remnant vegetation and pine plantations. The blocks of vegetation in the southern section of the State Forest were in poor to fair condition, with high levels of weed invasion and frequent burning. There are a large number of roads in

Table 5.5a. The conservation status of remnant native vegetation within Gingin Stock Route Nature Reserve that will be traversed by the proposed transmission line route.

Plant Community*	Reservation Status**	Conservation Status**
W6	Well Reserved	Low Risk
W16	Well Reserved	Low Risk
S4	Well Reserved	Low Risk

* Plant communities mapped by Woodman Environmental Consulting Pty Ltd (2000)

** Determined by reference to Gibson et al (1994).

Table 5.5b. The quantity vegetation complexes that will be permanently cleared and temporarily disturbed within the Gingin Stock Route Nature Reserve as a result of the proposal.

Complex*	Vegetation Permanently Cleared (ha)	Vegetation Temporarily Disturbed (ha)
Cottesloe Complex North	0.0190	0.104
Karrakatta Complex North	0.006	0.593

* Vegetation Complexes mapped by Heddle et al (1980).

the area, some of which are used regularly. These roads have allowed weed species to spread into all of the blocks of vegetation surveyed, although this spread was most evident on limestone areas and in drainage lines.

The northern portion of the Forest consists of a large block of vegetation in very good condition. With the exception of recently burnt areas, weed invasion was low and very few existing tracks are present. The plant communities in this area contained a high number of species although none of these were restricted or significant. None of the plant communities mapped are listed as threatened, although the conservation significance of three of these is unknown.

Vegetation Clearing Requirements within State Forest 65 South

Figure 5.2 illustrates an example of the vegetation clearing that will occur within SF65-South. Figure 5.4a provides an overview of the vegetation clearing scenarios that will occur within SF65-South. See Section 2.4 for further details on vegetation clearing scenarios and methods.

As Figure 5.4a indicates, where-ever possible the transmission line corridor has been aligned within pine plantation and/or along existing tracks, thus reducing the amount of remnant vegetation that will be traversed within the Forest.

Transmission towers will be 50-60m in height, which thereby enables vegetation up to 9m to remain under the conductor (wire). Given that the remnant vegetation within SF65-South is predominantly low woodlands of Banksia, no clearing will be required other than for tower sites, tower construction, and approximately 4 access tracks with a maximum length of approximately 200m. Table 5.6a and Table 5.6b summarises the conservation status and quantity of remnant vegetation that will be permanently cleared and temporarily disturbed within SF65-South as a result of the proposal.

State Forest 65 North

SF65-North is located north of the Moore River, inland from Seabird. The boundaries of the Heddle et al. (1980) vegetation complexes within SF65-North

Table 5.6a: The conservation status of remnant native vegetation within SF65-South that will be traversed by the proposed transmission line route.

Plant Community*	Reservation Status**	Conservation Status**
W1	unreserved	Insufficiently known
W9	Well reserved	Low risk
W10	Well reserved	Low risk
W14	Well reserved	Low risk
W16	Well reserved	Low risk
W21	#	#
H1	Well reserved	susceptible

* Plant communities mapped by Woodman Environmental Consulting Pty Ltd (2000)

** Determined by reference to Gibson et al (1994).

Did not appear to fit into any of the floristic communities as defined by Gibson et al (1994).

Table 5.6b. The quantity vegetation complexes that will be permanently cleared and temporarily disturbed within SF65-South as a result of the proposal.

Complex*	Vegetation Permanently Cleared (ha)	Vegetation Temporarily Disturbed (ha)
Bassendean Complex North	0.0358	0.6009
Cottesloe Complex North	0.2791	3.2134
Karrakatta Complex North	0.345	4.0043

* Vegetation Complexes mapped by Heddle et al (1980).

correspond with the geomorphological units mapped by Churchward and McArthur (1980), i.e. the Cottesloe and Karrakatta geomorphological units. The vegetation complex of the south-western section of the Forest was mapped as Cottesloe Complex-North, which is predominately closed heaths on limestone outcroppings, with a mixture of banksia woodlands and low forests on deeper sands.

Heddle et al. (1980) mapped the vegetation of the eastern section of the State Forest 65 North as Karrakatta Complex-North, which is predominately a low open forest and low woodland of banksia – *Eucalytus todtiana*, with minor occurrences of *Eucalyptus gomphocephala* (tuart).

Vegetation communities mapped along the proposed transmission line corridor, i.e. W6, W11, W12, W13, W14, W16 and W17 appear to be components of community type 28, Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands, as described by Gibson et al (1994). **This community type is widespread north of Perth; it is well represented within the reserve system, and therefore has a low risk conservation status** (Woodman Environmental Consulting 2000).

The heath community H1 mapped along the proposed transmission line corridor within SF65-North is a component of the floristic community 24, northern Spearwood shrublands and woodlands, as described by Gibson et al. (1994). **This floristic community type is well reserved but has been identified as susceptible to human activity**.

The woodlands on limestone mapped as W20 along the proposed transmission line corridor did not appear to fit into any of the floristic communities as defined by Gibson et al (1994) and so therefore could not be assigned to a floristic community type. However **the woodlands on limestone are very well represented in areas of SF65-North that will not be disturbed during this project.**

The shrubland mapped as S1 along the proposed transmission line within SF65-North is floristic community 26a as described by Gibson et al (1994). **This community is unreserved and susceptible to human activities**. The Department of Conservation and Land Management also list it as a Threatened Ecological Community. However this vegetation community does not occur along Western Power's preferred alignment within SF65-North, i.e the eastern alignment.

SF65-North was the largest block of vegetation surveyed along the proposed line route. It was generally in a very good condition, with weed invasion restricted to the boundaries, track edges and some recently burnt areas. The block contains a relatively small number of existing tracks, which has assisted in maintaining the condition of the area. The vegetation within the block had a high diversity and variable composition due to the wide range of soil types encountered. One Declared Rare flora taxon was recorded along the proposed transmission line corridor, increasing the conservation significance of the area. **All of the plant communities mapped along the proposed transmission line corridor are represented elsewhere in SF65-North** (Woodman Environmental Consulting 2000).

Vegetation Clearing Requirements within SF65-North

Figure 5.3 illustrates an example of the vegetation clearing that will occur within SF65-North. Figure 5.4a provides an overview of the vegetation clearing scenarios that will occur within SF65-North. See Section 2.4 for further details on vegetation clearing scenarios and methods.

Where-ever possible the transmission line route has been aligned within or in close proximity to an exisitng access track. As the aerial photographs indicate, the transmission line corridor has been aligned in a South to North direction along Pickpocket Rd within the Forest, thereby utilising an existing track for access, tower placement and stringing of the conductor. The alignment then follows a north-westerly direction within close proximity to McCormicks Road within the Forest, thereby enabling the utilisation of the road as an access track. New access routes to tower sites will be provided by cut in spurs from McCormicks Road. Such spurs will be no longer than 300m in length.

Transmission towers will be 50-60m in height, which thereby enables vegetation up to 9m to remain under the conductor (wire). Given that the remnant vegetation within SF65-North is predominantly low woodlands of Banksia, no clearing will be required other than for tower sites, tower construction, cut in spurs with a maximum length of 300m.

Table 5.7a and 5.7b summarise the conservation status and quantity of remnant vegetation that will be permanently cleared and temporarily disturbed within SF65-North as a result of the proposal.

Remnant Vegetation on Private Property between Gingin Stock Route Reserve and SF65-North

Vegetation between the northern boundary of Gingin Stock Route Nature Reserve and Moore River was mapped as S4, a tall shrubland dominated by *Hakea*

trifucata, which was in very poor condition, with a high weed cover and only 12 native species recorded. Heddle et al. (1980) have mapped the vegetation within this area as Cottesloe Complex – North. Along this section, existing tracks will be utilised for access, with cut in spurs where the transmission line route alignment vears away from existing tracks. Where-ever possible tower structures will be placed in degraded areas.

The route then traverses vegetation mapped as W6 (the same as was mapped in Gingin Stock Route Nature Reserve) which is a component of community type 28, 'Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands', as described by Gibson et al (1994). **This community type is widespread north of Perth; it is well represented within the reserve system, and therefore has a low risk conservation status** (Woodman Environmental Consulting 2000). The southern several hundred metres of this remnant was in good condition, but degenerated closer to Gingin Brook Road as a result of disturbance by clearing, grazing or burning. Along this section, existing tracks will be utilised for access, with cut in spurs where the transmission line route alignment vears away from existing tracks. Where-ever possible tower structures will be placed in degraded areas.

Vegetation along the Moore River was mapped as F4, a Dense Forest of *Eucalyptus rudis, Melaleuca rhapiophylla* and *Banksia prionotes*, over weed species. Heddle et al. (1980) have mapped the vegetation within this area as Moore River Complex. The vegetation was in very degraded condition as it is unfenced and actively grazed by cattle and therefore could not be correlated to a floristic community. **The degraded condition of the vegetation in this area reduces its conservation significance**, although the Moore River may act as a corridor (Woodman Environmental Consulting 2000). Tower structures will be placed in degraded areas. However, given the composition of the vegetation that occurs within this section of the proposed line route, it will be necessary to selectively remove vegetation within the transmission line easement to ensure minimum safety clearances are met.

Table 5.7a. The conservation status of remnant native vegetation within SF65-North that will be traversed by the proposed transmission line route.

Plant Community*	Reservation Status**	Conservation Status**
W6	Well reserved	Low risk
W11	Well reserved	Low risk
W12	Well reserved	Low risk
W13	Well reserved	Low risk
W14	Well reserved	Low risk
W16	Well reserved	Low risk
W17	Well reserved	Low risk
W20	#	#
H1	Well reserved	Susceptible
S1	unreserved	Susceptible

* Plant communities mapped by Woodman Environmental Consulting Pty Ltd (2000)

** Determined by reference to Gibson et al (1994).

Did not appear to fit into any of the floristic communities as defined by Gibson et al (1994).

Table 5.7b. The quantity of vegetation complexes that will be permanently cleared and temporarily disturbed within SF65-North as a result of the proposal.

Complex*	Vegetation Permanently Cleared (ha^2)	Vegetation Temporarily Disturbed (ha^2)
Cottesloe Complex	0.5630	6.493
Karrakatta Complex North	0.686	7.990

* Vegetation Complexes mapped by Heddle et al (1980).

Remnant vegetation between Moore River and the southern boundary SF65-North was found to be remnant trees, such as *Corymbia calophylla, Banksia spp*, and *Nuytsia floribunda*, over pasture. **The understorey layer had been completely removed**. Wherever possible, tower structures will be placed in degraded areas, and existing access tracks will be utilised, with cut in spurs where the transmission line route alignment vears away from existing tracks.

See Figure 5.4a for an overview of the vegetation clearing scenarios that will occur within this area of remnant vegetation. See Section 2.4 for further details on vegetation clearing scenarios and methods.

Table 5.8 summarises the conservation status of remnant native vegetation between the northern boundary of Gingin Stock Route Nature Reserve and southern boundary of SF65-North that will be traversed as a result of the proposal.

Remnant Vegetation between SF65-North and Sappers Road

The very small area of remnant vegetation along this section of the proposed transmission line route was mapped as D3, Banksia Woodlands in which the understorey has been modified to the extent that the woodland cannot be adequately described.

See Figure 5.4b for an overview of the vegetation clearing scenario that will occur within this area of remnant vegetation. See Section 2.4 for further details on vegetation clearing scenarios.

Table 5.9 presents the conservation status of remnant vegetation between SF65-North and Sappers Road that will be traversed as a result of the proposal.

Remnant Vegetation between Sappers Road and Dingo Road

This area has the largest, most significant remnant vegetation on private property in relation to the proposed transmission line route. The vegetation, which is located immediately north of Sappers Road, was mapped as W18, Low woodland of *Banksia attenuata* and *Banksia menziesii*, and in the low-lying areas W19, an open low woodland of *Banksia ilicifolia* over low shrubs dominated by *Xanthorrhoea preissii*.

The conservation status and regional representation of these plant communities are difficult to determine as the available regional studies generally map these areas at a vegetation association, rather than a plant community, level. **Halpern Glick Maunsell (2000) mapped the vegetation in the area as 'Banksia woodland over heath' and described this association as being very widespread in the**

Table 5.8. The conservation status of remnant native vegetation on private property between Gingin Stock Route Nature Reserve and SF65-North that will be traversed by the proposed transmission line route.

Plant Community*	Reservation Status**	Conservation Status**
W6	Well reserved	Low risk
S4	Well reserved	Low risk
F4	#	#

* Plant communities mapped by Woodman Environmental Consulting Pty Ltd (2000)

** Determined by reference to Gibson et al (1994).

\# Did not appear to fit into any of the floristic communities as defined by Gibson et al (1994).

Table 5.9 The conservation status of remnant native vegetation between SF65-North and Sappers Road that will be traversed as a result of the proposed transmission line route.

Plant Community*	Reservation Status	Conservation Status
D3	#	#

* Plant communities mapped by Woodman Environmental Consulting Pty Ltd (2000)

\# The understorey of the woodland has been so disturbed that little or none of the original understorey is remaining.

region. It has also been mapped extensively in the Department of Defence training area west of the proposed transmission line (ecologia 2000). *Banksia* woodland is also present within the majority of nature reserves in the area, although the composition of the understorey layer can vary significantly between locations (Griffin and Keighery 1989).

A smaller remnant further north was mapped as W16, a component of community type 28, Spearwood *Banksia attenuata* or *Banksia attenuata-Eucalyptus* woodlands, as described by Gibson et al (1994). **This community type is widespread north of Perth; it is well represented within the reserve system, and therefore has a low risk conservation status** (Woodman Environmental Consulting 2000).

See Figure 5.4b for an overview of the vegetation clearing scenario that will occur within this area of remnant vegetation. See Section 2.4 for further details on vegetation clearing scenarios.

Table 5.10 summarises the conservation status of remnant vegetation between Sappers Road and Dingo Road that will be traversed as a result of the proposal.

Remnant Vegetation on Private Property between Dingo Road and Mimegarra Road

The majority of the vegetation in this area was found to be a dense Banksia Woodland over a very disturbed understorey, too modified by fire, clearing or grazing to be described and mapped.

The only area of vegetation in moderate condition was a very small area of Shrubland mapped immediately south of Dingo Road. This area was mapped as S1/H1 as it contained many of the dominants from both plant communities. The Heath community **H1 is a component of the floristic community 24, northern Spearwood shrublands and woodlands; it is well reserved but has been identified as susceptible to human** activity (Woodman Environmental Consulting Pty Ltd, 2000). The shrubland mapped as **S1 is unreserved and susceptible to human activities**.

All of the areas north of Dingo Road were in poor condition, with the understorey layer varying between scattered shrubs and weeds and no native shrubs. None of the remnants were fully fenced from adjacent grazing land and as such had been disturbed over a period of time.

See Figure 5.4b for an overview of the vegetation clearing scenario that will occur within this area of remnant vegetation. See Section 2.4 for further details on vegetation clearing scenarios.

Table 5.11 summarises the conservation status of remnant vegetation between Dingo Road and Mimegarra Road that will be traversed as a result of the proposal.

Table 5.10 Conservation Status of remnant native vegetation between Sappers Road and Dingo Road that will be traversed as a result of the proposed transmission line route.

Plant Community*	Reservation Status**	Conservation Status**
W16	Well reserved	Low risk
W18	#	#
W19	#	#

* Plant communities mapped by Woodman Environmental Consulting Pty Ltd (2000)

** Determined by reference to Gibson et al (1994).

\# Difficult to determine as available regional studies generally map these areas at vegetation association level rather than plant community level (Woodman Environmental Consulting Pty Ltd (2000))

Table 5.11 Conservation Status of remnant native vegetation between Dingo Road and Mimegarra Road that will be traversed as a result of the proposed transmission line route.

Plant Community*	Reservation Status	Conservation Status
H1	Well reserved**	Susceptible**
S1	Unreserved***	Susceptible***

* Plant communities mapped by Woodman Environmental Consulting Pty Ltd (2000)

** Determined by reference to Halpern Glick Maunsell (2000)

*** Determined by reference to Gibson et al (1994).

Remnant Vegetation on Private Property and Vacant Crown Land between Tiwest Joint Venture and properties adjacent to Mimegarra Road

Within this section seven plant communities were mapped within the Vacant Crown Land, they being F5, F6, W5, W5b, S5, H4 and H5.

Forests F5 and F6 were mapped in drainage lines and depressions on Vacant Crown Land. Plant community F5 was also mapped by Halpern Glick Maunsell (2000), on Vacant Crown Land in several areas to the east and west of the proposed transmission line route. *Eucalyptus decipiens* is common near Jurien and north-west of Eneabba, with restricted distribution within the vicinity of the transmission line (Brooker and Kleinig 1990). **F5 distribution within the reserve system is unknown, and it is likely to be poorly conserved.** A small pocket has been mapped within the Southern Beekeepers Reserve (Burbidge and Boscacci 1989), although the composition of the understorey in this area would be different to that mapped along the transmission line route.

The *Eucalyptus rudis* Woodland of F6 is locally and regionally restricted due to its narrow linear nature. Woodlands of these types in drainage lines and swamps have been recorded in Reserve #27993 (Halpern Glick Maunsell (2000), and Reserve #27216 and Wongonderrah Nature Reserve (Crook et al. 1984).

The conservation status and regional representation of the Banksia Woodland community W5b is difficult to determine as the available regional studies generally map these areas at a vegetation association, rather than a plant community, level. Halpern Glick Maunsell (2000) mapped the vegetation in the area as 'Banksia woodland over heath' and described this association as being very widespread in the region. It has also been mapped extensively in the Department of Defence training area west of the proposed transmission line (ecologia 2000). Banksia woodland is also present within the majority of nature reserves in the area, although the composition of the understorey layer can vary significantly between locations (Griffin and Keighery 1989).

The Shrubland S5 is a component of Wet Heath Super Group III as described by Griffin and Keighery (1989). **These wet heaths are widespread in the Moore River National Park and Namming Nature Reserve.**

The majority of the remnant vegetation within the Vacant Crown Land (VCL) was in very good condition. All remnants on private property within this section were mapped as disturbed communities as the condition of remnants varied between moderate and poor.

See Figure 5.4b for an overview of the vegetation clearing scenario that will occur within this area of remnant vegetation. See Section 2.4 for further details on vegetation clearing scenarios.

Table 5.12 summarises the conservation status of remnant vegetation on private property and vacant crown land between Tiwest Joint Venture and properties adjacent to Mimegarra Rd that will be permanently cleared and temporarily disturbed as a result of the proposal.

Remnant Vegetation on Tiwest Joint Venture Lease

Extensive areas at the northern end of the proposed transmission line route have been cleared for mining. A total of seven plant communities were decscribed and mapped along the proposed transmission line route by Mattiske Consulting Pty Ltd (1997). The plant communities mapped were 1a.1, 1a.2, 1b, 1c, 1f, 3a and 3k.

Mattiske Consulting Pty Ltd (1997) discussed the conservation significant of the plant communities in the Tiwest lease area; the report states that all are well represented locally and regionally within the reserve system.

See Figure 5.4b for an overview of the vegetation clearing scenario that will occur within this area of remnant vegetation. See Section 2.4 for further details on vegetation clearing scenarios.

Table 5.12 The conservation status of remnant native vegetation between Tiwest Joint Venture and properties adjacent to Mimegarra Rd that will be traversed as a result of the proposed transmission line route.

Plant Community*	Reservation Status	Conservation Status
F5	Unknown	Likely to be poorly conserved**
F6	Recorded in Reserves**	Unable to determine****
W5	Recorded in Reserves and Moore River National Park**	Unable to determine****
S5	Widespread in Moore River National Park**	Unable to determine****

* Plant communities mapped by Woodman Environmental Consulting Pty Ltd (2000)

** Woodman Environmental Consulting Pty Ltd (2000)

*** Determined by reference to Gibson et al (1994).

**** Conservation significance of plant communities mapped along the line route could not determined as current available studies all discuss vegetation at different levels of detail, thereby making specific comparisons not possible

Table 5.13 The regional significance of the remnant native vegetation that will be traversed on the Tiwest Joint Venture Lease as a result of the proposed transmission line route.

Plant Communities*	Well Represented Locally and Regionally within the Reserve System**
1a1	YES
1a2	YES
1b	YES
1e	YES
1f	YES
3a	YES
3k	YES

* Plant communities described and mapped by Mattiske Consulting Pty Ltd (1997)

** Described by Mattiske Consulting Pty Ltd (1997)

Table 5.13 provides details on the significance of remnant vegetation on the Tiwest Joint Venture lease that will be permanently cleared and temporarily disturbed as a result of the proposal.

5.2.1.2 Declared Rare Flora, Priority Listed Flora and other Significant Flora

EPA Objective:

- *"Protect Declared Rare and Priority Flora consistent with the provisions of the Wildlife Conservation Act 1950, and the Commonwealth Endangered Species Act."*
- *"Protect other flora of conservation significance."*

Description of Potential Impact

Construction and maintenance of the proposed transmission line has the potential to adversely impact rare, priority and other flora of conservation significance occurring within the proposed corridor alignment. Such impacts could be due to:

- Clearing for tower construction and access to tower sites.
- Increased access – the creation of vehicle access into previously isolated areas will allow entry into these areas by non-Western Power personnel. This may increase the risk of vehicles driving into areas of vegetation containing significant species.

- Risk of fire – construction activities have the potential to cause fires in the densely vegetated areas.
- Other threatening processes potentially associated with transmission line construction and maintenance activities such as Phytophthora cinnamomi and weed spread.

One population of Declared Rare Flora (DRF) species was identified within the proposed transmission line corridor. Tower placement and the location of access along the proposed transmission line corridor will be designed to avoid clearing of the Declared Rare species recorded along this route.

Three Priority Listed Flora (PLF) species were identified within the proposed corridor in Vacant Crown Land south of the TiWest Joint Venture Lease area. However a wide firebreak exists in this area close to the proposed alignment that will provide access for construction and maintenance activities.

No other PLF species or species of significance were identified within or close to the proposed corridor. A Priority 4 species, one Threatened Ecological Community (as defined by the Department of Conservation and Land Management) and one other plant community not well represented in State Forest was identified in SF65-North within an alternative alignment (i.e. the western alignment within SF65-North) considered for the proposal. However this alternative alignment through SF65-North has now been discarded.

Legislation enacted to protect DRF and other significant flora is contained within the following Acts and Regulations:

- *Conservation and Land Management Act 1986 (WA)*
- *Wildlife Conservation Act 1950 (WA)*
- *Declared Rare Flora section 23F*
- *Protected flora on crown land 23B(1)*
- *Environmental Protection and Biodiversity Conservation Act (1999) Commonwealth (EPBC Act)*

Policies and guidelines designed to protect DRF and other significant flora are:

- Western Australian Environmental Protection Authority Position Statement No. 2 December 2000 "Environmental Protection of Native Vegetation in Western Australia – Clearing of Native Vegetation, with Particular Reference to the Agricultural Area"
- Department of Conservation and Land Management Policy Statement No. 9 December 1992 "Conservation of Threatened Flora in the Wild"

The threat of destruction or taking of DRF exists at one location along the proposed transmission line. Within SF65-North one DRF species, *Anigozanthos humilis subsp. chrysanthus*, was identified.

The Western Power Environmental Management System (EMS) identifies the following activities as potentially causing the loss or destruction of DRF:

- Selection/location of the transmission line corridor,
- Vehicle movement for corridor investigations and survey,
- Machine clearing of vegetation,
- Burning of clearing products/debris,
- Creation of new access for construction and maintenance,
- Vehicle movement for construction and maintenance.

Potential threats from Phytophthora cinnamomi and weed spread resulting from the proposal would also need to be managed to prevent loss of any Declared Rare *Anigozanthos humilis subsp. chrysanthus* plants.

Loss of the *Anigozanthos humilis subsp. chrysanthus* plants would be significant because in total there are 13 recorded populations of Anigozanthos humilis subsp. chrysanthus, not including the 3 plants recorded on the proposed Pinjar to Cataby transmission line corridor. The 13 populations total approximately 2474 individuals.

Management Strategies

A vegetation and flora survey was commissioned by Western Power to identify any significant species including rare and priority species within or close to proposed transmission line corridors. The results of this survey were used in line route selection and transmission line design to avoid impacts on populations of rare, priority or significant species. The results of this survey are provided in detail in Section 4.5.

The results of this vegetation and flora survey will form the basis for strategies to protect significant flora. Specifications for contractors employed during construction will require compliance with conditions necessary to protect significant flora.

Though the *Anigozanthos humilis subsp. chrysanthus* DRF population occurs on the centreline of the proposed transmission line corridor, realignment of the proposed transmission line corridor population is not considered necessary. The construction and maintenance activities associated with this project will not require any vehicle access or clearing in the vicinity of the DRF population. Towers will not be located close to the population and

The following lists the breakdown of populations per land vesting:

Land Vesting	Populations	Number of Plants
Westrail	3	307
Shire	8	251
MRDWA	2	15
NPNCA	2	469
Private	4	1432
TOTAL	**19***	**2474**

* Note: Some populations extend across property boundaries and land vestings.

access to tower sites closest to the DRF population will be several hundred metres from the population, along McCormicks Road within State Forest 65 North. Though the conductor will need to be strung over the top of the population (as it is on the centreline of the proposed transmission line alignment), precautions will be taken during the stringing operation to ensure no disturbance to the DRF population. The population will be fenced during stringing operations and the draw wire, used to raise the conductor up to the tower supports, will initially be laid on the ground outside the population then raised up to avoid the fenced area containing the DRF population.

As mentioned above, populations of Priority species were found within the proposed corridor south of the TiWest Joint Venture Lease area. These Priority species will be protected by locating towers and access routes away from them. This is possible because of the existence of a wide firebreak in this area close to the centreline of the proposed transmission line corridor that will provide access for construction and maintenance. Also because the Priority species are not located on the centreline of the proposed corridor, conductor stringing operations will not affect the populations. An exclusion zone will be imposed around significant environmental features including Priority species ton ensure towers are not located close to these features.

Strategies for protection of DRF, Priority and significant flora will be contained in the Environmental Management Plan for the construction and maintenance of the proposed transmission line and will include:

- Minimising vegetation clearing by using existing tracks and cleared land for construction wherever possible. No vegetation clearing will be permitted in the vicinity of the *Anigozanthos humilis subsp. chrysanthus* population.
- The placement of towers and new access to prevent the clearing of significant flora species and to minimise the risks of clearing significant flora species. No towers will be placed within a predetermined buffer zone of the DRF population.
- Conducting vegetation and flora surveys of any additional access routes to tower positions required for construction.
- Marking the location of all Declared Rare in the field to assist in their protection.
- Taking all necessary precautions to prevent accidental fires.
- The temporary fencing of the *Anigozanthos humilis subsp. chrysanthus* population during construction to prevent accidental disturbance.
- The recording of the population of *Anigozanthos humilis subsp. chrysanthus* in the Department of CALM database and in the Western Power EMS. The entry of appropriate management procedures into the Western Power EMIS and the use of appropriate signage in the field to alert maintenance crews to the risk of impacting on the DRF population.
- Construction through Vacant Crown Land south of the Tiwest lease area utilising all available tracks and fire-breaks to minimise clearing as the vegetation in this area is in very good condition.
- The investigation and control of threatening processes such as *Phytophthora cinnamomi* and weed spread.
- The proponent will commit to control all activities of its employees, agents and Contractors to ensure that all construction and maintenance personnel adhere to conditions imposed by the project EMP.

With respect to the threatening processes such as *Phytophthora cinnamomi* on DRF, the Wildlife Protection Branch of the Department of CALM indicates that

whilst it is unlikely that *Anigozanthos humilis subsp. chrysanthus* is susceptible to *Phytophthora cinnamomi*, no research has been conducted to confirm the *Phytophthora cinnamomi* susceptibility status of this species. A precautionary approach will be adopted to ensure that the risk of spread of *Phytophthora cinnamomi* into the vicinity of the DRF population is minimised. The risk of spread of *Phytophthora cinnamomi* will be controlled along the entire length of the proposed transmission line corridor. Advice from the Wildlife Protection Branch also indicates that the threat from introduced weeds should be minimal provided vegetation disturbance in the vicinity of the DRF population is minimised.

Given that only a single population of DRF and no priority or other significant species have been identified within the proposed corridor, the EPA objectives for DRF, Priority Listed and other significant flora should be met provided appropriate management strategies are developed and applied during transmission line construction and maintenance activities.

5.2.1.3 Weeds

EPA Objective:

"Ensure that regionally significant flora and vegetation are adequately protected from the spread of weeds."

Description of Potential Impact

Large areas of Western Australia are infested with noxious weeds. Seeds and other plant material from these weeds can be transported over sections of a transmission line corridor and thereby infest areas of previously uninfested land. Common transport methods are through burrs attached to rubber tyres or seeds and plant matter contained in muddy soil attached to mud flaps and the underside of vehicles.

Transmission corridors generally traverse individual property, catchment and local authority boundaries so weed spread may occur at local and regional levels. Burrs such as double gees (Emex australis) can easily attach to rubber tyres, however many kilometres can be travelled before they are dislodged. Weed seeds collected in soil adhering to vehicles may also be carried many kilometres until the soil falls off allowing transport much greater distances than by natural elements (such as wind).

Weed seeds transported into areas of native vegetation may degrade the quality of that vegetation, particularly if transport is associated with disturbance activities such as vegetation clearing. Habitat disturbance allows the recruitment of non-native species, particularly exotic weeds to the detriment of native species and native plant communities.

The Western Power Environmental Management System (EMS) describes the following legislation and guidelines to protect the environment from threats posed by the spread of weeds:

- Noxious Weeds Regulations, 1973 Agriculture and Related Resources Protection Act 1976 Codes of Practice

The most significant aspect of the proposal having the potential to spread weeds is increased vehicle access. The creation of vehicle access will allow access by Western Power employees and Western Power representatives, including contractors and non-Western Power personnel. This may increase the spread of weeds during Western Power construction and maintenance activities, as well as through the use of new access by members of the public.

Any activities associated with the construction and maintenance of the proposed transmission line having the potential to transport plant material present a risk

of spread of weeds. Activities relevant to the proposal, associated with transmission lines and identified in the Western Power Environmental Management System (EMS) as potentially contributing to the risk of weed spread are:

- Selection/location of the transmission line corridor,
- Vehicle movement for corridor investigations and survey,
- Machine clearing of vegetation,
- Creation of new access for construction and maintenance,
- Vehicle movement for construction and maintenance

A total of thirty two weed species were recorded in the vegetation surveyed along the proposed transmission line corridor. None of these were Declared Weeds, as listed by Agriculture Western Australia. The majority of weed species, most of which are common and non-aggressive, were recorded in unfenced remnants on private property and along existing tracks and firebreaks. Within the Gingin Stock Route Reserve, SF65-South and SF65-North weeds had also invaded into recently burnt areas, as burning creates open ground into which weed spores can germinate. The limestone communities mapped (S4, S1/H1) appear to be the most susceptible to weed invasion as all of these areas contained some annual weeds. The high cover of bare ground around limestone outcropping in these communities provides suitable habitat for weed spores.

The northern end of SF65-South, SF65-North and the Vacant Crown Land towards the northern end of the proposed transmission line corridor all contained large blocks of vegetation relatively unaffected by weeds. Hygiene measures should be put in place to ensure weeds are not spread into these areas during construction and maintenance activities. These should include ensuring all vehicles are clean prior to entering vegetated areas, and not allowing any soil movement between blocks of vegetation and agricultural areas.

Management Strategies

In order to determine the weed infestation status of the proposed transmission line corridor, Western Power commissioned consultants Woodman Environmental Consulting to conduct a survey to identify the type and location of weed species located within or proximate to the proposed transmission line corridor. The results of this survey are provided in detail in Section 4.5 and Woodman Environmental Consulting (2000). The survey identified large undisturbed areas of remnant vegetation free of introduced weed species. Management strategies will aim to minimise the spread of weeds into these undisturbed areas. Management will also aim to minimise the spread of weeds on privately owned agricultural land.

Measures will include ensuring all vehicles are clean on entry to the transmission line corridor, ensuring that construction and operations activities do not move soil and plant material along the transmission line corridor, and minimising the creation of new access pathways.

The project EMP will contain strategies to minimise the risk of spreading weeds. These strategies will include:

- The minimising of vegetation clearing and the use where possible of existing tracks and cleared land for construction and maintenance access;
- The certification of all vehicles commencing work on the project as weed free (ie. clean and free of any dirt that could carry weed spores and seeds);
- The prohibition of soil movement or movement of plant material between agricultural areas and areas of native vegetation;
- The location of the transmission line corridor on the western edge of the Gingin Stock Route Reserve as this side is the most disturbed.

Specifications for contractors employed on this project will require compliance with conditions related to weed spread, outlined in the project EMP, and any contract employee or agent will be removed from the construction site for a breach of these conditions.

Post construction audits will be conducted to determine the status of weed spread along the transmission line corridor. Where appropriate remedial action will be taken to eradicate any weeds introduced by construction and maintenance activities.

Provided appropriate management strategies are devised and adopted during construction and maintenance activities the EPA objective to "Ensure that regionally significant flora and vegetation are adequately protected from the spread of weeds", should be met.

Commitment 5:

Prepare a weed management plan that addresses:

1. *Appropriate hygiene techniques to control the spread of noxious and environmental weeds along the proposed transmission line corridor between areas of native vegetation on agricultural land.*
2. *The conduct of post construction audits.*
3. *Where necessary the eradication of introduced weeds.*

Commitment 6:

Implement the approved weed management plan referred to in Commitment 5.

5.2.1.4 Dieback (Phytophthora Cinnamomi)

EPA Objective:

"Ensure that regionally significant flora and vegetation are adequately protected from the spread of dieback".

Description of Potential Impact

Phytophthora. cinnamomi (dieback) is a largely soil-borne pathogen that invades and destroys the root and root collar cells of susceptible species primarily from the plant families Proteaceae, Epacridaceae, Dilleniaceae, Papilionaceae, Xanthorrhoeaceae and Myrtaceae. It is for this reason that it is often referred to as a root and collar rot pathogen. The pathogen is commonly spread in infested soil material during road construction and other soil disturbing activities, and in water via both surface and sub-surface drainage. The pathogen also spreads within root systems and from plant to plant via root to root contact. Spread of the pathogen upslope within and between root systems has been measured at one metre per year under ideal conditions in the jarrah (Eucalyptus marginata) forest (Department of Conservation and Land Management 1999b). Rates of spread upslope in Bassendean Dune Banksia Woodland have been measured at 1.2 m per year (Hill et al. 1994). Spread of the pathogen across and down slope can be rapid depending on slope, soil type, vegetation type and drainage patterns.

The spread of the pathogen has been conclusively attributed to the movement of soil on motor vehicles, machinery and equipment. The key factor in soil movement is the accumulation of soil on vehicles, machinery and equipment through compaction or adherence with moisture.

Legislation has been enacted to protect the environment from threats posed by activities having the potential to introduce the pathogen into uninfested areas. The relevant requirements/ legislation are listed in the Western Power EMS Legal and Other Requirements Database and include:

- *Conservation and Land Management Act 1984 (WA)*
- Department of Conservation and Land Management Policy Statement No. 3 December 1998 "Management of Phytophthora and Disease Caused by it".

The threat of *P. cinnamomi* infestation from activities associated with the proposed transmission line exists over the entire length of the transmission line corridor between Pinjar and Cataby, except in areas already infested with P. cinnamomi. Assessment of this impact was conducted over the entire length of the proposed transmission line corridor.

The risk of dieback spread is high if a transmission line corridor crosses boundaries between infested and uninfested areas, particularly where conditions are conducive to soil adherence to vehicles and equipment used for construction and maintenance. The proposed transmission line corridor is located almost entirely in well-drained sandy soil, except at several locations close to Cataby in the proximity of land subject to seasonal inundation.

Any activities associated with the construction and maintenance of the proposed transmission line having the potential to transport soil or root material present a risk of spread of the pathogen. Activities relevant to the proposal, associated with transmission lines and identified in the Western Power EMS as potentially contributing to the risk of dieback spread are:

- Selection/location of the transmission line corridor,
- Vehicle movement for corridor investigations and survey,
- Machine clearing of vegetation,
- Burning of clearing products/debris,
- Creation of new access for construction and maintenance,
- Vehicle movement for construction and maintenance,
- Foundation works

The potential impacts of introducing *P. cinnamomi* to the proposed transmission line corridor will vary depending on the location and site characteristics of the introduction. The proposed transmission line corridor, being located primarily on Spearwood Dune system has well drained soils with limestone a common feature as a basement material or present at the surface. The risk of *P. cinnamomi* establishing disease foci along this route option is low. Risk increases with moisture status of the soils and is greatest in low wet areas such as swamps, drains and creeks (Hill et al. 1994).

The potential impact on the vegetation along the routes should P. *cinnamomi* be introduced could be extreme, especially in the lower, moist portions of the transmission line corridor. Infested areas in Bassendean Dune Banksia Woodlands tend to have a high impact with extreme modification of both the overstorey and understorey (Hill et al. 1994).

Management Strategies

In order to determine the *P. cinnamomi* infestation status Western Power commissioned consultants Woodman Environmental Consulting to conduct a dieback survey of the proposed transmission line corridor. The results of this survey are provided in detail in Section 4.5 and Woodman Environmental Consulting (2000). The dieback survey identified large uninfested areas of remnant vegetation, uninterpretable areas mainly on cleared agriculture land and a single infested area at the Moore River crossing.

The uninfested areas will be regarded as protectable and a hygiene plan will be devised to protect these areas from infestation. Measures will include ensuring all vehicles entering protectable areas are clean on entry and those operations within protectable areas do not move soil along the transmission line corridor.

Specifications for contractors employed on this project will require compliance with conditions outlined in the hygiene plan and any contract employee or agents will be removed from the construction site for a breach of these conditions.

The project EMP will contain strategies to minimise the risk of spreading of *P. cinnamomi* during construction and subsequent maintenance activities. These strategies will include:

- The preparation of a *P. cinnamomi* hygiene plan that takes into account land tenure, vegetation condition and identified access routes;
- Development of this hygiene plan to the satisfaction of CALM prior to commencement of construction activities. Consultations with CALM will address the issue of controlling public access during and after construction of the transmission line;
- Inclusion in the plan of specific strategies addressing post construction activities associated with transmission line maintenance;
- Undertaking construction and where practicable, maintenance and ground inspection activities during dry soil conditions;
- Conduct of all activities within the Tiwest Joint Venture lease in accordance with the company's Dieback Management Plan; and
- The use of water dosed with Sodium hypochlorite for dust suppression and/or fire fighting to prevent the accidental introduction of *P. cinnamomi*.

Given the relatively low risk of the spread of *P. cinnamomi* because of soil and moisture conditions along the proposed transmission line corridor, the EPA objective to "Ensure that regionally significant flora and vegetation are adequately protected from the spread of dieback", should be met provided appropriate management strategies are developed and adopted.

Commitment 7:

The proponent will prepare a Phytophthora hygiene management plan based on the protectable areas protocol that addresses:

1. *land tenure, vegetation condition and identified access routes;*
2. *specific strategies addressing post-construction activities associated with transmission line maintenance;*
3. *the conduct of all activities within the Tiwest Joint Venture lease in accordance with the company's Dieback Management Plan.*

Commitment 8:

Implement the approved Phytophthora hygiene management plan referred to in Committment 7.

5.2.2 Fauna/Specially Protected (Threatened) Fauna

EPA Objectives:

- *"Maintain the species abundance, diversity and geographical distribution of fauna"*
- *"Protect Specially Protected, Threatened and Priority Fauna and their habitats, consistent with the provisions of the Wildlife Conservation Act 1950 and the Commonwealth Environmental Protection and Biodiversity Act 1999"*

Description of Potential Impacts

The most significant pressure affecting fauna species within the State is the modification of wildlife habitat (Department of Environmental Protection, 1998). Habitat can be defined as the specific type of place where an animal lives. The quality of the habitat depends on how well the available habitat meets the organsims' requirements for survival and reproduction (Environment Australia, 1997).

The proposed transmission line route has the potential to modify habitat through such processes such as clearing of native vegetation and the introduction and spread of feral animals, weeds and diseases. There is also the potential for birds striking transmission lines along some areas of the proposed transmission line.

Clearing of Native Vegetation

The clearing of native vegetation can have an associated loss of mammals, birds and other animals which depend upon sufficiently large areas of healthy native vegetation for food and shelter (Environmental Protection Authority, 2000).

Wetlands provide important habitats for waterbird for a variety of activities, which include feeding, breeding, nesting and moulting. Waterbird breeding success is compromised as a result of clearing and degradation of fringing and littoral wetland vegetation through the loss of habitat and increased vulnerability to predation by a range of species including cats and foxes.

The proposed line route passes through several areas of native vegetation, the most critical being SF65 North, the crossing of the Moore River and a complex of wetlands in the region south-west of Tiwest's Minesite (Bamford 2000).

Activities that have the potential to temporarily disturbed or permanently clear native are:

- during the construction phase of the project, and
- the maintenance of a service track and clearance between transmission lines and vegetation.

Strategies to Minimise the Clearing of Native Vegetation

Through the strategies listed below, the total amount of native vegetation along the 123km proposed transmission line route that will be permanently cleared as a result of this proposal is approximately 2.86 ha and approximately 37.6ha will be temporarily disturbed. See Section 5.2.1 on area specific details regarding vegetation clearing scenarios.

Strategies to miminise the clearing of native vegetation are:

- avoiding areas of significant habitat such as Tuart forests along the western side of SF65-North and the wetlands north-east of Pinjar;
- aligning the transmission line wherever possible alongside or in close proximity to existing access tracks - thereby minimising vegetation clearing.
- aligning the transmission line wherever possible in pine plantation (e.g. SF65-South) or cleared land;
- placing tower structures in areas where vegetation has already been cleared or is degraded (e.g. the western rather than the eastern side of Gingin Stock Route Nature Reserve);
- transmission towers will be 50-60m in height, which thereby enables vegetation up to 15m to occur under the conductor (wire). This in effect means that in areas of Banksia woodlands typical of most of the proposed alignment, no clearing will be required other than for access and tower sites (see Section 2.4 and Section 5.2.1.1 for details on vegetation clearing requirements along different sections of the proposed line corridor);
- where a transmission line traverses a wetland (Section 5.2.3.1), existing tracks located near the wetlands will be utilised for access during construction and maintenance activities;
- where the transmission line traverses or passes near a wetland, all tower structures will be placed outside of a 50 metre vegetation buffer surrounding the wetland's dependent vegetation.

Introduction and spread of feral animals.

Feral animals, such as foxes and cats, not only prey upon native fauna and compete with native fauna for food, shelter and water, they also graze native vegetation and destroy wildlife habitat (Department of Environmental Protection, 1998).

The proposal has the potential to improve the migration of feral animals through the creation of new access tracks during the construction and maintenance phase of the project.

Strategies to Minimise the Potential for the Introduction and Spread of Feral Animals.

- aligning the transmission line wherever possible alongside or in close proximity to existing access tracks - thereby minimising the creation of new access tracks for feral animal access.

Introduction and spread of weeds and diseases

Weeds constitute a major threat to remnant bushland as they compete with native plants for nutrients and light, with some weed species smothering native vegetation thereby reducing the value of native vegetation for native fauna.

Phytophthora cinnamomi (dieback) is a major threat to biodiversity and the ecological functioning processes of many ecosystems, resulting in impacts to ecological communities significant for their importance as habitat for native fauna.

The proposal has the potential to introduce and spread weeds and diseases through activities such as:

- vehicle movement for construction and maintenance;

- machine clearing of vegetation; and
- the creation of new access for construction and maintenance

Strategies to Minimise the Potential for the Introduction and Spread Weeds and Diseases.

Sections 5.2.1.3 and 5.2.1.4 detail the strategies that will be employed to minimise the potential for the introduction and spread of weeds and diseases. This includes the to development and implementation of and EMP that addresses appropriate hygiene techniques to control the spread of weeds and diseases along the proposed transmission line corridor between areas of native vegetation and agricultural.

Minimising the Potential for Birds Striking Transmission Lines.

Incidents of birds striking transmission lines are rare, however this can occur where large bird populations are concentrated, such as at water bird breeding colonies (Bamford, 2000). The transmission line crossing of the Moore River may be one location where there is the potential for bird-strikes to occur, as waterbirds such as Black Swans, ducks and cormorants may regularly fly along the river. Also, Emu Lake, south-west of Tiwest's Minesite, appears to be the site of a waterbird colony and Straw-necked Ibis are regularly seen flying in the region. It is not anticipated that there will be a significant number of bird strikes with the proposed transmission line, however Western Power will monitor the occurrence of such events and will if necessary institute appropriate measures, such as bird diverters, to reduce the incidence of bird-strikes.

5.2.3 Wetlands and Water Courses

5.2.3.1 Wetlands

Description of Potential Impacts

Transmission line construction and maintenance activities have the potential to impact on wetland ecosytems through the removal or disturbance of riperian zone and buffer vegetation surrounding a wetland or wetland system. Such wetland vegetation performs important functions such as:

- maintaining good water quality within a wetland by reducing sediment, nutrient and pollutant loads in runoff entering the wetlands;
- provide feeding and breeding habitats and shelter for wetland fauna;
- minimise the invasion of weeds; and
- contribute to wildlife corridors between the wetland and adjacent wetlands or bushlands.

Where-ever possible the transmission line route was aligned to avoid wetlands including EPP lakes. As such all EPP lakes in the area have been avoided, however, to the north of the line route, the proposed transmission line route does traverse one dampland located approximately 2km north west of the intersection of Mimegarra Rd and Dingo Rd in Dandaragan as well as passes through a complex of sumplands and damplands in the vicinity of Mimagarra Road up to the Tiwest Minesite. These wetlands have not been evaluated therefore a conservation status has not been determined for each.

Management Strategies

The WRC were consulted regarding the alignment of the transmission line through the above-mentioned wetland areas and have advised that Western Power's management strategies for the area are appropriate and acceptable to the WRC. The WRC have also advised that it would not be necessary for Western Power to arrange to evaluate the wetlands as the management strategies proposed would result in no impacts on the wetlands (Smith, 2000).

The management strategies involve the following:

- using existing tracks located near the wetlands as access for construction and maintenance activities;
- where the transmission line traverses or passes near a wetland, all tower structures will be placed outside of a 50 metre vegetation buffer surrounding the wetland's dependent vegetation; and
- all construction and maintenance activities will occur in dry conditions.

5.2.3.2 Water Courses

EPA Objective:

"Maintain the integrity, functions and environmental values of rivers, creeks and ephemeral streams."

Description of Potential Impacts

Transmission line construction and maintenance activities have the potential to impact on the ecology of river systems through the removal or disturbance of emergent and terrestrial vegetation (riparian vegetation) along banks of watercourses. Such vegetation provides habitat both terrestrially and in-stream, through the provision of large woody debris. The vegetation may also act as corridors and provide safe cover for the movement of fauna between areas of remnant bushland.

The removal of riparian vegetation may also lead to erosion of the banks and bed of the watercourse as the roots of the riparian vegetation provide stability to watercourse banks, enabling them to resist the erosive power of the flowing water. This can be particularly common where the root zone has been undercut.

The removal of vegetation within areas where widespread clearing in a catchment has occurred can be problematic as the increased rate and amount of run-off may increase the erosive power and the potential to undercut the stream bank, particularly at the outside of the meander bends (WRC, Waterways WA Program: Managing and enhancing our waterways for the future).

The proposed transmission line route traverses the Moore River west of Junction Bridge in Gingin, and heads directly north from this point. Vegetation surveys of the area found that the vegetation was a dense forest of Eucalyptus rudis, Melaleuca rhaphiophylla and Banksia prionotes over weed species, however the vegetation is in poor condition as it is unfenced and actively grazed by cattle.

Management Strategies

Western Power has consulted with the WRC regarding the alignment of the proposed transmission line as it crosses the Moore River. A number of alternative alignments have been investigated, with the proposed alignment having the least potential to impact on the Moore River due to less removal of vegetation required as well as the distance away from the bend in the Moore River.

The management strategies involve the following:

- using existing tracks located near the Moore River as access for construction and maintenance activities;
- all tower structures will be placed in already cleared areas;
- no tower structures will be placed within the Moore River;
- trees taller than 9 m will be selectively removed, leaving the tree roots in place to bind the soil, and maintain stability of the bank;
- all construction and maintenance activities will occur in dry conditions;
- if neccessary, large woody debris will be placed within the river to increase the roughness factor and hence reduce flow velocities.

5.2.4 Land Degradation

EPA Objective:

"Ensure that clearing does not result in land degradation"

Construction works associated with the proposed transmission line have the potential to cause land degradation through soil erosion resulting from the removal of topsoil including seed stock contained within the soil. As a result measures will be taken by Western Power to ensure the activities of its employees and representatives including the transmission line construction contractor do not cause erosion or any other land degradation.

With the exception of areas to be excavated for foundations, the construction contractor will be required to take all necessary precautions in order to protect topsoil, grasses, low vegetation and rootstock.

The work under the construction contract will be carried out so that the least practicable disturbance is caused to existing ground cover and contours. The use of tracked vehicles will be restricted to applications such as pile driving where an alternative non-tracked vehicle is not available.

The construction contractor will be required to comply with the requirements of the relevant authority regarding the methods it shall employ to minimise erosion. Wherever possible, natural drainage will be maintained without creating soil erosion.

The following measures will be incorporated into the construction specification to minimise the impact of water flow resulting from the construction activities:

- Low (<1 metre) vegetation to be retained where possible in natural drainage lines;
- In vegetated areas drainage to be directed into undisturbed bush on a gradient of 1 - 3% (i.e. not straight into forest/bush if significant slopes exist on which erosion may be caused on disturbed surfaces);
- Existing road or track drainage lines to be maintained or improved as required;
- Drainage paths under/through bridges, culverts shall not be blocked;
- No trees, soil, rock or debris to be pushed into drainage channels

Specific areas will be designated in advance as having slope and soil conditions that have the potential to erode following machinery disturbance. Construction activities in these areas must be carried out with the highest of emphasis to minimise surface erosion potential. Measures

which may need to be carried out include:

- Flatten scrub, rather than remove
- Establish contour grade drainage
- Only utilise the construction track for stringing activities
- Install culverts where necessary

The construction contractor will be required to instruct its employees and subcontractors, particularly plant operators, of the need for the utmost care to be exercised in carrying out all operations in order to avoid unnecessary damage.

The construction contractor will protect the condition of existing public roads, access roads and tracks during construction and will maintain access roads and tracks to their pre-existing condition prior to the commencement of construction works.

The construction contractor will be required at all times to minimise damage to creek crossings and contour bank crossings and will be required to make good any such damage.

Western Power shall arrange for restoration activities to be carried out to rectify any damage caused by excessive vehicular traffic along the transmission line corridor. In order to avoid erosion of restored land, plant seed or similar may be spread on the corridor.

5.3 Pollution Management Factors

5.3.1 Noise Impacts

EPA Objective:

> *"Protect the amenity of residents from noise impact during construction, ensuring that noise levels meet statutory requirements and acceptable standards"*

Transmission line construction activities having the potential to create noise emissions include the general movement of construction vehicles and the use of heavy machinery and construction equipment such as pile drivers and cranes. The principal source of post construction noise emissions is the use of helicopters for transmission line patrols and maintenance activities.

Potential Construction Impacts

The Environmental Protection (Noise) Regulations 1997 make provision for special cases to allow reasonable noise emission from activities that benefit the community. Activities falling within such special cases need not meet the assigned levels contained in the Noise Regulations but must comply with conditions set in the regulations. Construction sites are one of the special cases provided work is carried out between 7am and 7pm on any day that is not a Sunday or Public Holiday. The conditions in the Noise Regulations applying to daytime construction activities are that the work must be carried out in accordance with noise practices set out in AS 2436-1981 and that the equipment used for the construction work must be the quietest reasonably available.

The above requirements will be included in the construction specification and the construction contractor will be required to meet these requirements and any additional requirements deemed necessary by local government authorities.

The proposed transmission line corridor is generally located away from areas of human settlement and traverses no townships or rural residential subdivisions. The closest rural residence is at least 200m from the proposed transmission line. As a result construction noise will not generally impact significantly on rural residences. Also the hours of construction activity will normally be restricted to daytime operations on weekdays. However, all potentially affected residents will be consulted individually to determine any residences where construction noise impacts are likely to be significant. In such instances, mitigation measures will be adopted in consultation with residents to ensure that noise impacts are managed effectively.

Post Construction Impacts

Helicopter line patrols whilst somewhat intrusive are of short duration having only a temporary impact on individual properties and rural residential premises. Western Power normally manages such impacts by the use of consultative practices such as contacting affected landowners prior to helicopter flights. Sensitive properties such as Ostrich farms are indicated on maps and flight plans used for line patrol and maintenance operations. Areas containing sensitive stock are either avoided or arrangements are made with landowners to move stock prior to aircraft flights.

5.3.2 Dust Suppression

EPA Objective:

"Ensure that dust and particulate emission levels generated by the proposal, both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health problems"

The proposed transmission line corridor is generally located away from areas of human settlement and traverses no townships or rural residential subdivisions. The closest rural residence is at least 200m from the proposed transmission line. As a result it is not likely that dust resulting from transmission line construction activities will present a significant problem to rural residences. However, special measures for dust control will be employed if an assessment of the corridor during construction indicates that there is a risk of a nuisance arising due to dust. In such an instance the construction contractor shall take such measures, as the Western Power superintendent considers necessary to mitigate the nuisance that has arisen due to dust.

The construction contractor will also be required to take all necessary precautions to minimise the risk of any nuisance due to dust. The measures may include speed controls, elimination of unnecessary vehicle movements, water spraying, spreading of cut vegetation and other similar measures.

Rehabilitation of rural land following construction (Section 2.8) will ensure that there will be no post construction dust impacts attributable to the existence of the transmission line, the transmission line corridor or access created to service the transmission line corridor.

5.3.3 Electro-Magnetic Fields

EPA Objective:

"Protect the amenity and health of residents from potential impacts of electromagnetic fields, ensuring that levels meet statutory requirements and acceptable standards."

Electromagnetic fields (EMFs) can occur over a wide range of frequencies and are found wherever electricity is used. They are a natural by-product of the use of electricity and occur around all electric wires and electrical appliances. Hence, they are present in domestic and workplace environments as well as near ordinary street distribution lines and high voltage transmission lines such as the proposed line from Pinjar to Cataby.

Electricity is generated in WA at a frequency of 50 Hertz (Hz) or 50 cycles per second and this is referred to as the "power frequency". Power frequency EMFs consist of two field components, the electric field and the magnetic field. One cannot exist without the other and if the energy source is removed both fields cease to exist; the fields are effectively independent of each other and both diminish rapidly with distance. In general terms, the electric field is dependent on the voltage and the magnetic field on the current flow.

The issue of possible health effects from exposure to power frequency EMFs has been the subject of scientific research and media comment for many years. However, to date and after almost 30 years of research and studies around the world, there is still worldwide scientific consensus that adverse health effects from EMF exposure have not been established, but that further research should be undertaken.

Power frequency EMFs are not a form of radiation. Many newspaper and magazine articles on the subject talk about "radiation' from powerlines or electrical equipment. The word 'radiation' is a broad term, but generally refers to the propagation of energy away from some source. For example, light is a form of radiation, so are x-rays, radio waves and microwaves. EMFs do not travel away from their source, but are fixed in place around it. They do not propagate energy away from their source. They bear no relationship, in their physical nature or effects on the body, to true forms of radiation such as x-rays or microwaves.

The National Health and Medical Research Council of Australia (NH&MRC) has adopted the guidelines for human exposure to power frequency EMFs as recommended by the World Health Organisation (WHO). These guidelines recommend a set of limits of exposure to EMFs based on the WHO environmental

The recommended limits in the NH&MRC guidelines for exposure to power frequency electric and magnetic fields in areas with public access are as follows:

Exposure	Electric Field kiloVolts/ metre (kV/m)	Magnetic Field milli-Gauss (mG)
Up to 24 hours per day	5	1,000
Few hours per day	10	10,000

health criteria. Western Power accepts and endorses these guidelines implicitly, and designs, constructs and operates all its transmission lines, plants and facilities in compliance with these exposure guidelines.

In order to minimise the electric and magnetic fields emanating from the proposed Pinjar-Cataby transmission line, Western Power will design and arrange the phasing of the double-circuit line in an unsymmetrical configuration. The reduction of the field levels is due to the cancelling effect that the unsymmetrical configuration of the conductor phasing on the line has on both the electric and magnetic fields produced by the line.

At its maximum, worst case operating condition the proposed 330kV double-circuit transmission line is expected to produce electric and magnetic fields at one metre above the ground as depicted in Figures 5.5a & 5.5b. According to the field profiles on the figures, the maximum electric field produced by the transmission line within the line corridor is just under 2 kiloVolt per metre (kV/m) and approximately 0.25 kV/m along the edge of the corridor. The maximum magnetic field is just over 5 milliGauss (mG) within the corridor and just under 1 mG along the edge. These field levels are certainly well below the limits of exposure recommended by the NH&MRC of Australia.

For most people the greatest exposure to power frequency EMFs arises from distribution lines in the street, household wiring and domestic electrical appliances. Based on the field profiles described above, living near the proposed transmission line would not substantially increase this exposure.

Western Power is committed to the concept of prudent avoidance as a means of controlling exposures to EMFs if there is any doubt that they are harmless; it designs, constructs and operates all its plants and facilities prudently within the guidelines recommended by the NH&MRC of Australia. Western Power sees 'prudence' as embracing a range of actions which is sensible to the current state of scientific uncertainty as to whether power frequency EMFs cause adverse human health effects, the ongoing research on the subject, and the current community concerns. Such actions include monitoring research, sponsoring research, continually reviewing policies in the light of the most up-to-date research findings (with particular emphasis on the findings of scientific review panels), informing the public, and engaging in prudent avoidance when designing new plants and facilities (for example, design the phasing of the line conductors on a double-circuit line such as the proposed 330kV transmission line in an unsymmetrical configuration).

It has been accepted that it will be difficult to prove that power frequency EMF is safe. Experiments can prove whether there are harmful effects, and the levels at which these effects occur. However, the absence of some effect under particular exposure conditions does not prove safety as there is an infinite number of other effects and exposure conditions which could be tested. If there are harmful effects from exposure to power frequency EMFs, it is not at all clear what feature of the field – average level, exposure integrated over time, rate of change, etc – may be important. Nevertheless, the absence of a wide range of potentially harmful effects over a variety of exposure conditions can give good grounds for believing that harmful effects are unlikely.

It is worthy to note that the carcinogenic risks of both asbestos and smoking did show up very prominently in the very early, initial studies which investigated them, and were confirmed by subsequent studies. However, similar studies on EMFs have still shown no clear, unambiguous evidence of a carcinogenic risk. A prominent researcher who carried out studies establishing the carcinogenic potential of both asbestos and smoking has concluded that there is only very weak evidence to suggest the possibility that EMF may be associated with cancer.

In the light of existing evidence, it is clear that the EMF health effects issue is and will remain dynamic. The challenge to Western Power is to get ahead of the issue by adopting policies that meet the needs of its employees and the general public but at the same time allowing it to remain cost effective and competitive in a changing commercial environment. Western Power believes that the policies it has adopted so far have been responsive to both the community needs and expectations.

Western Power will continue to closely monitor overseas research and support such research here in Australia. It will also continue to design and operate all its plants and facilities prudently within the current guidelines as established by Australian health authorities, including the Australian National Health and Medical Research Council.

5.3.3.1 Effects of Electric Field on Honeybees

The EPA Guidelines for the proposed transmission line route also state that Western Power must identify the potential impact of electromagnetic fields on mating, navigation and physiology of honey bees, specifically Queen Bees.

All the research studies undertaken to date have shown that there is no detrimental effects to commercial apiary operations such as queen bee breeding and honeybee production if the apiary sites are located in areas where the electric field exposure is less than 2kV/m.

Studies by researchers Greenberg et al. (1981) and Bindokas (1985) indicate that honeybee colonies, located within wooden beehives, exposed to fields above 2kV/m may experience some adverse biological effects. In another study by Bindokas, Gauger and Greenberg (1988) it was found that the biological effects in honeybee colonies under transmission lines are primarily the result of electric shock from the induced hive currents rather than the exposure to intense electric fields.

Greenberg, Bindokas and Gauger (1981) found that honeybee colonies exposed to a 7kV/m electric field under a 765kV, 60Hz transmission line exhibited increased motor activity with transient increase in hive temperature, abnormal propolisation, impaired hive weight gain, queen loss and abnormal production of queen cells, a decrease in sealed brood and poor winter survival. This study also found that foraging rates were significantly lower at 7kV/m and 5.5kV/m but found no biological effects at 1.8kV/m. The study also concluded that bees flying through a field of 12kV/m external to the hive experienced no detectable detrimental biological effects.

A study carried out by Bragin (1984) established that hives exposed to very high level electric fields do experience increased mortality in developing bees, disturbance to the regulation of hive microclimate, decreased foraging activity and honey production.

However, Es'kov and Bragin (1986) found from laboratory studies and experiments conducted under a 500kV transmission line that adverse effects such as reduced foraging activity and honey production could be eliminated by moving the hive to a site at least 50m from the 500kV transmission line.

The electric field profile (transversely across the line easement area) of the proposed Pinjar–Cataby 330kV transmission line under the worst case operating condition is as shown on Figure 5.5a. According to the profile, the electric field is at its maximum level at just under 2kV/m immediately under the line conductors and the field level drops off rapidly as one moves transversely away from the line.

The field profile can be described as follows:

- At the centre of the line the level is approximately 1.35kV/m.
- At approximately 8m from the centre of the line, that is directly under the conductors, the field level is just under 2kV/m, which is the maximum level.
- At 10m from the centre of the line, the field level is approximately 1.8kV/m.
- At 20m from the centre of the line, the field level is approximately 0.75kV/m.
- At the edge of the corridor, that is at 30m from the centre of the line, the field level is approximately 0.2kV/m.

The maximum electric field produced by the proposed Pinjar-Cataby 330kV transmission line is less than 2kV/m. Based on the studies mentioned above, it can be concluded that the proposed 330kV transmission line would not have any detrimental effect upon any commercial apiary operations such as queen bee breeding and honey production in the area.

5.4 Social Surrounding Factors

5.4.1 Visual Amenity

EPA Objective:

"Ensure that the visual amenity of the area is not significantly affected by the proposal"

Western Power engaged a consultant Landscape Architect to investigate the visual resources of the area traversed by the proposal and alternative alignments investigated, the likely visual impacts of the project and possible management strategies to reduce visual impact. The visual study process is based on methodologies employed in other recent broadscale studies undertaken in Western Australia (Cleary et al 1999, CALM 1997) including assessment of values, development of management aims and standards, development of designs, impact assessment, evaluation and managemet

decisions. Findings of this investigation related to visual impact and management are summarised briefly below and the full landscape study is provided in Cleary (2001).

The visual impacts of the proposal were evaluated using three sets of management objectives described in detail in Cleary (2001). These objectives were CALM objectives, EPA and project objectives and related to landscape character, visual aesthetic significance, views and wilderness quality.

This evaluation revealed that the proposal had a moderate or high compliance with management objectives related to landscape character, visual aesthetic significance and wilderness quality. The proposal had a low to moderated compliance with objectives related to views. As a result the study recommended modifications to the proposal in the areas located near Wabling Hill, one section of the Wanneroo-Lancelin Road, near the junction of the Gingin Brook and Moore River and the Sappers Road Crossing.

These recommended modifications to the proposed alignment have been investigated and it is intended to adopt three of the four proposed changes. Social issues related to impacts on small private holdings and existing landuse make the adoption of the fourth proposed modification in the vicinity of the Gingin Brook / Moore River junction problematic.

The conclusions of the landscape and visual impact study were:

- There is a range or important aesthetic values in the project area that need to be protected.
- The Western Option, although having an impact on views and small areas of significance and wilderness, has less disadvantages than the other alignments and is the preferred option for aesthetic reasons.
- There will be a moderate impact on the natural character in the vicinity of the line, and that these changes comply with management objectives except where the line is close to key travel routes.
- Visual aesthetic significance is affected in the vicinity of the Coastal Ridges and the Moore River Valley. These impacts generally meet management objectives in the case of Moore River Valley but have only moderate compliance in the case of Coastal Ridges.
- There will be moderate impact on key views if the line is modified as suggested and these impact will have moderate compliance with management objectives.
- Wilderness quality will not generally be affected (high compliance).

The study also recommended that:

- the Western Option be adopted as the preferred option.
- the modifications of the Western Option proposed in this study be adopted if feasible.
- the guidelines outlined in Cleary (2001) be adopted for any further modification of the proposal. In particular, the alignment should: avoid traversing dense tall vegetation, particularly where the canopy is dark in colour and contrasts with the groundcover.

Based on the studies of the landscape study, Western Power will adopt the following management strategies.

During construction, care should be taken to:

- minimise the removal of vegetation;
- roll down rather than clear vegetation where possible;
- ensure that access tracks are designed to minimise impact.

For ongoing maintenance:

- vegetation removal should be minimised;
- where dedicated vehicle access is required, this access avoid shrubs and trees (where these are not cleared) and will restrict vegetation loss.

Recommendations from Cleary, (2001) suggested that Western Power investigate four alternative alignments along the proposed line route to minimise visual impacts. Two of the alternative alignments, one at the crossing of Sappers Road and the other in SF65-North were adopted. The other two recommended alternative alignments along the Western Option were not adopted as significant problems were identified on these alignments. They were within SF65-South and where the proposed line traverses the Moore River.

The recommended alternative alignment to reduce the visual impact of the proposed transmission line from view points at Wabling Hill in SF65-South and from Wanneroo Rd would require the transmission line to be located approximately 2.2km from the existing Gravitational Observatory and approximately 2km closer than the proposed alignment. Locations more distant from the Gravitational Observatory (between 2.2 and 4.2km from the observatory) would not significantly reduce visual impacts as the transmission line would be located on a ridge and would still be visible from Wabling Hill and Wanneroo Rd. However, studies performed by the Energy Systems Centre at the University of Western Australia indicate that there

is a substantial risk that multi-spectral noise generated by corona discharge from normal transmission line operations 2.2km from the Observatory would jeopardise recordings of sensitive equipment used in the gravitational wave measurement process. As this Gravitational Observatory is part of an international monitoring network, Western Power has accepted requests from Professor David Blair of the Physics Department at the University of Western Australia to locate the transmission line on the alignment approximately 4.2km from the observatory.

The other alternative alignment recommended as a result of the visual impact study was in the vicinity of the Moore River crossing. This alignment is not considered viable because of the effect it would have on private properties traversed. The area proposed for the alternative alignment contains small holdings, a poultry farm and pivot irrigation systems. The proposed alternative alignment would be located too close to dwellings or buildings forming part of the poultry farm to achieve safe electrical clearances or distances preferred by Western Power under its EMF prudent avoidance policy. More distant deviations would entail wider crossings of the Moore River, which would be unacceptable to the Water and Rivers Commission.

5.4.2 Culture and Heritage

5.4.2.1 Aboriginal Culture and Heritage

EPA Objective:

- *"Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972"; and*
- *"Ensure that the changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area"*

Potential Impacts

Aboriginal Cultural and Heritage values include places and objects customarily used by, or traditional to, the original inhabitants of Australia and to their descendants. The physical presence of the transmission line or any ground disturbing activities associated with the construction of the proposed transmission line has the potential to adversely affect Aboriginal Heritage values. Such construction activities include clearing of vegetation, the preparation of tower foundations, establishing equipment yards and constructing access roads.

Indirect adverse impacts can result after construction due to increased erosion or to improved access which makes sites more vulnerable to accidental of deliberate disturbance.

As a result Western Power will engage appropriately qualified consultants to conduct archaeological and ethnographic surveys of the proposed transmission line alignment. The consultancy brief for these surveys will require the consultants to make recommendations on any modifications to the location, construction and operation of the transmission line necessary to ensure that no heritage values are adversely affected. Accordingly Western Power will modify the proposal to avoid sites of significance identified by archaeological and ethnographic surveys. In addition during construction works Western Power will implement a groundworks monitoring procedure based on a model developed by Aboriginal Heritage consultants for proponents including MRWA and the WA Department of Education, and accepted by Aboriginal stakeholders during groundworks in the State's southwest.

Western Power will conduct Aboriginal Heritage surveys and modify the location of the transmission line to ensure that no Aboriginal Heritage values are adversely affected by the construction of the transmission line.

5.4.2.2 National Estate

EPA Objective:

"Ensure that the proposal complies with the requirements of the Western Australian Heritage Act 1972 and the Australian Heritage Commission Act 1975 and protects the identified values and places listed in the register of the National Estate and places listed on the Interim List of the Register of the National Estate"

Potential Impacts

The construction of the proposed transmission line has the potential to adversely affect National Estate places. National Estate places and the values associated with them could be adversely affected by the physical presence of the transmission line or by construction activities including clearing of vegetation, the preparation of tower foundations, establishing equipment yards and constructing access roads. There is also the potential for indirect adverse impacts which can result after construction due to increased erosion or to improved access which makes sites more vulnerable to accidental of deliberate disturbance.

The Heritage Council of Western Australia conducted a search of the Register of the National Estate, the State

Register of Heritage Places, and the State Places database to identify if there were any areas within the project area that may have cultural heritage significance. The project area included the City of Wanneroo, the Shire of Gingin and the Shire of Dandaragan.

The Register of the National Estate, compiled by the Australian Heritage Commission, is Australia's national inventory of natural and cultural heritage places that are worth keeping for the future. The Register includes natural, historic and indigenous places in Australia. They come from all parts of Australia and are owned variously by Commonwealth, State and local governments, by businesses, voluntary and other organisations and by private individuals. All places entered in the Register are strictly assessed against publicly available criteria outlining national estate values.

The State Register of Heritage Places is the statutory list of places given legal protection under the Heritage of Western Australia Act 1990, in recognition of their cultural heritage significance for the State.

The State Places database is a comprehensive list of heritage places, whether or not given legal protection, including all places listed in local government heritage inventories, and in other non-statutory lists. "Places" includes buildings and other structures, historic gardens, archaeological sites, or historic cemeteries.

Whilst the search of the databases did identify places of cultural significance within the region of the project area, there are no places in which the proposed transmission line route will impact on these places or the values associated with them.

5.4.3 Unexploded Ordinance

EPA Objective:

"Establish the area potentially affected by unexploded ordinances in the vicinity of the proposed route".

Introduction

The proposed Pinjar-Cataby transmission line route traverses three WW2 era gazetted live firing areas and portions of the existing Defence Training area north of Lancelin. As a result of preliminary discussions with the Department of Defence and the Unexploded Ordnance Unit of the Fire and Emergency Services Authority of Western Australia, Western Power decided to conduct an assessment of the extent of unexploded ordnance (UXO) within the proposed transmission line corridor and to eliminate any identified UXO hazards. The task was split into assessment and remediation phases. A consultant experienced in UXO assessment and remediation was engaged by Western Power to assist in preparing specifications, tender assessment and to act as Western Power's representative during the assessment and remediation works.

Assessment

A company specialising in the field of assessing and remediating land used for military purposes, Milsearch Pty Ltd, was selected through a competative tender process involving Australian companies and agencies. The assessment required:

- The conduct of an assessment along the transmission easement to determine locations, boundaries, densities, depths, types and nature of the UXO as well as inert ordnance related items;
- Recommendations for further investigation and the conduct of remediation to those areas deemed affected; and
- Detail the project findings in a final report.

The assessment consisted of a 10% search of the 60m wide transmission corridor in the three WW2 era gazetted live firing areas and the Lancelin Defence Training. The Survey Party sampled six 1-metre assessment lanes running parallel to the centre line using metal detectors. Detection was to locate the presence of munitions residues, such as fragmentation, fuse portions, mortar tail fins etc, the presence of which would indicate the existence of an impact area for high explosive filled munitions.

Two impact areas for field artillery were located within the proposed corridor which require remediation (Milsearch, 2000). One area of 700 metres in length or 4.2Ha, is located in the WW2 Yanchep Firing Range in the vicinity of Hombracht Road. This impact zone extends beyond the proposed corridor into State Forest 65 South.

The fragmentation pieces associated with the first impact area were almost all located on the east side of the search corridor and were buried slightly below the surface, no deeper than 50mm. Each find was an individual piece. No collections of finds consistent with an actual point of detonation were encountered. The fragmentation was corroded and appeared quite old, consistent with the WW2 era. The location of the finds on the eastern side of the easement suggests that the main target area is located further to the east of the transmission line route. The high ground of Wabling Hill further to the east may have been the principal target.

The second and more significant impact area of 1,700 metres in length or 10.2Ha, is located north of Sappers

Road on rural land that was previously within the WW2 Lancelin Firing Range, south and east of the current Lancelin Defence Training Area. This impact area is in the vicinity of two low but prominent hills. In this area 137 pieces of fragmentation were located. Most finds were made at depths between 150-250mm, which indicates that fragments have been pushed down by the ploughing and pasture improvement. Farmers working in this portion of land revealed that they has reported two finds of artillery ammunition to the Army in recent years. From the density of finds and the positive identification of actual impact points within the corridor, there is a high possibility of additional UXO remaining within the transmission line corridor.

The location of the fragmentation finds were recorded by GPS and provided in the UXO report(Milsearch, 2000). The assessment report indicates that no other locations along the assessed route are likely to be contaminated by UXO and future construction may proceed without risk from UXO hazards.

Remediation

Following a competative tender process, the UXO Unit of the Fire and Emergency Services Authority (FESA) of Western Australia was commissioned by Western Power to conduct a detailed search and remediation of the impact areas identified in the UXO assessment. FESA commenced this work on 8 January 2001.

Line Relocations

Should any additional changes to the proposed Pinjar to Cataby transmission line arise from the environmental planning or EIA process these changed alignments would be assessed for UXO contamination and where necessary remediated to eliminate UXO hazards.

5.5 Other Impacts

5.5.1 Landuse Impacts

The proposed transmission line has the potential to impact on a range of activities and landuse types. Consultation with potentially affected landowners and government agency representatives (see Section 4.9.1) indicated that the most significant landuse concerns associated with the proposal are:

- potential conflicts with intensive agriculture;
- effects on the conservation estate and Natural Heritage values;
- loss of public timber resources in SF 65-South and;
- effects on future subdivision potential of private land holdings.

Intensive Agriculture

The proposed transmission line could potentially affect intensive agriculture if agricultural operations need to be excluded from portions of the 60m wide transmission line corridor to ensure sufficient clearances exist between agricultural equipment and live electrical conductors. Certain additional restrictions would apply where an easement agreement exists between a private landowner and Western Power (see Section 2.7). Such restrictions would include prohibition of water bores, structures and changes to ground profiles within the easement area. Easement agreements negotiated between Western Power and affected landowners will include financial compensation for effects of the transmission line that restrict agricultural activities on private land.

The line route selected for the proposed transmission line avoids crossing properties utilising intensive agricultural equipment such as pivot irrigation systems. The transmission line route is located on the edge of one property using a pivot irrigation system, however the clearance between the live transmission line conductor and this equipment should be sufficient ensure agricultural operations will not be constrained.

Nature Conservation/Recreation

Within SF65-South the proposed transmission line traverses Zones 2, 5 & 6 of the proposed Gnangara Park Concept Plan (Department of Conservation and Land Management, 1999c). The primary focus for Zone 2 and Zone 6 under the 'Concept Plan' is for nature conservation. In particular, an area within Zone 6 between Hombracht Road and Wabling Road has been proposed in CALM's 1987 Northern Forest Region Management Plan to become a Nature Reserve, this will essentially be an extensive of Yeal Nature Reserve. At this stage it is still a proposed Nature Reserve. Management strategies for this area of SF65-South will include using existing access tracks for access and for location of tower structures. Also, vegetation control methods and tower design and location will result in minimal vegetation clearing and temporary vegetation disturbance. Within SF65-South the proposed transmission line has also been aligned to avoid Threatened Ecological Communities, Declared Rare and Priority Listed Flora as well as System 6 areas.

Nature conservation land will be affected to the extent that areas of permanent clearing for the tower bases and access will be excluded from the conservation estate. This impact will be mitigated by the negotiation of compensation agreements between Western Power and the management agency for the conservation estate,

the Department of Conservation. In addition environmental offsets will be provided by Western Power to ensure that there is no overall loss of vegetated area within the State's secure conservation estate as a result of the proposal.

Nature conservation values are also potentially threatened by processes such as the introduction of exotic weeds, fire and the spread of Phytophthora cinnamomi. Such threatening processes potentially resulting from the proposed transmission line are addressed specifically in other subsections of Section 5.0 of this PER.

In general the impact of the proposal on nature conservation and recreation has been minimised by the selection of the proposed alignment and by measures adopted to reduce the total area of clearing. In addition the visual impact of the proposal has been assessed and management strategies (Section 5.4.1) designed to minimise the visual impact of the transmission line particularly in areas of significant visual and aesthetic features and high public sensitivity.

Pine Plantations

A wide strip of land will be alienated from pine plantations than native vegetation. A wider cleared corridor will be required in pine plantations to ensure adequate safety clearances between vegetation and live electrical conductors and to ensure that the security of the transmission line is not jeopardised by falling pine trees. Pines will need to be removed to a "falling height" distance from the transmission line. Agreements will be negotiated between Western Power and the Forest Products Commission to compensate for the permanent loss of timber resource due to the presence of the transmission line. Such negotiations will also need to consider the plans to relocate areas of pine plantation to facilitate revegetation of the Gnangarra Regional Park.

Subdivision

Subdivision of rural land into residential or rural residential land could potentially be adversely affected by the presence of the proposed transmission line. The proposed alignment was selected to avoid existing rural residential subdivisions and where possible to avoid areas where subdivision plans and subdivision potential exists. Landuse planning information from local authority planning schemes and government agencies was considered during the line route selection process. Draft working papers of the Gingin Coast Structure Plan prepared for the Western Australian Planning Commission and the Ministry for Planning indicated that the proposed line route would not conflict with likely development scenarios. Western Power also consulted with planning consultants responsible for preparing these Gingin Coast Structure Plan working papers prior to selecting a preferred route alignment.

Consultations with landowners potentially affected by the Western, Common Corridor and Eastern line route options indicated that most landowners believe their properties have subdivision potential. Whilst many properties in the areas considered for the line route options may be suitable for subdivision, it was not possible to select a line route that would not conflict with the aspirations of landowners to subdivide their properties at some future time. Given that planning approval would need to be obtained before subdivision could occur Western Power was guided in selecting its preferred alignment by advice from relevant local and State authorities.

Sand Mining

Sand mining operations occur in the vicinity of the proposed transmission line corridor close to the Cataby Substation. Other prospective mineralised areas exist along sections of the Common Corridor Option investigated during the line route selection process. Given the dredging sand mining technique used at the TiWest Mine near Cataby, the area of land alienated from sand mining by the proposed transmission line would be equal to or greater than the transmission line corridor width. Negotiations with TiWest have produced a transmission line corridor path traversing the TiWest operations that will not alienate any prospective mineralised land from future sand mining.

Other Landuse Impacts

The proposed transmission line should not significantly impact on other landuse such as sheep and cattle grazing, and the growth of fodder crops. Where the presence of the transmission line adversely affects or constrains these and other landuses, Western Power will attempt to minimise such landuse impacts through consultation with affected parties.

5.5.2 Fire Management

Fire risks are associated with the construction phase and the post construction or operational phase of the proposed transmission line. The management of these risks is essential as fires have the potential to cause major environmental and social effects such as damage to native vegetation including rare and endangered plant species, and threats to people, wildlife and private property.

Construction Risks

During the construction phase fire risk may result from the activities of construction personnel. The construction activities of Western Power employees, contractors and their representatives will be strictly controlled to minimise fire risks.

The transmission line construction specification will require that:

- The transmission line contractor and all the contractor's representatives comply with the Bush Fires Act and Regulations, 1981 and the requirements of the relevant local authorities.
- The contractor and all the contractor's representatives shall be responsible for obtaining advice from local authorities regarding the potential for suspension of the Works due to possible fire bans.
- Under no circumstances shall fires be lit without the express permission of the landowner or land manager and the Superintendent and then only strictly in accordance with such conditions as the landowner / land manager, Western Power's Superintendent or local authority may impose.
- The contractor and all the contractor's representatives shall extinguish accidental fires that occur on the construction site or spread to the construction site. All fires that occur shall be reported immediately after detection to the Wanneroo CALM Office (08) 94050711.

The contractor shall ensure that every:

(a) Vehicle is fitted with a sound, efficient spark arrester exhaust system free from leaks; and

(b) Item of construction plant is fitted, where appropriate, with a vertical exhaust system including a spark arrester and maintained in a sound and efficient state.

The contractor shall provide and maintain on the construction site in good working order for the period of the contract the following fire fighting equipment whenever the relevant local authority indicates that there is a moderate, high, very high or extremely high fire danger:

(a) A 400 L minimum capacity tanker complete with motor driven pump, minimum 50m length of fire fighting hose on a suitable hose reel fitted with an approved nozzle and mounted on a suitable trailer or truck located where construction works are in progress; and

(b) A knapsack spray for each field work gang. Each knapsack spray shall be located within easy access of all members of the particular work gang and shall not be kept on vehicles.

To ensure compliance with the above requirements, the fire fighting equipment will be subject to prior inspection and approval by Western Power's superintendent, before issue to the contractor's personnel and periodically during the period of the contract. The contractor shall be responsible for ensuring that all units are kept filled with water, its employees and subcontractors are familiar with the use of the fire fighting equipment and are informed of the location of local water supplies. If the fire fighting equipment tank has no water, or insufficient water, Western Power's superintendent may elect to direct the contractor to suspend work under the contract until the tank is refilled.

All fire fighting equipment shall be dedicated to this purpose and shall not be used for any other purpose such as washdown of vehicles.

The Contractor shall comply with the instructions issued by the local authority and their fire officers on vehicle movement bans and machinery operating bans.

Post Construction Risks

Post construction risks are associated with the potential for the operating transmission line to provide an ignition source for fires. This risk will be minimised by ensuring that a satisfactory clearance distance is maintained between live electrical conductors and vegetation or any other flammable material. Provided a sufficient distance is maintained there should be no chance of a "flashover" between live conductor and vegetation or any other flammable material. A sufficient distance will be maintained by removing any objects such as structures or buildings from the restriction zone (60m corridor) of the proposed transmission line and by ensuring that where necessary vegetation re-growth is controlled to ensure satisfactory clearances.

The Western Power Vegetation Management Manual (Version 2 1997) provides a table of required clearances between live high voltage transmission line conductor and vegetation. This table indicates that for the proposed typical length of span between towers (450m), a vertical clearance of 6m would be required between a live conductor and vegetation. As the minimum height of conductors above ground will be at least 15m in areas of native vegetation, only vegetation greater than 9m in height would need to be removed.

It is unlikely that vegetation within the proposed corridor would be taller than 9m except in the vicinity of the Moore River crossing, however, where necessary individual plants will be selectively removed to ensure required clearances are achieved. At the Moore River

crossing trees will be selectively removed to achieve required clearances and regular vegetation control activities will ensure these required clearances are maintained.

5.5.3 Public Drinking-Water Resource

The proposed transmission line route traverses the Gnangara water mound, therefore there is the potential for construction activities associated with the proposal to impact on the water quality of this public drinking-water resource. Such activities relate to the storage and handling of fuel.

The WRC have advised Western Power that provided fuel, required for construction activities, is not stored on the water mound, and if a contingency plan for any fuel spillage is in place, the proposed transmission line route should not adversely impact on the public-drinking water qualities of the resource (Mazzela, 2000, pers. comm.)

Western Power will ensure that all construction staff and contractors working in gazetted ground waterprotection areas will:

- Not store any chemicals including fuel in ground water protection areas;
- Use chemical toilets or toilet facilities outside ground water protection areas;
- Not be permitted to camp out in ground water protection areas;
- Comply with all relevant Water Corporation By-laws when working in gazetted groundwater protection areas;
- Report to the Water Corporation any accidental spillage of any substance likely to pollute the surface water or groundwater.

Western Power commits to the following outlined in Table 5.14.

Table 5.14: Proponent's Environmental Management Commitments for the Pinjar to Cataby Transmission Line.

Topic	Objective/s	Action	Timing	Advice
General Environmental Management	Manage environmental effects of the proposal.	**Commitment 1** Develop and implement an Environmental Management Program (EMP) that: 1. includes specific plans and procedures developed in consultation with concerned stakeholders through ongoing stakeholder liaison and discussion by the proponents officers, which addresses construction impacts and stakeholder concerns; 2. includes monitoring procedures and control of the activities of employees, agents and contractors to ensure adherence to environmental requirements identified in the EMP; and 3. is integrated into the existing Western Power Corporate Environmental Management System and documented in the Environmental Management Information System (EMIS).	Pre-Construction	CALM W&RC Aboriginal Groups/ Agencies
		Commitment 2 Implement the approved environmental management program referred to in Committment 1.	Construction Post Construction	CALM W&RC Aboriginal Groups/ Agencies
Vegetation	Minimise the impact of the proposal on remnant native vegetation including threatened species and vegetation communitites.	**Commitment 3** Prepare a vegetation plan that addresses: 1. a system of environmental offsets; 2. procedures to ensure that the transmission line does not reduce the overall area of remnant native vegetation within the State's secure conservation estate; and 3. the protection of Declared Rare and Priority Species.	Pre- Construction	CALM
		Commitment 4 Implement the approved vegetation management plan required by Committment 3.	Construction	CALM

Table 5.14: Proponent's Environmental Management Commitments for the Pinjar to Cataby Transmission Line continued...

Topic	Objective/s	Action	Timing	Advice
Weeds	Control the spread of weeds along the transmission line corridor.	**Commitment 5** Prepare a weed management plan that addresses: 1. appropriate hygiene techniques to control the spread of noxious and environmental weeds along the proposed transmission line corridor between areas of native vegetation and agricultural land; 2. the conduct of post construction audits; and 3. where necessary the eradication of introduced weeds	Pre-Construction	CALM WRC Agriculture WA Landowners
		Commitment 6 Implement the approved weed management plan referred to in Committment 5.	Construction Post-Construction	CALM WRC Agriculture WA
Phytophthora cinnamomi (Dieback)	Control the spread of *Phytophthora cinnamomi* resulting from activities associated with the proposal.	**Commitment 7** The proponent will prepare and implement a *Phytophthora* hygiene management plan based on the protectable areas protocol that addresses: 1. land tenure, vegetation condition and identified access routes; 2. specific strategies addressing post-construction activities associated with transmission line maintenance; and 3. the conduct of all activities within the Tiwest Joint Venture lease in accordance with the company's Dieback Management Plan.	Pre-Construction	CALM
		Commitment 8 Implement the approved *Phytophthora* hygiene management plan referred to in Committment 7.	Construction Post-Construction	CALM

6.0 Community and Stakeholder Consultation

The processes of generating transmission line route options, transmission line route selection and modification of the preferred transmission line option have relied heavily on input from parties potentially affected by the proposal. Stakeholder interests have been considered from project inception, and all decisions about the proposal have endeavoured to minimise the overall effect on stakeholder interests.

Consultation will continue through the EIA process with a one-month period of public review allocated to allow interested parties to prepare submissions to the EPA that must be addressed by the proponent and considered by the DEP and the EPA in assessing the acceptability of the proposal.

The purpose of the public consultation employed by Western Power was to allow an interactive two-way flow of information between Western Power and potentially affected stakeholders to facilitate decision making to minimise the overall effects of the proposal.

The public consultation also aimed to achieve a shared understanding of the process and of the issues of concern to stakeholders. Unless some confidentiality provision existed (such as with the location of mineralised areas) information used in decision making was made available to all stakeholders. Public consultation provided a means of accessing local information, some of which was only available through the cooperation of the local community.

Learnings from the public consultation process were used in multi-criteria analysis as an input to the weighting of the relative importance of various environmental and social factors in decision making. Questions raised during the public consultation process also guided Western Power in the selection, consideration and refinement of alternative line route options.

Level of Involvement in Decision Making

Public consultation processes can range from the provision of information to participation by stakeholders to joint planning and /or decision-making to decision making by the affected community.

Western Power retained control over decision making for the project, although suggestions on potential options and the form of the project were sought from all stakeholders. Any questions raised by stakeholders that could not be adequately answered were investigated. Suggestions on modifications to the proposal were investigated and if regarded as viable incorporated into the selection and final design of the proposal.

The forms of public consultation used to inform Western Power's decision-making process included:

Information Dissemination- Potentially affected parties were provided with details about the proposal;

Information Gathering- Information about social, environmental and economic issues associated with the proposal was sought from potentially affected parties;

Consultation- Stakeholders were asked to comment on and discuss the proposal including possible modifications to the proposal;

Community Participation- Western Power Representatives conducted briefings and attended meetings with community groups to explain the proposal, answer questions about specific issues and provide a forum for discussion of concerns and suggestions related to the proposal;

Joint Planning- A consensus decision on a specific aspect or aspects of the proposal was reached through negotiation with stakeholders, however final decision making remained with the proponent Western Power.

6.1 Methods of Consultation Employed

The consultation techniques employed are detailed below:

Information Dissemination/Gathering

Western Power provided brochures and maps outlining details of the proposal to stakeholders including representatives of environmental agencies, landowners and local authority representatives. Western Power representatives also contributed to articles and notices published in local newspapers. Western Power representatives provided briefings to community representatives including members of State Parliament, local authority employees and elected representatives, landowner action groups (Western Option Group, Dandaragan Group, Eastern Option Group) and the Gingin Land Conservation District Committee.

The nature of the information provided included technical details about the project including the type of construction, clearing requirements, physical size and extent of the project, project timing, the nature of the environment potentially affected and the project planning and approval process.

Information was solicited from stakeholders by recording interviews and meetings with individual and groups and obtaining digital mapping data from relevant agencies. This information informed the proponent about local issues, deviations that should be considered including other geographic options and issues considered significant by stakeholders.

Consultation

During the planning phase of the project, Western Power consulted with representatives of environmental agencies, local authorities, private landowners and State Members of Parliament potentially affected by or concerned about the proposal. These consultations were conducted by face to face meetings, including one on one meetings and meetings with stakeholder groups, phones conversations, exchanges of written information by letters and other correspondence.

Western Power representatives addressed meetings attended by landowners and other concerned stakeholders, including local authority representatives, Members of State Parliament and representatives of farming organisations including the Rural Action Movement. These meetings were open to the general public. Western Power responded to concerns raised at the meetings and used the discussions at the meetings as a basis for further interaction on the formulation and modification of the proposal.

Western Power representatives will be available during the environmental assessment phase of the project to answer questions and respond to suggestions.

Contact details for Western Power representatives are:

John Morrell	(08) 9326 6169
Michelle Hurley	(08) 9326 4598
Axel Brutty	(08) 9326 4744
Rudy Teh	(08) 93264897

Issues Raised

The major issues raised by the various stakeholders and a brief statement of Western Powers' response is provided in Table 6.1. A more detailed series of questions and answers addressed during public consultation by Western Power is provided in Appendix 4.

Table 6.1: The major issues raised by the various stakeholders and a brief statement of Western Powers' response.

Issue	Response/Issues Raised
Need for Transmission Line (TL)	PER Section 2.1 (see also Q1 Appendix 4)
Use Existing TL Structures	Security Risk/High Cost (see Q2 Appendix 4)
Build new TL next to existing TL	Wetlands/Mineralisation/Moore River NP/Low Flight Areas (see Q3 Appendix 4)
Build new TL on Eastern Option	Wetlands/Mineralisation/Low Flight Areas/ Remnant Vegetation (see Q4 Appendix 4)
Build new TL on Western Option	Minimise Overall Social / Environmental Impact (see Q5 Appendix 4)
Gingin Coast Structure Plan	Subdivision Potential (see Q6 Appendix 4)
Underground TL	Cost (see Q7 Appendix 4)
EMF – General Issues	PER Section 5.3.3 (see also Q8 Appendix 4)
EMF – Honey Production/Queen Breeding	PER Section 5.3.3.1 (see also Q9 Appendix 4)
Vegetation Clearing	PER Section 2.4 (see also Q10 Appendix 4)
Effects on Conservation Estate	PER Section 5.2
Visual Impact	PER Section 5.4.1

Glossary

Common Corridor Option – An alternative transmission line route option investigated by Western Power during the proposed Pinjar to Cataby transmission line selection route process.

Conductor - An aluminium cable which is strung from transmission tower to transmission tower to transport live electricity from a power generation station or a substation to another substation.

Cut in Spurs –Where-ever possible, the transmission line has been aligned to follow existing tracks. In areas where there is presently no access to a tower site, cut in spurs will provide this access from existing tracks and roads. Such spurs will range in length from 10m – 200m depending on the location of existing tracks.

Declared Rare Flora (DRF) - Under the Wildlife Conservation Act 1950, the Minister for the Environment may declare species of protected flora to be "Rare Flora" if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Such species are referred to as Threatened Flora, and receive special management attention by CALM.

Eastern Option - An alternative transmission line route option investigated by Western Power during the proposed Pinjar to Cataby transmission line route selection process.

Gas Turbine Station – A facility which generates electricity from gas fired generators.

Gibson Communities – Gibson et al (1994) conducted a vegetation study within the Swan Coastal Plain (SCP) over several seasons and classified vegetation communities within the SCP based on the species composition.

The 'Gibson Communities' (defined by Gibson et al, 1994) and the 'Woodman Communities' (defined by Woodman Environmental Consulting, 2000, and described in this PER) are essentially the same, although Woodman Environmental Consulting (2000) further subdivided the Gibson communities in some cases, based on the presence of specific dominant understorey species.

Heddle Complex - Heddle et al (1980) mapped vegetation on the Swan Coastal Plain at the complex level. This was done at a very large scale, with a complex defined as a series of vegetation communities forming regularly repeating vegetation complexes, based on geomorphology. These complexes can be divided into many floristic/plant communities based on differences in species composition.

Insulators – A porcelain or polymeric fixture located on a transmission tower which is used to separate the live conductor from the tower.

Permanent Vegetation Clearing - It will be necessary to permanently remove vegetation in some areas of the transmission line corridor for tower sites and to provide access to tower sites where access tracks do not already exist. Access to tower sites will be provided by cut in spurs from existing tracks and roads. Such spurs will be no longer than 300m in length.

Palusplain – seasonally waterlogged flat wetland

Phytophthora cinnamomi - Also known as Dieback, is a plant diseases known to impact significantly on native vegetation in Western Australia.

Priority Listed Flora - Because of the large Western Australian flora, there are many species that are known from only a few collections, or a few sites, but which have not been adequately surveyed. Such flora may be rare or threatened, but cannot be considered for declaration as rare flora until such survey has been undertaken. These flora are included on a supplementary conservation list called the Priority Flora List.

There are three categories of priority flora covering these poorly known species. The categories are arranged to give an indication of the priority for undertaking further surveys based on the number of known sites, and the degree of threat to those populations. A fourth category of priority flora is included for those species that have been adequately surveyed and are considered to be rare but not currently threatened.

Sumpland – Seasonally inundated basin wetland.

Stringing – A term given to describe the process of attaching the conductors to the towers during construction phase.

Temporary Vegetation Disturbance - During the construction phase of the project it will be necessary to temporarily disturb or remove vegetation in some areas along the transmission line route in order to carry out the activities associated with tower erection and stringing of wire (conductors) between towers. After construction, vegetation that has been disturbed or removed for such activities will be allowed to regenerate.

Tower – a lattice steel structure built to support the conductors.

Western Option – The proposed transmission line route for the Pinjar to Cataby transmission line proposal.

Woodman communities – Woodman Environmental Consulting (2000) conducted a vegetation study of all areas of native vegetation, 30m either side of the proposed transmission line centreline, between June and November 2000. The vegetation identified during this survey was mapped and classified into vegetation communities based on the species composition.

As a requirement of the EPA, where possible and appropriate, the regional vegetation community data set as defined by Gibson et al (1994) was referred to when classifying the vegetation communities mapped by Woodman Environmental Consulting (2000) during the flora and vegetation survey for this proposal.

Essentially, the 'Woodman Communities' (defined by Woodman Environmental Consulting, 2000, and described in this PER) are the same as the 'Gibson Communities' (defined by Gibson et al, 1994), although Woodman Environmental Consulting (2000) have further subdivided the Gibson communities in some cases, based on the presence of specific dominant understorey species.

Acronyms

4WD	Four wheel drive vehicle
AgWest	Agriculture Western Australia
CALM	Department of Conservation and Land Management.
DEP	Department of Environmental Protection
DME	Department of Minerals and Energy
DRF	Declared Rare Flora
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
EMIS	Environmental Management Information System
EMP	Environmental Management Plan
EMS	Environmental Management System
EPA	Environmental Protection Authority
EPP Lake	Environmental Protection Policy Lake
FESA	Fire and Emergency Services Authority
kV	Kilovolts
NH&MRC	National Health and Medical Research Council
PER	Public Environmental Review
PLF	Priority Listed Flora
RILS	Remote Instrument Landing System
SCP	Swan Coastal Plain
SF65-North	State Forest 65 North
SF65-South	State Forest 65 South
TEC	Threatened Ecological Communities
UXO	Unexploded Ordinances
VCL	Vacant Crown Land
W&RC	Water and Rivers Commission

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Appendix 1

Environmental Protection Authority Guidelines for the proposed Pinjar to Cataby Transmission Line

Environmental Protection Authority
Guidelines

TRANSMISSION LINE, PINJAR GAS TURBINE STATION TO CATABY SUBSTATION

(City of Wanneroo, Shire of Gingin, Shire of Dandaragan)

(Assessment Number 1356)

Part A	Specific Guidelines for the preparation of the Public Environmental Review
Part B	Generic Guidelines for the preparation of an environmental review document

Attachment 1	Example of the invitation to make a submission
Attachment 2	Advertising the environmental review
Attachment 3	Project location map

These guidelines are provided for the preparation of the proponent's environmental review document. The specific environmental factors to be addressed are identified in Part A. The generic guidelines for the format of an environmental review document are provided in Part B.

The environmental review document must address all elements of Part 'A' and Part 'B' of these guidelines prior to approval being given to commence the public review.

Part A: Specific Guidelines for the preparation of the Public Environmental Review

1. The proposal

Western Power Corporation (the proponent) intends to construct a 132 kV transmission line from the Pinjar Gas Turbine Station to the Cataby Substation. The line is proposed to ensure that the quality and reliability of the power supply in the North Country Region is adequately maintained beyond 2002. Western Power has put forward three transmission line options, as indicated on the attached plan (Attachment 3). The Western Option is the proponent's preferred option.

The installation of the transmission line and the associated corridor will require vegetation clearing. Regardless of route, the proposed transmission line corridor is 50 - 60 m wide, with 15 m around each tower to be cleared of vegetation. A 3 m wide area along the length of the corridor will be cleared of vegetation to enable construction access and stringing of the conductors. The typical span between towers is 450 – 550 m. The average tower height is 40 - 50 m. Minimum conductor-to-ground clearance is 6.7 - 8 m. The number of tower structures required has not been determined.

All route options pass through areas of remnant vegetation (Western Option 60 km, Middle Option 35 km and Eastern Option 35 km) and private property (Western Option 18 landowners on 60 private properties, Middle Option 38 landowners on 38 private properties, Eastern Option 51 landowners on 51 private properties). The Middle and Eastern Options impact on wetland areas that extend for approximately 20 km and are generally seasonally inundated or waterlogged. This area includes conservation category wetlands. The Western Option traverses approximately 100m of conservation category wetland.

2. Consultation

In setting the Level of Assessment for this proposal at Public Environmental Review with a four week public review period, the Environmental Protection Authority (EPA) expects that Western Power will consult with relevant agencies (including but not limited to the Department of Conservation and Land Management, the Department of Environmental Protection and the Water and Rivers Commission) and the general public, with a view to resolving environmental matters and preparing suitable commitments prior to public release of the document.

The EPA considers that adequate consultation can be demonstrated by the proponent when stakeholders:

- are kept informed about the potential and actual environmental impacts of the proposal;
- are included in the consultation process and are able to make their concerns, in regard to environmental impacts, known to the proponent;
- receive well informed responses to concerns raised; and
- are able to have meaningful input into the proponent's management of environmental impacts.

3. Environmental factors relevant to this proposal

At this preliminary stage, the Environmental Protection Authority (EPA) believes the relevant environmental factors, objectives and work required is as detailed in the table below:

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**EPA objective**	**Work required for the environmental review**
BIOPHYSICAL			
Terrestrial Flora	Vegetation	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.	Baseline studies by appropriately trained and experienced persons under successive appropriate seasonal conditions to identify existing vegetation within the proposed transmission line corridor. Map and describe the vegetation and relate these mapped units to soil/ landform types, using a recognised and appropriate vegetation mapping system. Provide an assessment of the local and regional significance of the vegetation communities present in the proposal area. Discuss the conservation value by referring to regional data sets, including Griffin EA 1994; Griffin EA 1998; Gibson et al 1994; English & Blyth 1997; and Burbidge et al 1990. Clearly describe the methodology used and its limitations. Assess potential impacts (direct and indirect) on vegetation (local and regional, terrestrial and aquatic) as a result of the proposed transmission line. Delineate areas, including adequate buffer zones, that may provide habitat for threatened, rare, priority or significant taxa or species that may be particularly sensitive to disturbance associated with construction and operation of the transmission line. Describe proposed management measures, including fire management and waste management, to: - Minimise clearing or loss of vegetation; - Rehabilitate areas and access tracks.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**EPA objective**	**Work required for the environmental review**
	Existing and proposed conservation reserves and regional conservation values	Ensure that the conservation values and management of existing and proposed reserves are not compromised. Ensure that regionally significant flora and vegetation communities in these reserves are protected.	Identify existing and proposed reserves and areas with regional conservation significance within and adjoining the proposed transmission line corridor. Describe measures proposed to ensure that these areas are protected and that their use and management is not compromised. Provide an assessment of the importance of existing vegetation communities in their function as a link between existing conservation reserves. Describe proposed management measures to protect significant conservation values within the proposed transmission line corridor. Provide an assessment of impacts on adjacent plant communities as a result of any habitat fragmentation from the proposed transmission line corridor.
	Weeds and disease, including Dieback (Phytophthora)	Ensure that regionally significant flora and vegetation are adequately protected from the spread of weeds and diseases, including Dieback.	Identify weeds and diseases that may potentially cause adverse impacts as a result of implementation of the proposal. Identify the habitats that are most vulnerable to weed invasion or spread of disease. Describe proposed management measures to prevent or mitigate the impacts of weed invasion and spread of disease by development (construction and operation) of the proposed transmission line corridor. Detail how management measures will be carried out, and to whose satisfaction this work will be carried out.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**EPA objective**	**Work required for the environmental review**
	Declared Rare Flora, Priority Flora and other significant flora	Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.* Protect other flora of conservation significance	Targeted search by appropriately trained and experienced persons under appropriate seasonal conditions to identify Declared Rare and Priority flora and significant taxa likely to occur on the subject land. Analysis of likelihood of occurrence of taxa not flowering at time of survey. Identify other species of significance which may be impacted by the proposal and discuss the reason for their conservation significance. These species may include undescribed species, new records for the region, species or taxa that are endemic to the region, or species confined to specific sites of limited occurrence in the region. Provide copies of survey data and reports in electronic form. Retain voucher specimens from all significant species and lodge them with the WA Herbarium. Propose measures to manage and/or mitigate impacts.
Terrestrial Fauna		Maintain the species abundance, diversity and geographical distribution of fauna	Baseline studies to identify existing fauna in the project area. Assessment of potential impacts (direct and indirect) on fauna (local and regional, terrestrial and aquatic) as a result of development of the proposed transmission line corridor. Identify risks of exotic species and diseases being introduced to the environment. Identify the potential for impact on significant invertebrate species, referring to CALM's 02/2000 list of threatened species in the Midwest region. Propose measures to manage and/or mitigate impacts.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**EPA objective**	**Work required for the environmental review**
	Specially Protected (Threatened) Fauna	Protect Specially Protected, Threatened and Priority Fauna and their habitats, consistent with the provisions of the *Wildlife Conservation Act 1950* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.*	Baseline study or targeted search by appropriately trained persons for specially protected, threatened and Priority Fauna that may occur in the project area. Analyse the values of affected land as habitat for endangered fauna. Identify other significant fauna which may be impacted by the proposal and discuss the reason for their significance. These species may include undescribed taxa; new records for the region; taxa at the limit of their range; or species confined to specific sites of limited occurrence in the region. Describe proposed management measures to ensure maintenance of abundance, diversity and distribution of fauna.
Wetlands	Wetlands (including lakes)	Maintain the integrity, functions and environmental values of wetlands. Ensure Environmental Protection Policy (EPP) lakes are protected and their key ecological functions are maintained.	Describe how wetlands may be directly or indirectly impacted by the proposal. Identify transmission line design, alignment, construction and management measures to protect wetlands from adverse impacts. Delineate areas, including adequate buffer zones, that may provide habitat of threatened species or species that may be particularly sensitive to disturbance associated with development (construction and operation) of the transmission line corridor. Propose measures to manage impacts.
	Watercourses	Maintain the integrity, function and environmental values of rivers, creeks and ephemeral streams.	Describe how rivers, creeks and ephemeral streams may be directly or indirectly impacted by the proposal. Propose measures to manage impacts.
Land	Soil	Ensure that vegetation clearing does not result in land degradation.	Describe how the proposed transmission line corridor is to be constructed and managed to ensure land degradation does not occur. Propose measures to manage impacts.
POLLUTION MANAGEMENT			
Non-chemical emissions	Noise	Protect the amenity of residents from noise impact during construction, ensuring that noise levels meet statutory requirements and acceptable standards	Discuss the direct and indirect impacts of noise from installation, operation and maintenance of the transmission line on residents in townships or rural residences. Propose measures to manage and/or mitigate impacts.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**EPA objective**	**Work required for the environmental review**
	Dust	Ensure that dust and particulate emission levels generated by the proposal, both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health problems	Discuss the direct and indirect impacts of dust from installation, operation and maintenance of the transmission line on residents in townships or rural residences and on the surrounding environment. Propose measures to manage and/or mitigate impacts.
	Electro-magnetic fields	Protect the amenity and health of residents from potential impacts of electromagnetic fields, ensuring that levels meet statutory requirements and acceptable standards	Discuss the direct, indirect and perceived impacts of electro-magnetic fields from the transmission line on residents in townships or rural residences. Analyse at ground electro-magnetic field strength along edge of the proposed transmission line corridor. Identify the potential impact of electro-magnetic fields on mating, navigation and physiology of honey bees, specifically Queen Bees. Propose measures to manage and/or mitigate impacts.
SOCIAL SURROUNDINGS			
Aesthetic	Visual amenity	Ensure that the visual amenity of the area is not significantly affected by the proposal.	Conduct a visual impact analysis using recognised methodology. Propose measures to manage impacts.
Culture and Heritage	Aboriginal culture and heritage	Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act 1972*. Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Identify any Aboriginal cultural and heritage sites/issues of significance through archaeological and ethnographical surveys of the project area and through consultation with local Aboriginal groups, Native Title claimants and the Aboriginal Affairs Department. Identify potential impacts on any identified sites or cultural activities. Propose measures to manage impacts.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**EPA objective**	**Work required for the environmental review**
	Places listed in the Register of the National Estate and places listed in the Interim List of the Register of the National Estate.	Ensure that the proposal complies with the requirements of the Western Australian *Heritage Act 1972* and the *Australian Heritage Commission Act 1975* and protects the identified values of places listed in the register of the National Estate and places listed on the Interim List of the Register of the National Estate.	Identify any places listed on the register of the National Estate and places listed on the Interim List of the National Estate which are potentially affected by the proposal and explain any impacts on these places and their management Propose measures to manage and/or mitigate impacts.
Public health and safety	Risk and hazard – Unexploded ordinance	Ensure that the proposal is managed so that the level of public risk meets the EPA's criteria for individual fatality risk off-site and meets the DME's requirements in respect of public safety.	Establish the area potentially affected by unexploded ordinances in the vicinity of the proposed route. Describe measures undertaken or adopted to ensure the safety of the public.

Notes: Vegetation

Regional vegetation data sets are mentioned under the factor 'Terrestrial Flora' in the table above. Some are currently under preparation (the West Midlands Study) and others are available from E A Griffin. Some examples of other vegetation studies are:

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Griffin E A, 1998, *Interim Bioregions*: West Midlands, unpub, DEP, Perth, WA.

Griffin EA & Keighery B J, 1989, *Moore River to Jurien Bay Sandplain Survey*, Wildflower Society of Western Australia, Perth, WA.

These factors should be addressed within the environmental review document for the public to consider and make comment to the EPA. The EPA expects to address these factors in its report to the Minister for the Environment.

The EPA expects the proponent to fully consult with interested members of the public and take due care in ensuring any other relevant environmental factors, which may be of interest to the public, are addressed.

4. Availability of the environmental review

4.1 Copies for distribution free of charge

Supplied to DEP:	• Library/Information Centre	9
	• EPA members	6
	• Officers of the DEP (Perth)	5
Distributed by the proponent to:		
Government departments	• Aboriginal Affairs Department	2
	• Agriculture Western Australia (Commissioner for Soil and Land Conservation)	2
	• Agriculture Western Australia	1
	• Australian Heritage Commission	1
	• Department of Conservation and Land Management	3
	• Department of Defence	1
	• Department of Land Administration	1
	• Department of Main Roads	2
	• Department of Minerals and Energy	2
	• Emergency Services Department	1
	• Ministry for Planning	2
	• Conservation Commission	2
	• Office of Energy	1
	• Water and Rivers Commission	2
Local government authorities	• Shire of Dandaragan	2
	• Shire of Gingin	2
	• City of Wanneroo	2
Libraries	• J S Battye Library	3
	• The Environment Centre	2
	• Dandaragan Shire Library	2
	• Dandaragan Shire Library (Jurien Bay Office)	1
	• Dandaragan Shire Library (c/o Cervantes Post Office)	1
	• Dandaragan Shire Library (c/o Badgingarra Post Office)	1
	• Gingin Shire Library	2
	• Gingin Shire Library (Lancelin Office)	1
	• Wanneroo Shire Library	2
	• Wanneroo Shire Library (Girraween)	1
	• Wanneroo Shire Library (Yanchep/ Two Rocks)	1
Other	• Conservation Council of WA	1
	• Affected Landholders Group (Western Option)	1

4.2 Available for public viewing

- J S Battye Library;
- local libraries;
- Department of Environmental Protection Library;
- The Environment Centre; and
- other places as the proponent sees fit

Part B: Generic Guidelines for the preparation of an environmental review document

1. Overview

All environmental reviews have the objective of protecting the environment. Environmental impact assessment is deliberately a public process in order to obtain broad ranging advice. The review requires the proponent to describe:

- the proposal;
- receiving environment;
- potential impacts of the proposal on factors of the environment; and
- proposed management strategies to ensure those environmental factors are appropriately protected.

Throughout the assessment process it is the objective of the Environmental Protection Authority (EPA) to help the proponent to improve the proposal so the environment is protected. The DEP administers the environmental impact assessment process on behalf of the EPA.

The primary purpose of the environmental review is to provide information on the proposal within the local and regional framework to the EPA, with the aim of emphasising how the proposal may impact the relevant environmental factors and how those impacts may be mitigated and managed.

The language used in the body of the environmental review should be kept simple and concise, considering the audience includes non-technical people, and any extensive, technical detail should either be referenced or appended to the environmental review. The environmental review document will form the legal basis of the Minister for the Environment's approval of the proposal and therefore should include a description of all the main and ancillary components of the proposal, including options where relevant.

Information used to reach conclusions should be properly referenced, including personal communications. Such information should not be misleading or presented in a way that could be construed to mislead readers. Assessments of the significance of an impact should be soundly based rather than unsubstantiated opinion, and each assessment should lead to a discussion of the management of the environmental factor.

2. Objectives of the environmental review

The objectives of the environmental review are to:

- place this proposal in the context of the local and regional environment;
- adequately describe all components of the proposal, so that the Minister for the Environment can consider approval of a well-defined project;
- provide the basis of the proponent's environmental management program, which shows that the environmental impacts resulting from the proposal, including cumulative impact, can be acceptably managed; and
- communicate clearly with the public (including government agencies), so that the EPA can obtain informed public comment to assist in providing advice to government.

3. Environmental management

The EPA expects the proponent to have in place an environmental management system appropriate to the scale and impacts of the proposal including provisions for performance review and a commitment to continuous improvement. The system may be integrated with quality and health and safety systems and should include the following elements:

- environmental policy and commitment;
- planning of environmental requirements;
- implementation and operation of environmental requirements;
- measurement and evaluation of environmental performance;
- review and improvement of environmental outcomes.

A description of the proposed environmental management system should be included in the environmental review documentation. If appropriate, the documentation can be incorporated into a formal environmental management system (such as AS/NZS ISO 14001). Public accountability should be incorporated into the approach on environmental management.

The environmental management program (EMP) is the key document of an environmental management system that should be adequately defined in an environmental review document. The EMP should provide plans to manage the relevant environmental factors, define the performance objectives, describe the resources to be used, outline the operational procedures and outline the monitoring and reporting procedures which would demonstrate the achievement of the objectives.

4. Format of the environmental review document

The environmental review should be provided to the DEP officer for comment. At this stage the document should have all figures produced in the final format and colours.

Following approval to release the review for public comment, the final document should also be provided to the DEP in an electronic format.

The proponent is requested to supply the project officer with an electronic copy of the environmental review document for use on Macintosh, Microsoft Word Version 6, and any scanned figures. Where possible, figures should be reproducible in a black and white format.

5. Contents of the environmental review document

The contents of the environmental review should include an executive summary, introduction and at least the following:

5.1 The proposal

A comprehensive description of the proposal including its location (address and certificate of title details where relevant) is required.

Justification and alternatives

- justification and objectives for the proposed development;
- the legal framework, including existing zoning and environmental approvals, and decision making authorities and involved agencies; and
- consideration of alternative options.

Key characteristics

The Minister's statement will bind the proponent to implementing the proposal in accordance with any technical specifications and key characteristics[1] in the environmental review document. It is important therefore, that the level of technical detail in the environmental review, while sufficient for environmental assessment, does not bind the proponent in areas where the project is likely to change in ways that have no environmental significance.

Include a description of the components of the proposal, including the nature and extent of works proposed. This information must be summarised in the form of a table as follows:

Table 1: Key characteristics (example only)

Element	Description
Life of project (mine production)	< 5yrs (continual operation)
Size of ore body	682 000 tonnes (upper limit)
Area of disturbance (including access)	100 hectares
List of major components • pit • waste dump • infrastructure (water supply, roads, etc)	refer plans, specifications, charts section immediately below for details of map requirements
Ore mining rate • maximum	• 200 000 tonnes per year
Solid waste materials • maximum	• 800,000 tonnes per year

[1] Changes to the key characteristics of the proposal following final approval, would require assessment of the change and can be treated as non-substantial and approved by the Minister, if the environmental impacts are not significant. If the change is significant, it would require assessment under section 38 or section 46. Changes to other aspects of the proposal are generally inconsequential and can be implemented without further assessment. It is prudent to consult with the Department of Environmental Protection about changes to the proposal.

Water supply • source • maximum hourly requirement • maximum annual requirement	 • XYZ borefield, ABC aquifer • 180 cubic metres • 1 000 000 cubic metres
Fuel storage capacity and quantity used	litres; litres per year
Heavy mineral concentrate transport • truck movements (maximum)	 • 75 return truck loads per week

Plans, Specifications, Charts

Adequately dimensioned plans showing clearly the location and elements of the proposal which are significant from the point of view of environmental protection, should be included. The location and dimensions (for progressive stages of development, if relevant) of plant, amenities buildings, accessways, stockpile areas, dredge areas, waste product disposal and treatment areas, all dams and water storage areas, mining areas, storage areas including fuel storage, landscaped areas etc.

Only those elements of plans, specifications and charts that are significant from the point of view of environmental protection are of relevance here.

Figures that should always be included are:

- a map showing the proposal in the local context - an overlay of the proposal on a base map of the main environmental constraints;
- a map showing the proposal in the regional context; and, if appropriate,
- a process chart / mass balance diagram showing inputs, outputs and waste streams.

The plan/s should include contours, a north arrow, a scale bar, a legend, grid co-ordinates, the source of the data, and a title. If the data is overlaid on an aerial photo then the date of the aerial photo should be shown.

Other logistics

- timing and staging of project; and
- ownership and liability for waste during transport, disposal operations and long-term disposal (where appropriate to the proposal).

5.2 Environmental factors

The environmental review should focus on the relevant environmental factors for the proposal, and these should be agreed in consultation with the EPA and DEP and relevant public and government agencies. Preliminary environmental factors identified for the proposal are shown in Part A of these guidelines.

Further environmental factors may be identified during the preparation of the environmental review, therefore on-going consultation with the EPA, DEP and other relevant agencies is recommended. The DEP can advise the proponent on the recommended EPA objective for any new environmental factors raised. Minor matters which can be readily managed as part of normal operations for the existing operations or similar projects may be briefly described.

Items that should be discussed under each environmental factor are:

- a clear definition of the area of assessment for this factor;
- the EPA objective for this factor;
- a description of what is being affected - why this factor is relevant to the proposal;
- a description of how this factor is being affected by the proposal - the predicted extent of impact;
- a description of where this factor fits into the broader environmental / ecological context (only if relevant - this may not be applicable to all factors);
- a straightforward description or explanation of any relevant standards / regulations / policy;
- environmental evaluation - does the proposal meet the EPA's objective as defined above;
- if not, environmental management proposed to ensure the EPA's objective is met;
- predicted outcome.

The proponent should provide a summary table of the above information for all environmental factors, under the three categories of biophysical, pollution management and social surroundings:

Table 2: Environmental factors and management (example only)

Environ-mental Factor	EPA Objective	Existing environment	Potential impact	Environ-mental management	Predicted outcome
BIOPHYSICAL					
vegetation community types 3b and 20b	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation community types 3b and 20b	Reserve 34587 contains 45 ha of community type 20b and 34 ha of community type 3b	Proposal avoids all areas of community types 20b and 3b	Surrounding area will be fully rehabilitated following construction	Community types 20b and 3b will remain untouched Area surrounding will be revegetated with seed stock of 20b and 3b community types
POLLUTION MANAGEMENT					
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	Light industrial area - three other dust producing industries in close vicinity Nearest residential area is 800 metres	Proposal may generate dust on two days of each working week.	Dust Control Plan will be implemented	Dust can be managed to meet EPA's objective

SOCIAL SURROUNDINGS					
Visual amenity	Visual amenity of the area adjacent to the project should not be unduly affected by the proposal	Area already built-up	This proposal will contribute negligibly to the overall visual amenity of the area	Main building will be in 'forest colours' and screening trees will be planted on road	Proposal will blend well with existing visual amenity and the EPA's objective can be met

5.3 Environmental management commitments

The final stage of the Environmental Impact Assessment (EIA) process is reached when the Minister for the Environment issues the Ministerial statement for the project, which is a set of legally enforceable conditions and procedures for the implementation of the project. One of the standard procedures is a requirement for the proponent to implement the commitments which it has made during the EIA process. It is accepted practice for a consolidated list of the proponent's commitments to be attached to the Minister's statement.

Commitment formatting

1. Commitment components

Commitments which address key environmental factors will be audited by the DEP, together with the environmental conditions. Unless the commitments are framed in a standard format, it may become difficult in practice to implement or audit them. By applying the principles of quality management, a standard format for the commitments has been arrived at. The format ensures that a chain of responsibility is established to facilitate compliance and that redundant, overlapping or non-enforceable commitments are avoided.

The required standard format for all commitments comprises a number of components as follows:

The proponent **(who)** will undertake an action **(what, how, where)** to meet an environmental objective **(why)** to a time frame **(when)**, and on advice of somebody **(to whom**, eg. third party, government agencies such as Department of Conservation and Land Management, Department of Minerals and Energy, Water and Rivers Commission, Shire Council). With regard to 'whom' this need only be included if the expertise of a third party is relevant to implementing the commitment.

It is important for the consolidated list of commitments to be numbered correctly for easy reference in the implementation and auditing stages of the project. These should therefore be sequentially numbered 1, 2, 3, ... without use of subgroups such as 1.1, 1.2 or 2(i) or 2(a), 2(b).

2. Paragraph format

In applying the standard components (who, what, why, how, where, when, to whom) an example of a commitment in paragraph form is as follows:

The proponent will prepare and implement a Dust Control Program which will minimise dust generation on-site and prevent dust emission from construction of the foreshore extension in order to protect the amenity of nearby land users. The Program will be prepared during the design (project planning) phase and will meet EPA dust control criteria (EPA, 1996), on advice of the Shire of Widgiemooltha. The approved Program will be implemented during the construction phase.

However in writing the commitment in paragraph form, a confusing or clumsy sentence structure can result that may be difficult to interpret for future auditing purposes. Also it is difficult to verify that all components have been incorporated into every commitment. A paragraph format is therefore not the preferred format.

3. Tabular format

Due to the limitations of the paragraph format, it is preferable to format a commitment in tabular form. It is recommended that the table column headings be ordered as: 'commitment number', 'topic', 'action', 'objective', 'timing' and 'advice'. However table headings can be re-ordered if necessary.

The example in paragraph form on page 1 can therefore be written in tabular form as per examples 1 and 2 below. Note that the tabular format makes it easier to ensure that no component of the commitment is left out and that each action is recognised as a separate commitment. This format also permits the inclusion of additional clauses or more precise wording of clauses which can be difficult in a sentence structure. It is acceptable for table columns to be re-ordered if necessary. Finally, the tabular format provides an immediate audit framework for use by the proponent and the DEP, enabling efficient administration of environmental approvals.

Examples 1 & 2.

The proponent is committed to the following:

No.	Topic	Action **(What/How/Where)**	Objective/s **(Why)**	Timing **(When)**	Advice **(To whom)**
1.	Dust management	Prepare a Dust Control Program for the foreshore construction site which addresses: 1) abc 2) xyz	• Minimise dust during the construction phase • Maintain the amenity of nearby land users • To meet EPA dust control criteria	Pre-construction	Shire
2.	Dust management	Implement the approved Dust Control Program	Achieve the objectives of Commitment 1	Construction	-

Example 3.

No.	Topic	Action	Objective/s	Timing	Advice
3.	Fauna protection	Undertake a trapping programme for capturing and relocating the Southern Brown Bandicoots	Minimise impact on Southern Brown Bandicoots	Pre- construction (prior to commencement of ground disturbance)	CALM

Example 4.

No.	Topic	Action	Objective/s	Timing	Advice
4.	Vege-tation	Revegetate disturbed areas with vegetation types indigenous to the area	• To minimise impact on local flora • To achieve the completion criteria stated in CER (Section 5.1.1)	Post-construction (progressively during operations)	Kings Park Board

Example 5.

No	Topic	Objective	Action	Timing	Advice
5.	Ground water	Minimise impact on groundwater levels, surface water levels and surrounding vegetation	Groundwater drawdown shall not exceed 0.5 m at any boundary of the mine site	Operation	Water and Rivers Commis-sion

Example 6.

No.	Topic	Action	Objective	Timing	Advice
6.	Clean-up	Post-clean up activities will only proceed after demonstrating to (and gaining approval from) the DEP that the site clean-up criteria identified in the 1993 CER have been met	To achieve the soil quality objectives in the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Jan 1992	Post-clean up (On completion of cleanup and prior to commencement of post-cleanup activities)	–

5.4 Public consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent in preparing the environmental review. It should describe the activities undertaken, the dates, the groups/individuals involved and the objectives of the activities. Cross reference should be made with the description of environmental management of the factors which should clearly indicate how community concerns have been addressed. Those concerns which are dealt with outside the EPA process can be noted and referenced.

5.5 Other information

Additional detail and description of the proposal, if provided, should go in a separate section.

Attachment 1

The first page of the proponent's environmental review document must be the following invitation to make a submission, with the parts in square brackets amended to apply to each specific proposal. Its purpose is to explain what submissions are used for and to detail why and how to make a submission.

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

[the proponent] proposes [the rezoning of land and the development of a Marina Complex in the City of Bunbury]. In accordance with the Environmental Protection Act, a [PER] has been prepared which describes this proposal and its likely effects on the environment. The [PER] is available for a public review period of [8] weeks from **[date]** closing on **[date]**.

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in the EPA's report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the [PER] or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the [PER]:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the [PER];
- if you discuss different sections of the [PER], keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: **[date]**

Submissions should be addressed to:

The Environmental Protection Authority
Westralia Square
141 St George's Terrace
PERTH WA 6000

Attention: **[Project Officer name]**

Attachment 2

Advertising the environmental review

The proponent is responsible for advertising the release and arranging the availability of the environmental review document in accordance with the following guidelines:

Format and content

The format and content of the advertisement should be approved by the DEP before appearing in the media. For joint State-Commonwealth assessments, the Commonwealth also has to approve the advertisement. The advertisement should be consistent with the attached example.

Note that the DEP officer's name should appear in the advertisement.

Size

The size of the advertisement should be two newspaper columns (about 10 cm) wide by about 14 cm long. Dimensions less than these would be difficult to read.

Location

The approved advertisement should, for CER's, appear in the news section of the main local newspaper and, for PER's and ERMP's, appear in the news section of the main daily paper's ("The West Australian") Saturday edition, and in the news section of the main local paper at the commencement of the public review period and again two weeks prior to the closure of the public review period.

Timing

Within the guidelines already given, it is the proponent's prerogative to set the time of release, although the DEP should be informed. The advertisement should not go out before the report is actually available, or the review period may need to be extended.

Example of the newspaper advertisement

Proponent Name

Consultative/Public/ Environmental Review/and Management Programme

TITLE OF PROPOSAL

(Public Review Period: **[date]** to **[date]**)

Proponent is planning to brief description of proposal.

A Consultative Environmental Review (CER)/Public Environmental Review (PER)/Environmental Review and Management Programme (ERMP) has been prepared by the company to examine the environmental effects associated with the proposed development, in accordance with Western Australian Government procedures. The CER/PER/ERMP describes the proposal, examines the likely environmental effects and the proposed environmental management procedures.

Proponent has prepared a project summary which is available free of charge from the company's office address.

Copies of the CER/PER/ERMP may be purchased for $5/$10 from:

Company Name
Street
Suburb/Town WA Postcode
Telephone: (08) 9xxx xxxx

Copies of the complete CER/PER/ERMP will be available for examination at:

- Department of Environmental Protection
  Library Information Centre
  8th Floor, Westralia Square
  141 St Georges Terrace
  PERTH WA 6000
- Relevant local libraries
- Department of Environmental Protection
  Regional Office - if appropriate

Submissions on this proposal are invited by **[closing date]**. Please address your submission to:

Chairman
Environmental Protection Authority
8th Floor, Westralia Square
141 St Georges Terrace
PERTH WA 6000
Attention: **[Project Officer name]**

If you have any questions on how to make a submission, please ring the project officer, **[Project Officer name]**, on (08) 9222 7xxx.

Appendix 2

Fauna species of the Project Area

Table A2.1: Freshwater fish known to occur within the project area.

Species		Habitat	Status*
Plotosidae (eel-tailed catfish)			
Freshwater Cobbler	*Tandanus bostocki*	rivers	-
Galaxiidae (Australian minnows)			
Western Minnow	*Galaxias occidentalis*	rivers	-
Percichthyidae (Australian perches)			
Nightfish	*Bostockia porosa*	rivers	-
Nannopercidae (pygmy-perches)			
Western Pygmy-perch	*Edelia vittata*	rivers	-
Atherinidae (hardyheads)			
Western Hardyhead	*Leptatherina wallacei*	rivers	-
Gobiidae (gobies)			
Swan River Goby	*Pseudogobius olorum*	rivers, swamps	-
Big-headed Goby	*Afurcagobius suppositus*	rivers, swamps	-
Poeciliidae (live-bearing tooth-carps)			
Mosquito Fish	*Gambusia holbrooki*(I)	rivers, swamps	Int.

* NCS indicates species of national conservation significance, while Int. indicates introduced species.

Table A2.2: Frog species known to occur within the project area.

Species		Status*
Myobatrachidae (ground frogs)		
Glauert's Froglet	*Crinia glauerti*	-
Sandplain Froglet	*Crinia insignifera*	-
Granite Froglet	*Crinia pseudinsignifera*	-
Moaning Frog	*Heleioporus eyrei*	-
Spotted Burrowing Frog	*Heleioporus albopunctatus*	-
	Heleioporus psammophilus	-
Pobblebonk	*Limnodynastes dorsalis*	-
Turtle Frog	*Myobatrachus gouldii*	-
Humming Frog	*Neobatrachus pelobatoides*	-
Guenther's Toadlet	*Pseudophryne guentheri*	-
Hylidae (tree frogs)		
Slender Tree Frog	*Litoria adelaidensis*	-
Motorbike Frog	*Litoria moorei*	-

* NCS indicates species of national conservation significance.

Table A2.3: Reptile species known to occur within the project area.

Species		Status*
Chelidae (side-neck tortoises)		
Long-necked Tortoise	*Chelodina oblonga*	-
Gekkonidae (geckoes)		
Clawless Gecko	*Crenadactylus ocellatus*	-
	Diplodactylus alboguttatus	-
	Diplodactylus polyopthalmus	-
Spiny-tailed Gecko	*Diplodactylus spinigerus*	-
Marbled Gecko	*Phyllodactylus marmoratus*	-
Pygopodidae (legless lizards)		
Sandplain Worm Lizard	*Aprasia repens*	-
	Aclys concinna	-
Fraser's Legless Lizard	*Delma fraseri*	-
	Delma grayii	-
Burton's Legless Lizard	*Lialis burtonis*	-
	Pletholax gracilis	-
Common Scaleyfoot	*Pygopus lepidopodus*	-
Agamidae (dragon lizards)		
Western Bearded Dragon	*Pogona minor*	-
Sandhill Dragon	*Tympanocryptis adelaidensis*	-
Varanidae (monitors or goannas)		
Gould's Sand Goanna	*Varanus gouldii*	-
Black-tailed Tree Goanna	*Varanus tristis*	-

* NCS indicates species of national conservation significance. While (ncs) indicates species listed by Cogger et al. (1993) but not included in more recent lists of threatened species.

Table A2.3: Reptile species known to occur within the project area continued...

Species		Status*
Scincidae (skink lizards)		
Fence Skink	*Cryptoblepharus plagiocephalus*	-
	Ctenotus australis	-
	Ctenotus fallens	-
	Ctenotus gemmula	-
	Ctenotus impar	-
	Ctenotus pantherinus	-
King's Skink	*Egernia kingii*	-
	Egernia multiscutata	-
Salmon-bellied Skink	*Egernia napoleonis*	-
	Hemiergis quadrilineata	-
	Lerista christinae	(ncs)
	Lerista distinguenda	-
	Lerista elegans	-
	Lerista lineopunctulata	-
	Lerista praepedita	-
Dwarf Skink	*Menetia greyii*	-
Spotted Morethia	*Morethia lineoocellata*	-
Dusky Morethia	*Morethia obscura*	-
Western Bluetongue	*Tiliqua occipitalis*	-
Bobtail	Tiliqua rugosa	-
Typhlopidae (blind snakes)		
	Ramphotyphlops australis	-
Boidae (pythons)		
Carpet Python	*Morelia spilota imbricata*	NCS
Woma	*Aspidites ramsayi*	NCS

* NCS indicates species of national conservation significance. While (ncs) indicates species listed by Cogger et al. (1993) but not included in more recent lists of threatened species.

Table A2.3: Reptile species known to occur within the project area continued...

Species		Status*
Elapidae (front-fanged snakes)		
Yellow-faced Whip-Snake	*Demansia psammophis*	-
Bardick	*Echiopsis curtus*	-
Tiger Snake	*Notechis scutatus*	-
Crowned Snake	*Drysdalia coronatus*	-
Mulga Snake	*Pseudechis australis*	-
Dugite	*Pseudonaja affinis*	-
Gould's Snake	*Parasuta gouldii*	-
Jan's Bandy-Bandy	*Simoselaps bertholdi*	-
Black-naped Snake	*Neelaps bimaculata*	-
Black-striped Snake	*Neelaps calonotos*	(ncs)
Half-ringed Snake	*Brachyurophis semifasciata*	-
Narrow Banded Snake	*Brachyurophis fasciolata*	-

* (ncs) indicates species listed by Cogger et al. (1993) but not included in more recent lists of threatened species.

Table A2.4a: Wetland bird species known to occur within the project area.

Species		Status*
Anatidae (ducks, geese and swans)		
Freckled Duck	*Stictonetta naevosa*	NCS
Black Swan	*Cygnus atratus*	-
Australian Shelduck	*Tadorna tadornoides*	-
Pacific Black Duck	*Anas superciliosus*	-
Grey Teal	*Anas gibberifrons*	-
Chestnut Teal	*Anas castanea*	-
Australasian Shoveler	*Anas rhynchotis*	-
Pink-eared Duck	*Malacorhynchus membranaceus*	-
Hardhead (White-eyed Duck)	*Aythya australis*	-
Australian Wood Duck	*Chenonetta jubata*	-
Musk Duck	*Biziura lobata*	-
Blue-billed Duck	*Oxyura australis*	-
Podicepididae (grebes)		
Great Crested Grebe	*Podiceps cristatus*	-
Hoary-headed Grebe	*Poliocephalus poliocephalus*	-
Australasian Grebe	*Tachybaptus novaehollandiae*	-
Anhingidae (darters)		
Darter	*Anhinga melanogaster*	-
Phalacrocoracidae (cormorants)		
Little Black Cormorant	*Phalacrocorax sulcirostris*	-
Little Pied Cormorant	*Phalacrocorax melanoleucos*	-
Pelecanoididae (pelicans)		
Australian Pelican	*Pelecanus conspicillatus*	-

* NCS indicates species of national conservation significance.

Table A2.4a: Wetland bird species known to occur within the project area continued...

Species		Status*
Ardeidae (herons and egrets)		
White-faced Heron	*Egretta novaehollandiae*	-
Little Egret	*Egretta garzetta*	-
White-necked Heron	*Ardea pacifica*	-
Great Egret	*Egretta alba*	-
Nankeen Night Heron	*Nycticorax caledonicus*	-
Little Bittern	*Ixobrychus minutus*	NCS
Australasian Bittern	*Botaurus poiciloptilus*	NCS
Plataleidae (ibis and spoonbills)		
Glossy Ibis	*Plegadis falcinellus*	-
Australian White Ibis	*Threskiornis molucca*	-
Straw-necked Ibis	*Threskiornis spinicollis*	-
Yellow-billed Spoonbill	*Platalea flavipes*	-
Accipitridae (hawks and eagles)		
Swamp Harrier	*Circus approximans*	-
Rallidae (crakes and rails)		
Buff-banded Rail	*Rallus philippensis*	-
Baillon's Crake	*Porzana pusilla*	-
Australian Spotted Crake	*Porzana fluminea*	-
Spotless Crake	*Porzana tabuensis*	-
Black-tailed Native-hen	*Gallinula ventralis*	-
Dusky Moorhen	*Gallinula tenebrosa*	-
Purple Swamphen	*Porphyrio porphyrio*	-
Eurasian Coot	*Fulica atra*	-

* NCS indicates species of national conservation significance.

Table A2.4a: Wetland bird species known to occur within the project area continued...

Species		Status*
Scolopacidae (sandpipers)		
Marsh Sandpiper	*Tringa stagnatalis*	-
Common Greenshank	*Tringa nebularia*	-
Wood Sandpiper	*Tringa glareola*	-
Common Sandpiper	*Tringa hypoleucos*	-
Red-necked Stint	*Calidris ruficollis*	-
Sharp-tailed Sandpiper	*Calidris acuminata*	-
Recurvirostridae (stilts and avocets)		
Black-winged Stilt	*Himantopus himantopus*	-
Banded Stilt	*Cladorhynchus leucocephalus*	-
Red-necked Avocet	*Recurvirostra novaehollandiae*	-
Charadriidae (lapwings and plovers)		
Red-capped Plover	*Charadrius ruficapillus*	-
Black-fronted Dotterel	*Elseyornis melanops*	-
Laridae (gulls and terns)		
Whiskered Tern	*Chlidonias hybrida*	-
Sylviidae (Old World warblers)		
Clamorous Reed-Warbler	*Acrocephalus stentoreus*	-
Little Grassbird	*Megalurus gramineus*	-

* NCS indicates species of national conservation significance.

Table A2.4b: Dryland bird species known to occur within the project area.

Species		Status*
Dromaiidae (emus)		
Emu	*Dromaius novaehollandiae*	-
Phasianidae (pheasants and quails)		
Stubble Quail	*Coturnix pectoralis*	-
Accipitridae (kites, hawks and eagles)		
Black-shouldered Kite	*Elanus notatus*	-
Square-tailed Kite	*Lophoictinia isura*	NCS
Whistling Kite	*Haliastur sphenurus*	-
Spotted Harrier	*Circus assimilis*	-
Brown Goshawk	*Accipiter fasciatus*	-
Collared Sparrowhawk	*Accipiter cirrhocephalus*	-
Wedge-tailed Eagle	*Aquila audax*	-
Little Eagle	*Hieraaetus morphnoides*	-
Falconidae (falcons)		
Peregrine Falcon	*Falco peregrinus*	NCS
Australian Hobby	*Falco longipennis*	-
Brown Falcon	*Falco berigora*	-
Nankeen Kestrel	*Falco cenchroides*	-
Turnicidae (button-quails)		
Painted Button-quail	*Turnix varia*	-
Little Button-quail	*Turnix velox*	-
Otidae (bustards)		
Australian Bustard	*Ardeotis australis*	-
Charadriidae (lapwings and plovers)		
Banded Lapwing	*Vanellus tricolor*	-

* NCS indicates species of national conservation significance.

Table A2.4b: Dryland bird species known to occur within the project area continued...

Species		Status*
Columbidae (pigeons and doves)		
Rock Dove (Domestic Pigeon)	*Columba livia*	Int.
Laughing Turtle-Dove	*Streptopelia senegalensis*	Int.
Common Bronzewing	*Phaps chalcoptera*	-
Brush Bronzewing	*Phaps elegans*	-
Crested Pigeon	*Ocyphaps lophotes*	-
Cacatuidae (cockatoos)		
Short-billed Black-Cockatoo	*Calyptorhynchus latirostris*	NCS
Galah	*Cacatua roseicapilla*	-
Western Corella	*Cacatua pastinator*	-
Psittacidae (lorikeets and parrots)		
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*	-
Regent Parrot	*Polytelis anthopeplus*	-
Red-capped Parrot	*Purpureicephalus spurius*	-
Western Rosella	*Platycercus icterotis*	-
Australian Ringneck	*Barnardius zonarius*	-
Elegant Parrot	*Neophema elegans*	-
Cuculidae (cuckoos)		
Pallid Cuckoo	*Cuculus pallidus*	-
Fan-tailed Cuckoo	*Cuculus pyrrhophanus*	-
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*	-
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	-
Strigidae (hawk-owls)		
Southern Boobook Owl	*Ninox novaeseelandiae*	-
Barking Owl (southern race)	*Ninox connivens connivens*	NCS

* NCS indicates species of national conservation significance, while Int. indicates introduced species.

Table A2.4b: Dryland bird species known to occur within the project area continued...

Species		Status*
Tytonidae (barn owls)		
Masked Owl	*Tyto novaehollandiae*	NCS
Barn Owl	*Tyto alba*	-
Podargidae (frogmouths)		
Tawny Frogmouth	*Podargus strigoides*	-
Caprimulgidae (nightjars)		
Spotted Nightjar	*Eurostopodus argus*	-
Apodidae (swifts)		
Fork-tailed Swift	*Apus pacificus*	-
Halcyonidae (forest kingfishers)		
Laughing Kookaburra	*Dacelo novaeguineae*	Int.
Sacred Kingfisher	*Todiramphus sanctus*	-
Meropidae (bee-eaters)		
Rainbow Bee-eater	*Merops ornatus*	-
Maluridae (fairy-wrens)		
Splendid Fairy-wren	*Malurus splendens*	-
Variegated Fairy-wren	*Malurus lamberti*	-
Blue-breasted Fairy-wren	*Malurus pulcherrimus*	-
White-winged Fairy-wren	*Malurus leucopterus*	-
Southern Emu-wren	*Stipiturus malachurus*	-

* NCS indicates species of national conservation significance, while Int. indicates introduced species.

Table A2.4b: Dryland bird species known to occur within the project area continued...

Species		Status*
Pardalotidae (pardalotes)		
Spotted Pardalote	*Pardalotus punctatus*	-
Striated Pardalote	*Pardalotus striatus*	-
White-browed Scrubwren	*Sericornis frontalis*	-
Rufous Fieldwren	*Sericornis campestris montanellus*	NCS
Weebill	*Smicrornis brevirostris*	-
Western Gerygone	*Gerygone fusca*	-
Inland Thornbill	*Acanthiza apicalis*	-
Western Thornbill	*Acanthiza inornata*	-
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	-
Meliphagidae (honeyeaters)		
Red Wattlebird	*Anthochaera carunculata*	-
Little Wattlebird	*Anthochaera chrysoptera*	-
Yellow-throated Miner	*Manorina flavigula*	-
Singing Honeyeater	*Lichenostomus virescens*	-
Brown-headed Honeyeater	*Melithreptus brevirostris*	-
White-naped Honeyeater	*Melithreptus lunatus*	-
Brown Honeyeater	*Lichmera indistincta*	-
New Holland Honeyeater	*Phylidonyris novaehollandiae*	-
White-cheeked Honeyeater	*Phylidonyris nigra*	-
Tawny-crowned Honeyeater	*Phylidonyris melanops*	-
Western Spinebill	*Acanthorhynchus superciliosus*	-
Black Honeyeater	*Certhionyx niger*	-
Crimson Chat	*Epthianura tricolor*	-
White-fronted Chat	*Epthianura albifrons*	-

* NCS indicates species of national conservation significance, while Int. indicates introduced species.

Table A2.4b: Dryland bird species known to occur within the project area continued...

Species		Status*
Petroicidae (Australian robins)		
Jacky Winter	*Microeca leucophaea*	-
Scarlet Robin	*Petroica multicolor*	-
Red-capped Robin	*Petroica goodenovii*	-
Hooded Robin	*Melanodryas cucullata*	-
Neosittidae (sittellas)		
Varied Sittella	*Daphoenositta chrysoptera*	-
Pachycephalidae (whistlers)		
Crested Bellbird	*Oreoica gutturalis gutturalis*	NCS
Golden Whistler	*Pachycephala pectoralis*	-
Rufous Whistler	*Pachycephala rufiventris*	-
Grey Shrike-thrush	*Colluricincla harmonica*	-
Dicruridae (flycatchers)		
Restless Flycatcher	*Myiagra inquieta*	-
Magpie-lark	*Grallina cyanoleuca*	-
Grey Fantail	*Rhipidura fuliginosa*	-
Willie Wagtail	*Rhipidura leucophrys*	-
Campephagidae (cuckoo-shrikes)		
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	-
White-winged Triller	*Lalage sueurii*	-
Artamidae (woodswallows)		
Masked Woodswallow	*Artamus personatus*	-
Black-faced Woodswallow	*Artamus cinereus*	-
Dusky Woodswallow	*Artamus cyanopterus*	-
Grey Butcherbird	*Cracticus torquatus*	-
Pied Butcherbird	*Cracticus nigrogularis*	-
Australian Magpie	*Gymnorhina tibicen*	-
Grey Currawong	*Strepera versicolor*	-

* NCS indicates species of national conservation significance.

Table A2.4b: Dryland bird species known to occur within the project area continued...

Species		Status*
Corvidae (ravens and crows)		
Australian Raven	*Corvus coronoides*	-
Little Crow	*Corvus bennetti*	-
Motacillidae (pipits and true wagtails)		
Richard's Pipit	*Anthus novaeseelandiae*	-
Passeridae (finches and allies)		
Zebra Finch	*Taeniopygia guttata*	-
Dicaeidae (flower-peckers)		
Mistletoebird	*Dicaeum hirundinaceum*	-
Hirundinidae (swallows)		
White-backed Swallow	*Cheramoeca leucosternus*	-
Welcome Swallow	*Hirundo neoxena*	-
Tree Martin	*Hirundo nigricans*	-
Fairy Martin	*Hirundo ariel*	-
Sylviidae (Old World warblers)		
Rufous Songlark	*Cincloramphus mathewsi*	-
Brown Songlark	*Cincloramphus cruralis*	-
Zosteropidae (white-eyes)		
Silvereye	*Zosterops lateralis*	-

* NCS indicates species of national conservation significance.

Table A2.5: Mammal species known to occur in the project area.

Species		Status*
Tachyglossidae (echidnas)		
Echidna	Tachyglossus aculeatus	
Dasyuridae		
Chuditch	Dasyurus geoffroii	NCS
Brush-tailed Phascogale	Phascogale tapoatafa	NCS
dunnart	Sminthopsis dolichura	
White-footed Dunnart	Sminthopsis granulipes	
dunnart	Sminthopsis griseoventer	
Peramelidae (bandicoots)		
Quenda or Southern Brown Bandicoot	Isoodon obesulus	NCS
Phalangeridae (possums)		
Brush-tailed Possum	Trichosurus vulpecula	
Burramyidae (pygmy possums)		
Western Pygmy Possum	Cercartetus concinnus	
Tarsipedidae (honey possum)		
Honey Possum	Tarsipes rostratus	
Macropodidae (kangaroos and wallabies)		
Western Grey Kangaroo	Macropus fuliginosus	
Brush or Black-gloved Wallaby	Macropus irma	NCS
Mollosidae (mastiff bats)		
White-striped Bat	Nyctinomus australis	
	Mormopterus planiceps	

* NCS indicates species of national conservation significance.

Table A2.5: Mammal species known to occur in the project area.

Species		Status*
Vespertilionidae (vesper bats)		
Gould's Wattled Bat	*Chalinolobus gouldii*	-
Chocolate Wattled Bat	*Chalinolobus morio*	-
King River Eptesicus	*Vespadelus (Eptesicus) regulus*	-
	Falsistrellus mackenziei	NCS
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	-
Gould's Long-eared Bat	*Nyctophilus gouldii*	-
Greater Long-eared Bat	*Nyctophilus timoriensis*	-
Muridae (rats and mice)		
Rakali or Water Rat	*Hydromys chrysogaster*	NCS
House Mouse	*Mus musculus*	Int.
Noodji or Ashy-grey Mouse	*Pseudomys albocinereus*	-
Black Rat	*Rattus rattus*	Int.
Leporidae (rabbits and hares)		
Rabbit	*Oryctolagus cuniculus*	Int.
Canidae (foxes and dogs)		
European Red Fox	*Vulpes vulpes*	Int.
Felidae (cats)		
Feral Cat	*Felis catus*	Int.

* NCS indicates species of national conservation significance, while Int. indicates introduced species.

Table A2.6: Species believed to be extinct in the general region of the project.

Species		Conservation Status
Megapodiidae (mound-builders)		
Mallee Fowl	*Leipoa ocellata*	Vulv (WA Act, ANZECC and Garnett)
Ardeidae (herons and egrets)		
Black Bittern (South-West)	*Dupetor flavicollis*	Priority 2 (CALM)
Burhinidae (stone-curlews)		
Bush stone-curlew	*Burhinus grallarius*	Priority 4 (CALM), near-Threatened (Garnett)
Psitaccidae (parrots and lorikeets)		
Ground Parrot (South-West)	*Pezoporus wallicus flaviventris*	Vulv (WA Act, ANZECC and Garnett)
Cinclosomatidae (quail-thrushes and allies)		
Western Whipbird	*Psophodes nigrogularis nigrogularis*	End (WA Act, ANZECC), Vuln (Garnett)
Myrmecobiidae (numbat)		
Numbat	*Myrmecobius fasciatus*	Vulv (WA Act, ANZECC)
Thylacomyidae (bilbies or rabbit-eared bandicoots)		
Bilby, Dalgyte or Walpiri	*Macrotis lagotis*	Vulv (WA Act, ANZECC)
Peramelidae (bandicoots)		
Western Barred Bandicoot	*Perameles bougainville*	End (WA Act, ANZECC)
Pseudocheiridae (ring-tailed possums)		
Western Ring-tailed Possum	*Pseudochierus occidentalis*	Vulv (WA Act, ANZECC)
Potoroidae (rat-kangaroos and allies)		
Woylie	*Bettongia penicillata*	Cons Dep (WA Act)
Boodie	*Bettongia lesueur*	Vulv (WA Act, ANZECC)
Macropodidae (kangaroos and wallabies)		
Muning or Banded Hare-Wallaby	*Lagostrophus fasciatus*	Vulv (WA Act, ANZECC)
Mala or Rufous Hare-Wallaby	*Lagostrophus hirsutus*	Cr End (WA Act, ANZECC)
Tammar	*Macropus eugenii*	Cons Dep (WA Act)
Tjawalpa or Crescent Nailtail Wallaby	*Onychogalea lunata*	Extinct
Black-flanked Rock-Wallaby	*Petrogale lateralis*	Vulv (WA Act, ANZECC)
Quokka	*Setonix brachyurus*	Vulv (WA Act, ANZECC)
Muridae (rats and mice)		
Noompa or Big-eared Hopping-Mouse	*Notomys macrotis*	Extinct
Koolawa or Long-tailed Hopping-Mouse	*Notomys longicaudatus*	Extinct
Dayang or Heath Rat	*Pseudomys shortridgei*	Vulv (WA Act)
Canidae (foxes and dogs)		
Dingo	*Canis lupus dingo*	Least Concern

Abbreviations are: Con Dep - Conservation Department; Vuln - Vulnerable; End - Endangered; Cr End - Critically Endangered.

Appendix 3

Categories used in the Recognition of Fauna Conservation Significance

Categories used in the Recognition of Fauna Conservation Significance

WA Wildlife Conservation Act.

Schedule 1. Fauna which is rare or likely to become extinct (taxa also classed according to IUCN categories as Extinct, Critically Endangered, Endangered or Vulnerable).

Schedule 2. Fauna presumed to be extinct.

Schedule 3. Birds protected under an international agreement.

Schedule 4. Other specially protected fauna.

Conservation Dependent. Species that require conservation measures, such as predator control, to maintain their populations.

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

Priority 1. Taxa with few, poorly known populations on threatened lands.

Priority 2. Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.

Priority 3. Taxa with several, poorly known populations, some on conservation lands.

Priority 4. Taxa in need of monitoring.

International Union for the Conservation of Nature and Natural Resources (IUCN) (As refined by Mace and Stuart 1994).

Extinct. Taxa for which there is no reasonable doubt that the last individual has died.

Extinct in the Wild. Taxa that survive only in captivity or in translocated populations outside the original natural range of the species.

Critically Endangered. Taxa facing an extremely high risk of extinction in the wild in the immediate future.

Endangered. Taxa facing a very high risk of extinction in the wild in the near future.

Vulnerable. Taxa facing a high risk of extinction in the wild in the medium-term future.

Threatened. Taxa that are Critically Endangered, Endangered or Vulnerable.

NearThreatened. Taxa that may become Threatened if current trends continue.

Conservation Dependent. Taxa that are not threatened but are dependent upon active conservation measures.

Least Concern. Taxa that are secure.

Appendix 4

Frequently asked questions during the Consultation Process

Q1. Why do we need a new transmission line from Pinjar to Cataby?

The construction of this line is necessary to ensure that the quality and reliability of the power supply in the North Country Region is adequately maintained beyond 2002. \The Region is currently connected to Western Power's metropolitan transmission system via two 132 kV lines.

These two transmission lines are operating close to their power transfer and operating capabilities, and given the anticipated growth in power demand in the Region over the coming years, the ability for these lines to cope with the load growth is expected to diminish by the summer of 2002/2003.

One of the consequences of not building the transmission line would be low voltages on the power system between Muchea and Geraldton. As Western Power has to meet statutory voltage limits the only alternative to building the transmission line would be the installation of equipment to shed large numbers of customers, during Summer and Winter peak electrical load times.

Another consequence of not building the transmission line would be the imposition of limits on electrical load in the region, resulting in constraints to growth and economic development.

The construction of this new transmission line is necessary to support and maintain the anticipated increase in power demand in the Region and mitigate the following problems:

Quality and Reliability of Supply

The design of the existing 132 kV lines does not incorporate overhead earths, and the high isokeraunic levels (electric storms) result in poor local power quality due to numerous fault trips. The proposed new line will be designed to operate in this high isokeraunic region with higher levels of security.

Generation Expansion

Due to transient and dynamic stability limitations, Western Power is unable to add the generation capacity substantially in the North Country area without significantly reinforcing its existing transmission system, or reducing the security of the system. The installation of the transmission line will accommodate the generation expansion in the Region.

Following construction of the Pinjar to Cataby transmission line and other transmission lines to the north of Cataby it will become possible to connect gas powered generators at certain locations to supply customers in the Great Northern Region or at more distant locations on the South West Interconnected System.

New Loads

It is predicted that by 2002/2003 Western Power would not be able to supply new loads in the North Country Region to the current levels of reliability and security. The new transmission line will allow Western Power to accommodate significant or unexpected expansion of residential, commercial and industrial developments in the Region. Developments at Yanchep, Guilderton and Lancelin indicate that expansion along the north coast will continue. Without the proposed new line, regional growth may be constrained and problematic.

Though the transmission line will enable new industrial and commercial loads to be connected to the power system, the primary reason for building the transmission line is to ensure a satisfactory power supply to residential customers and landowners in the region into the foreseeable future.

Q2. Why don't you use the existing structures, which runs up the Brand Hwy?

The existing line was constructed 24 years ago, before the area it traverses was recognised for its significance in terms of its conservation wetlands and extent of mineralisation.

By upgrading the line to carry all of the region's electricity there is a very real risk (especially during high-fire danger periods and periods of lightning activity) of losing supply to the entire region. In effect, you put all your eggs in one basket and the risk of compromise to supply is too high to justify upgrading the existing structures to carry the required additional electrical circuits.

Apart from these very significant reasons, to upgrade the additional structure to cope with the increased load would cost between 50% and 70% more than building a new transmission line on new structures.

Q3. Why doesn't Western Power build the transmission line adjacent to the existing line (i.e. Common Corridor Option) ?

The existing alignment traverses an area of low flying aircraft controlled by the Department of Defence. Though the existing line poses no threat to the safety of these aircraft as the poles are less than 20m in height, the new transmission towers (50m in height) are not acceptable to the Department of Defence on this

alignment. In fact to accommodate the new transmission towers a deviation of at least 3km to the west would be required. Such a diversion would place the alignment within a large area of wetlands classified as Conservation Wetlands by the Water & Rivers Commission. A diversion to the east would not be practical as structures would be limited to a height of no more than 15m.

The Water and Rivers Commission would oppose this option on the grounds that the activity of constructing of new transmission towers in areas of Conservation status wetlands would cause significant damage to these wetlands. An area of 42m by 42m would be affected by tower foundations and tower construction. Towers would be spaced at around 450-500m intervals, however, given the concentration of the wetlands, it would not be possible to construct the towers without impacting significantly on wetlands and fringing wetland vegetation. The impact of new tower construction is much greater than the impacts involved in constructing the existing wood pole transmission line some 24 years ago, and is much greater than current maintenance access impacts.

Mineralisation on this alignment creates a liability in that Western Power could potentially be required to move the line at some future time if minerals are to be mined in the areas within the transmission line easements. An easement adjacent to the existing transmission line would contain areas of mineralisation. Due to the nature of the mineralisation and the mining technique required to mine it, the structures would need to be moved to allow mining in these areas.

Q4. Why doesn't Western Power build the transmission line on the Eastern Option alignment?

As the Eastern Option alignment is common with the an alignment parallel to the existing transmission line up to Beermullah, problems associated with the Common Corridor Option (Q.3), controlled low flight areas and wetlands apply, while issues associated with mineralisation are not as significant. An additional problem with the Eastern Option is the requirement to clear small isolated fragments of remnant vegetation unique to this area. Because this vegetation is tall Marri woodland, extensive clearing would be required. The transmission line conductors could not span such trees.

Q5. Why the Western Option?

The Western Option is preferred by Western Power because it minimises the overall social and environmental impacts.

Approximately 15 landowners would be affected compared with 40 or 50 landowners that would be affected by the other options.

Threats to vegetation can be minimised because vegetation in this area is lower (generally less than 5m in height) than in the other areas. The vegetation that lies between the structures (towers) will not require the same extent of clearing as taller vegetation on other options. The alignment can generally use existing access tracks for construction and future maintenance.

Unlike the Common Corridor and Eastern Options there are no significant problems associated with controlled low flight areas or conservation wetlands.

Q6. Why hasn't Western Power considered the Gingin Coast Structure Plan in its decision making?

Western Power has. Advice from representatives of the consultant conducting the study for the Western Australian Planning Commission and the Ministry for Planning advised Western Power that the alignment proposed for the Western Option is the "best possible" to minimise effects on future landuse plans for the region. The Pinjar-Cataby transmission line is discussed in the second draft of Working Paper No 2 – Infrastructure.

Q7. Why not place the transmission line underground?

The Western Option is 123km in length (75km through private land-the shortest distance through private land of the three options investigated). If Western Power were to underground a double circuit 330kV-transmission line over the entire 123km the cost would be $861M. If Western Power were to underground the sections through private land only, the cost would be $525M. Western Power could not fund either of these undergrounding options despite obvious benefits from reduced clearing. Western Power would certainly not entertain selective undergrounding on some private properties unless this was funded by the property owners concerned.

Q8. Will EMF be a problem?

All wires carrying electrical current generate electric and magnetic fields, including house wiring and general household applicances. After more than 25 years of

epidemiological and other studies no significant relationships between fields and human health effects have been established. It is not possible to prove that no relationship exits between fields and human health. The nature the scientific hypothesis testing is that it is not possible to prove a negative proposition. The levels of electric and magnetic fields at the edge of the transmission line easements are comparable with background levels encountered in normal suburban locations. High numbers of residents in the Perth Metropolitan Area live in close proximity to existing transmission lines.

Q9. Could EMFs from the proposed transmission line affect beekeeping operations?

We understand that there may be biological effects to bees and bee production resulting from electric fields. Information on such effects has been sourced from the International Bee Research Association. This advice suggest that the magnitude of electric fields likely to be produced by the new transmission line would not affect any bee keeping operations including honey production and queen rearing provided hives were located outside the 60m wide transmission line easement.

Q10. Will the transmission line require the clearing of remnant vegetation?

Yes, but the clearing will be minimised on the Western Option by clearing only where it is absolutely necessary for construction and maintenance activities. Clearing will be required around tower bases for construction (a 15m strip outside the tower bases), for access and conductor stringing between the towers, and wherever a safe clearance distance does not exist between vegetation and conductors. Towers will be located approximately 500m apart and a 4m wide strip will be required for access and stringing. The alignment will be located to minimise the effects on significant areas of remnant vegetation.

Proposed Pinjar to Cataby Transmission Line Public Environmental Review

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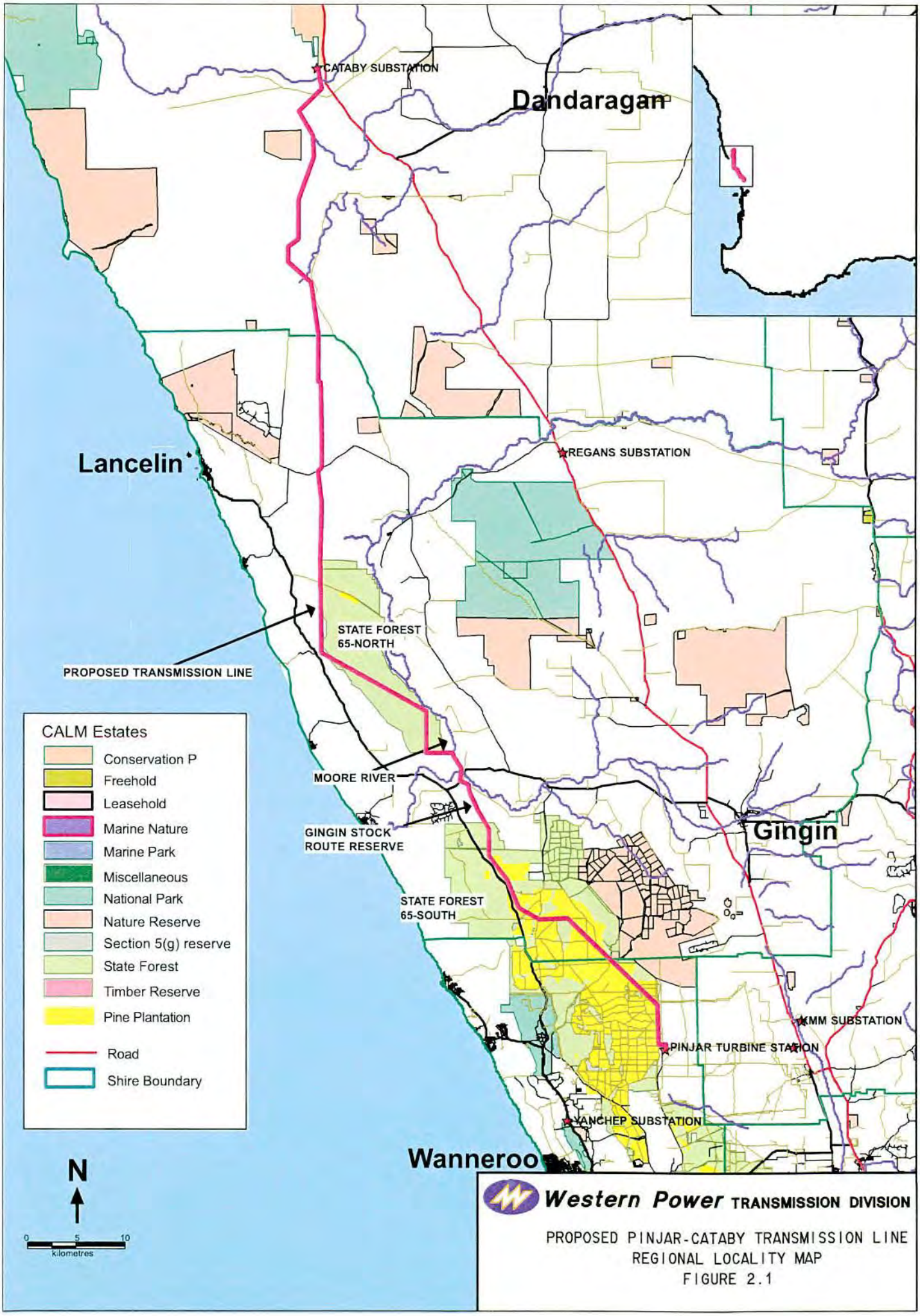
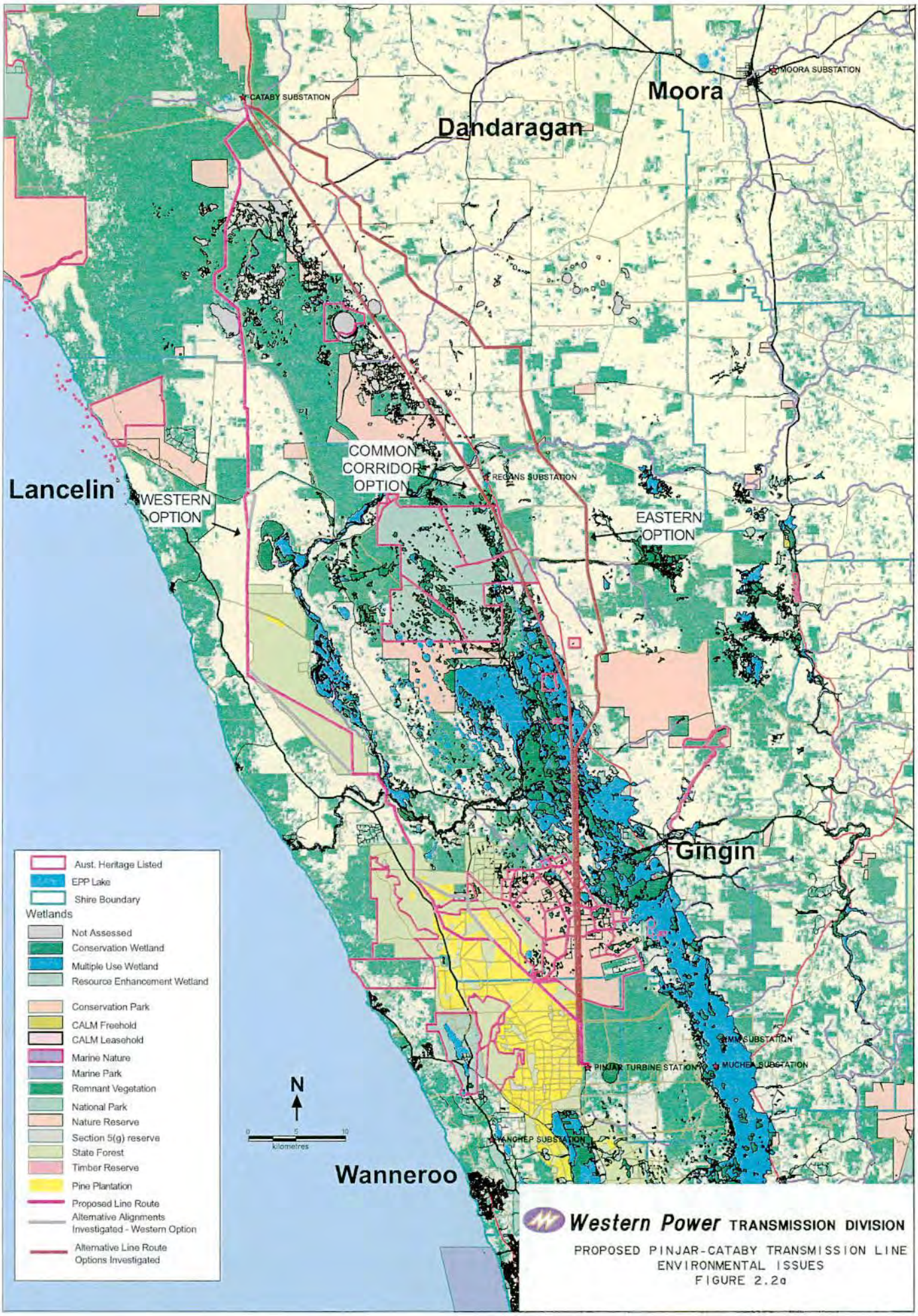


Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
REGIONAL LOCALITY MAP
FIGURE 2.1


CATABY SUBSTATION
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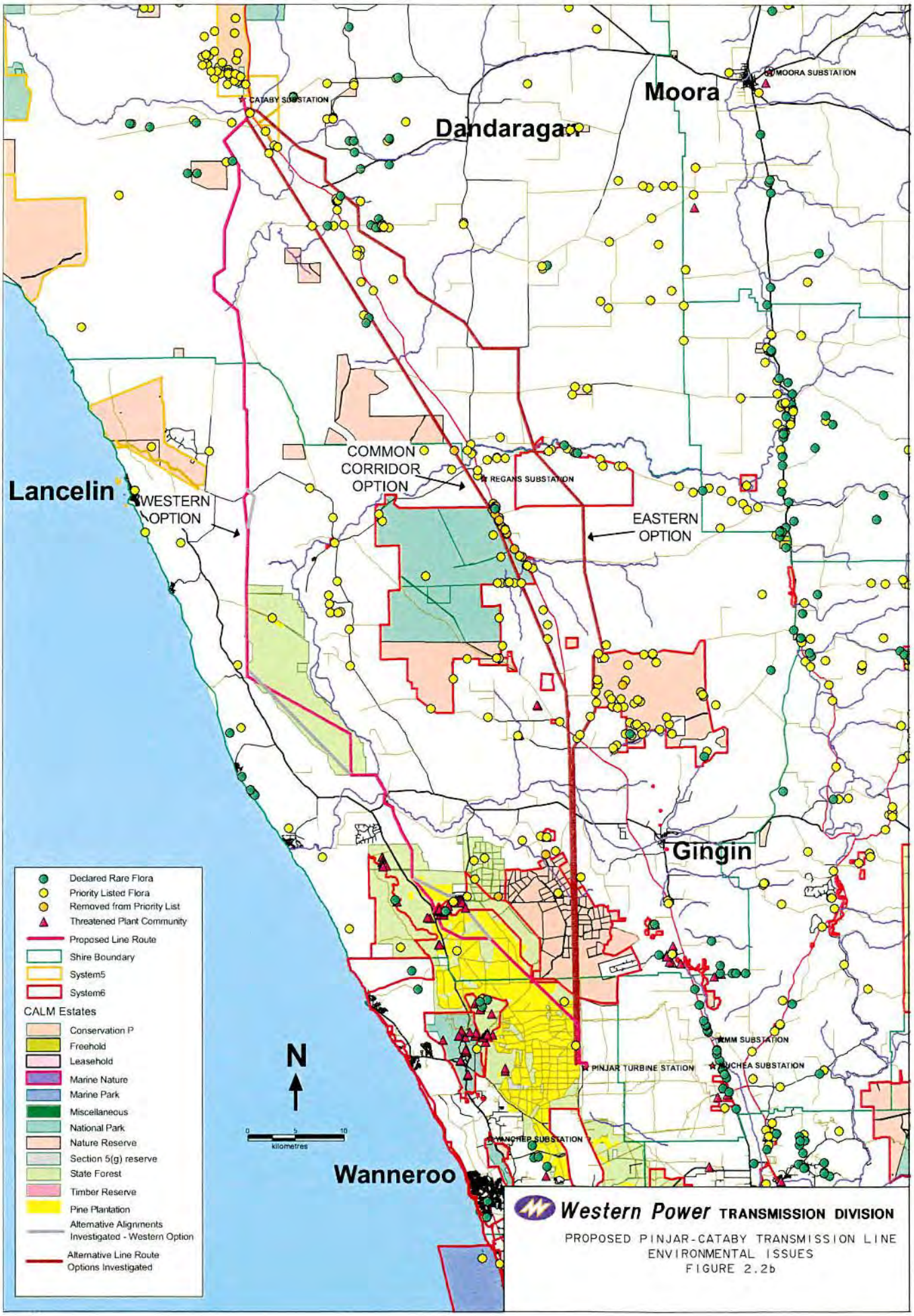
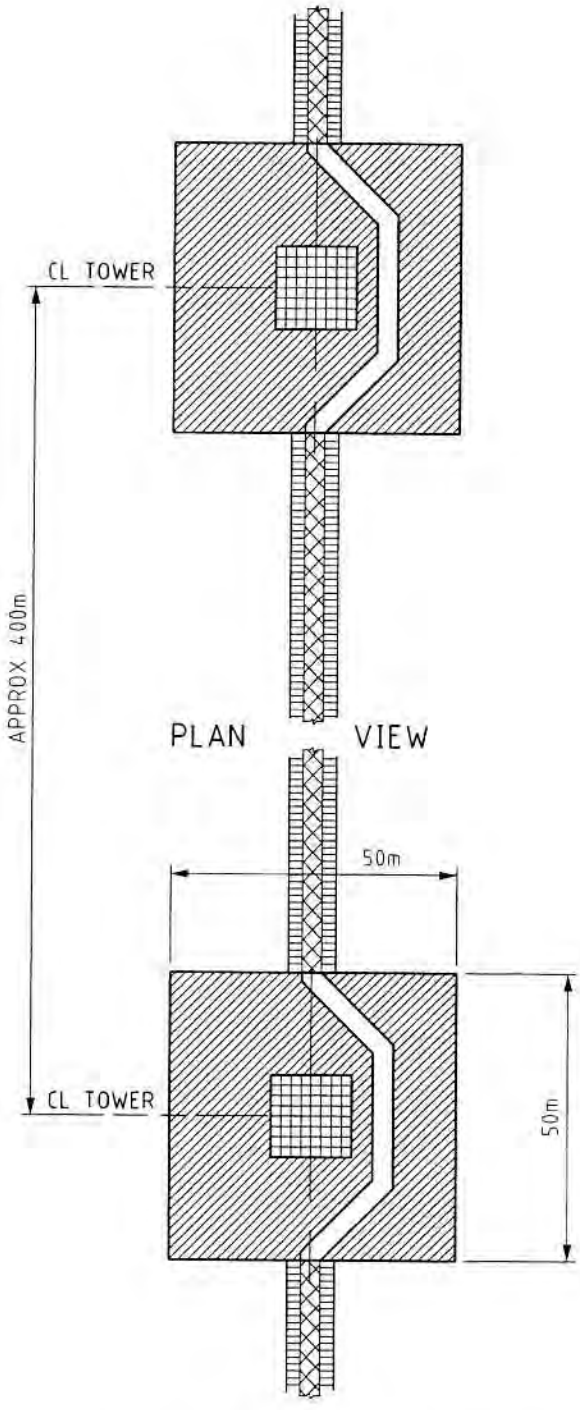
COMMON CORRIDOR OPTION
REGANS SUBSTATION
Lancelin
WESTERN OPTION
EASTERN OPTION
Gingin
MUCHEA SUBSTATION
PINJAR TURBINE STATION
KWINANA SUBSTATION
Wanneroo
N
0 5 10
kilometres
Aust. Heritage Listed
EPP Lake
Shire Boundary
Wetlands
Not Assessed
Conservation Wetland
Multiple Use Wetland
Resource Enhancement Wetland
Conservation Park
CALM Freehold
CALM Leasehold
Marine Nature
Marine Park
Remnant Vegetation
National Park
Nature Reserve
Section 5(g) reserve
State Forest
Timber Reserve
Pine Plantation
Proposed Line Route
Alternative Alignments Investigated - Western Option
Alternative Line Route Options Investigated
Western Power TRANSMISSION DIVISION
PROPOSED PINJAR-CATABY TRANSMISSION LINE
ENVIRONMENTAL ISSUES
FIGURE 2.2a


Moora
MOORA SUBSTATION
CATABY SUBSTATION
Dandaragan
COMMON CORRIDOR OPTION
REGANS SUBSTATION
Lancelin
WESTERN OPTION
EASTERN OPTION
Gingin
MM SUBSTATION
PINJAR TURBINE STATION
MUCHEA SUBSTATION
WANCHEP SUBSTATION
Wanneroo
N
0 5 10
kilometres
Declared Rare Flora
Priority Listed Flora
Removed from Priority List
Threatened Plant Community
Proposed Line Route
Shire Boundary
System5
System6
CALM Estates
Conservation P
Freehold
Leasehold
Marine Nature
Marine Park
Miscellaneous
National Park
Nature Reserve
Section 5(g) reserve
State Forest
Timber Reserve
Pine Plantation
Alternative Alignments Investigated - Western Option
Alternative Line Route Options Investigated
Western Power TRANSMISSION DIVISION
PROPOSED PINJAR-CATABY TRANSMISSION LINE
ENVIRONMENTAL ISSUES
FIGURE 2.2b



LEGEND

= TEMPORARY VEGETATION DISTURBANCE FOR TOWER SITE ACCESS APPROX 2304m²

= PERMANENT VEGETATION CLEARING FOR TOWER SITE 196m² (14m X 14m)

= PERMANENT VEGETATION CLEARING FOR NEW ACCESS TRACK 2m WIDE.

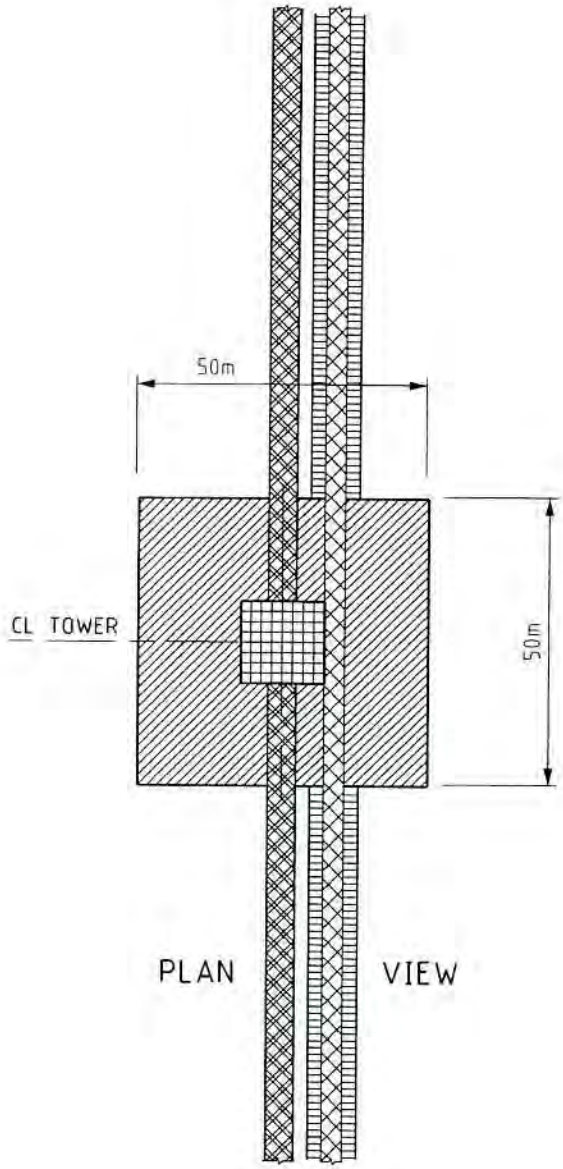
= PERMANENT EXISTING ACCESS TRACK

= TEMPORARY VEGETATION DISTURBANCE AROUND EXISTING ACCESS TRACK (4m WIDE IN TOTAL)

TL_T141
TEK010101.DGN
SR 6/2/01

Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
VEGETATION CLEARING SCENERIO No1
FIGURE 2.3



LEGEND

= TEMPORARY VEGETATION DISTURBANCE FOR TOWER SITE ACCESS APPROX 2304m²

= PERMANENT VEGETATION CLEARING FOR TOWER SITE 196m² (14m X 14m)

= TEMPORARY VEGETATION DISTURBANCE FOR STRINGING ACCESS 2m WIDE.

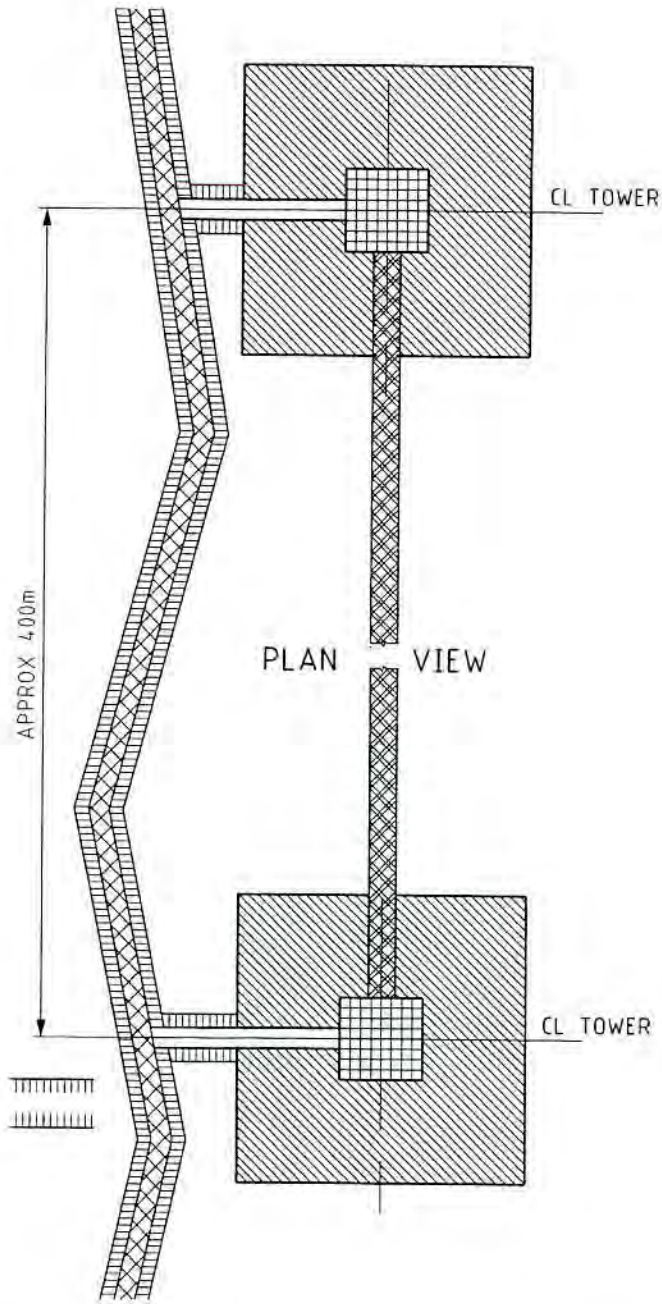
= EXISTING ACCESS TRACK

= TEMPORARY VEGETATION DISTURBANCE AROUND EXISTING ACCESS TRACK (4m WIDE IN TOTAL)

TL_T141
TEK010101.DGN
SR 6/2/01

Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
VEGETATION CLEARING SCENERIO No2
FIGURE 2.4



LEGEND

= TEMPORARY VEGETATION DISTURBANCE FOR TOWER SITE ACCESS APPROX 2304m²

= PERMANENT VEGETATION CLEARING FOR TOWER SITE 196m² (14m X 14m)

= TEMPORARY VEGETATION DISTURBANCE FOR STRINGING ACCESS 2m WIDE.

= PERMANENT VEGETATION CLEARING FOR NEW ACCESS TRACK 2m WIDE.

= TEMPORARY VEGETATION DISTURBANCE AROUND PERMANENT ACCESS TRACK (4m WIDE IN TOTAL)

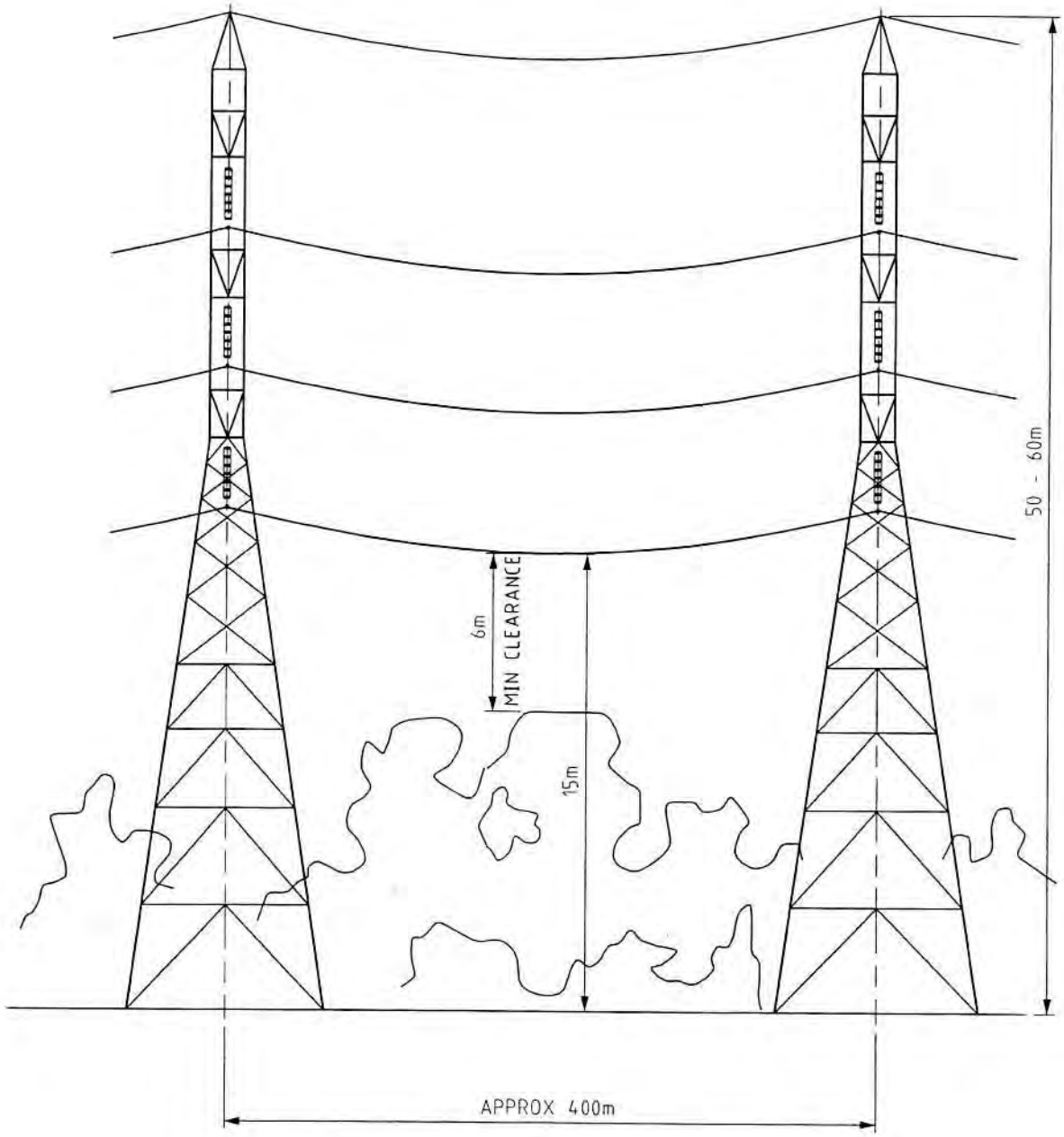
= EXISTING ACCESS TRACK

= TEMPORARY VEGETATION DISTURBANCE AROUND EXISTING ACCESS TRACK (4m WIDE IN TOTAL)

Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
VEGETATION CLEARING SCENERIO No3
FIGURE 2.5

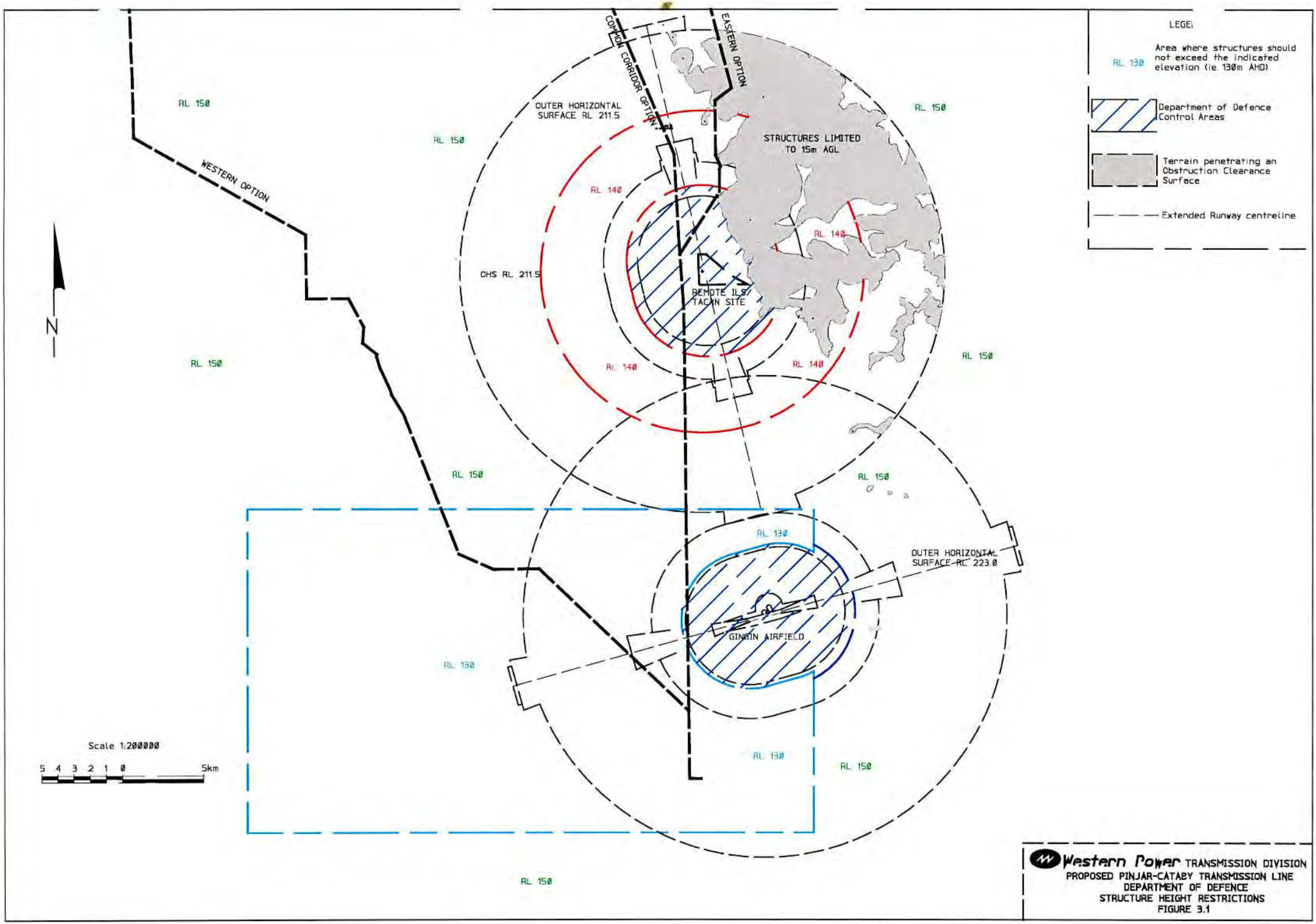
TL_T141
TEK010101.DGN
SR 6/2/01



Western Power TRANSMISSION DIVISION

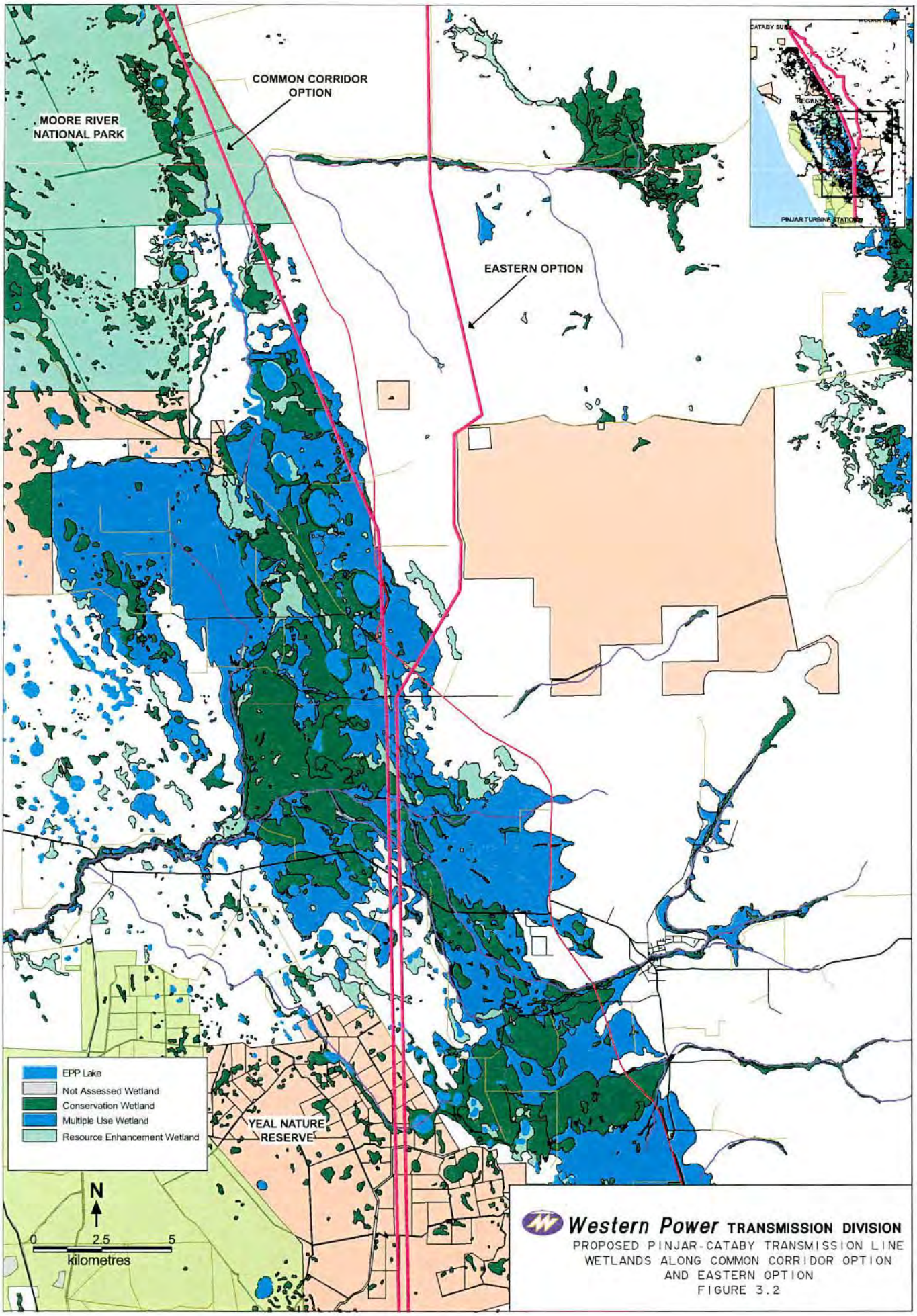
PROPOSED PINJAR-CATABY TRANSMISSION LINE
VEGETATION CLEARING PROFILE
FIGURE 2.6

TL_T141
TEK010101.DGN
SR 6/2/01



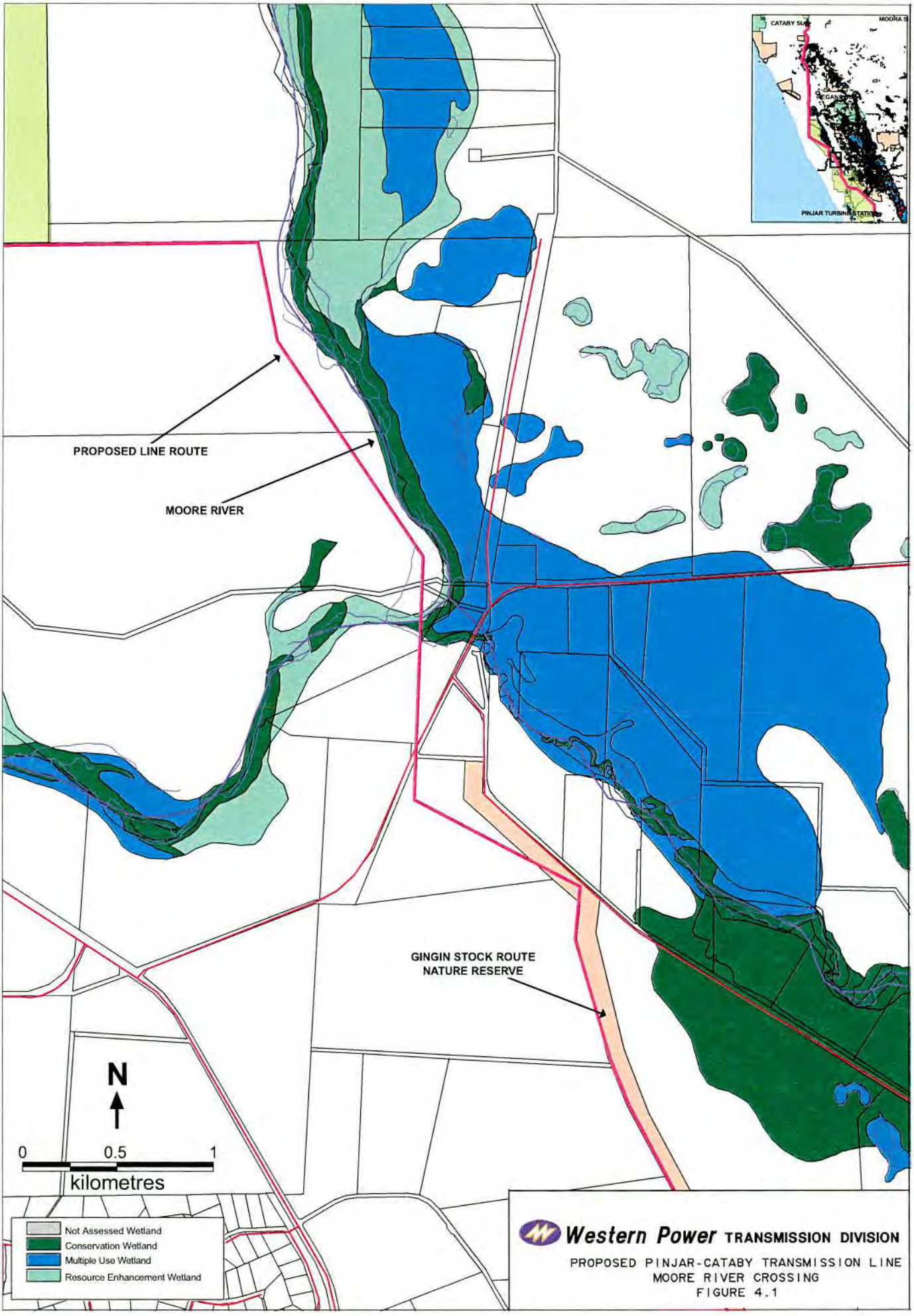
Western Power TRANSMISSION DIVISION

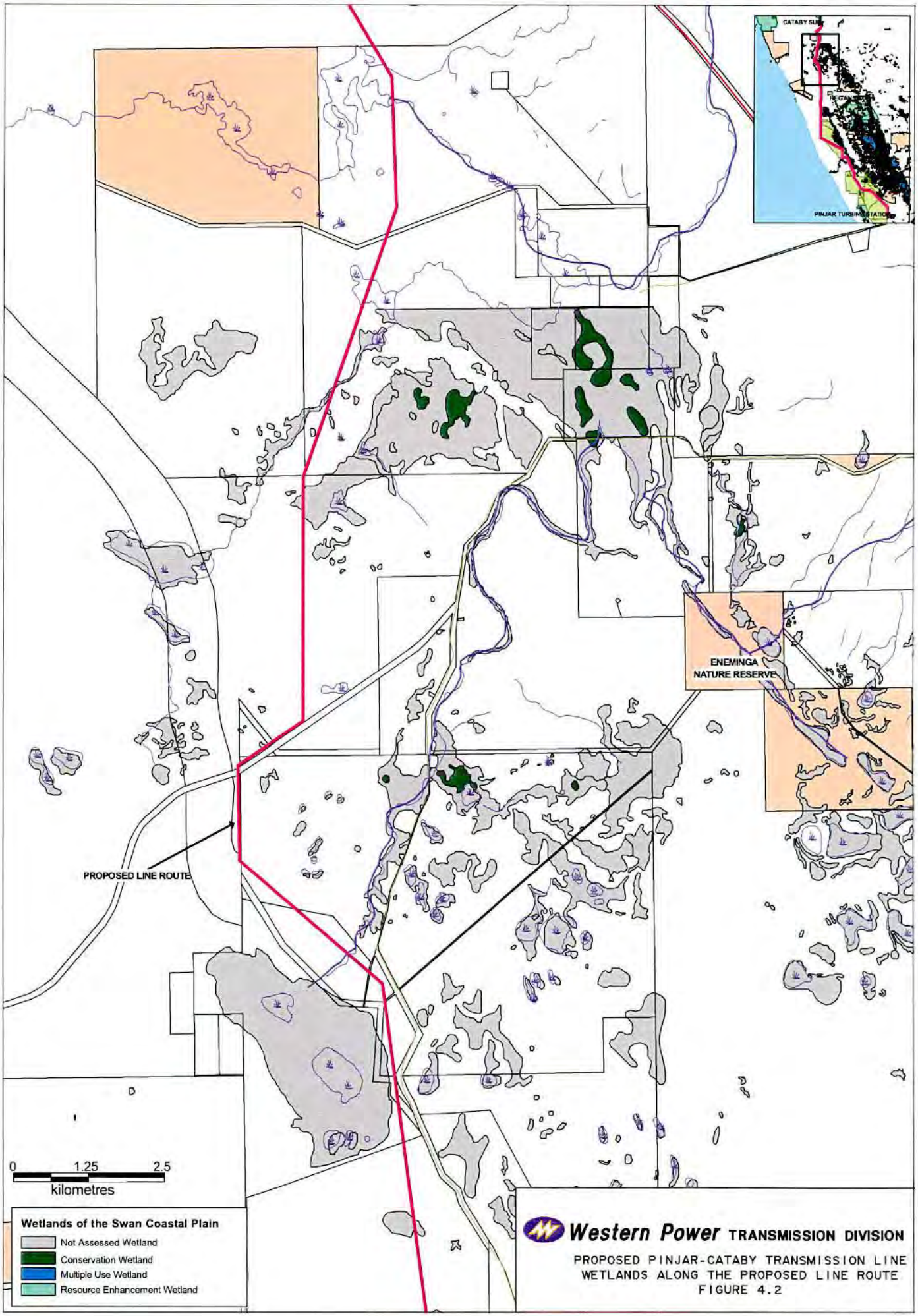
PROPOSED PINJAR-CATABY TRANSMISSION LINE
DEPARTMENT OF DEFENCE
STRUCTURE HEIGHT RESTRICTIONS
FIGURE 3.1

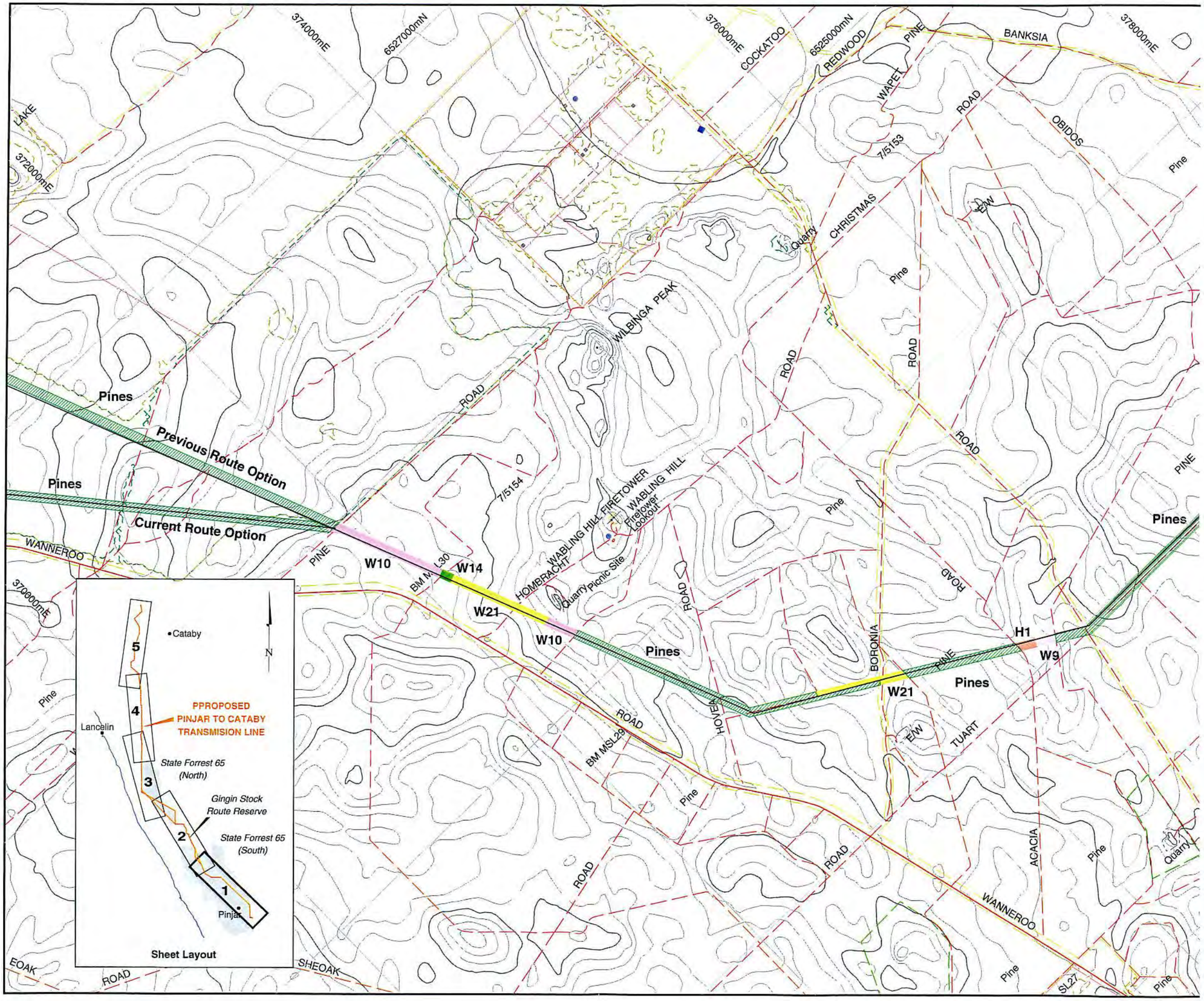


Western Power TRANSMISSION DIVISION

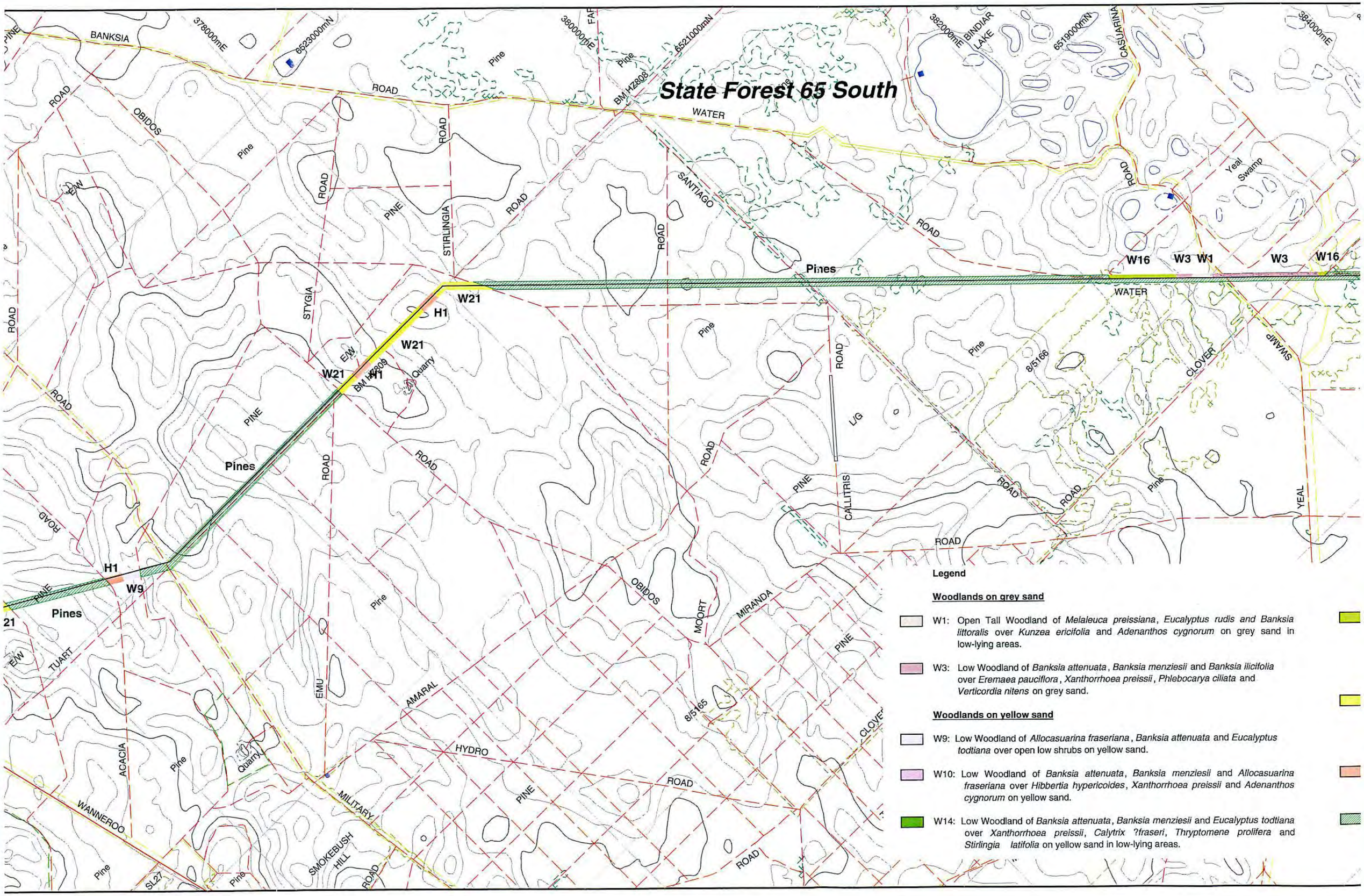
PROPOSED PINJAR-CATABY TRANSMISSION LINE
WETLANDS ALONG COMMON CORRIDOR OPTION
AND EASTERN OPTION
FIGURE 3.2


CATABY SUB
MOORA S
REGANS
PINJAR TURBINE STATION
PROPOSED LINE ROUTE
MOORE RIVER
GINGIN STOCK ROUTE
NATURE RESERVE
N
0
0.5
1
kilometres
Not Assessed Wetland
Conservation Wetland
Multiple Use Wetland
Resource Enhancement Wetland
Western Power TRANSMISSION DIVISION
PROPOSED PINJAR-CATABY TRANSMISSION LINE
MOORE RIVER CROSSING
FIGURE 4.1


CATABY SUB
PINJAR TURBINE STATION
ENEMINGA
NATURE RESERVE
PROPOSED LINE ROUTE
0
1.25
2.5
kilometres
Wetlands of the Swan Coastal Plain
Not Assessed Wetland
Conservation Wetland
Multiple Use Wetland
Resource Enhancement Wetland
Western Power TRANSMISSION DIVISION
PROPOSED PINJAR-CATABY TRANSMISSION LINE
WETLANDS ALONG THE PROPOSED LINE ROUTE
FIGURE 4.2


374000mE
6527000mN
376000mE
COCKATOO
6525000mN
REDWOOD
PINE
BANKSIA
378000mE
WAPET
ROAD
OBIDOS
LAKE
372000mE
7/5153
Pine
CHRISTMAS
Quarry
Pine
WILBINGA PEAK
ROAD
ROAD
ROAD
ROAD
Pines
Previous Route Option
Current Route Option
7/5154
WABLING HILL FIRETOWER
WABLING HILL
Firetower
Lookout
Pine
Pines
WANNEROO
PINE
W10
BM M 30
W14
HOMEBRACHT
Quarry
Picnic Site
W21
W10
ROAD
Pines
BORONIA
H1
W9
PINE
Pines
W21
HOVEA
ROAD
BM MSL29
EW
TUART
Pine
ROAD
ROAD
ACACIA
Pine
Quarry
WANNEROO
370000mE
Pine
EOAK
ROAD
SHEOAK
SL27
Pine
Cataby
N
5
4
3
2
1
PPROPOSED
PINJAR TO CATABY
TRANSMISION LINE
Lancelin
State Forrest 65
(North)
Gingin Stock
Route Reserve
State Forrest 65
(South)
Pinjar
Sheet Layout

State Forest 65 South



Legend

Woodlands on grey sand

W1: Open Tall Woodland of *Melaleuca preissiana*, *Eucalyptus rudis and Banksia littoralis* over *Kunzea ericifolia* and *Adenanthos cygnorum* on grey sand in low-lying areas.

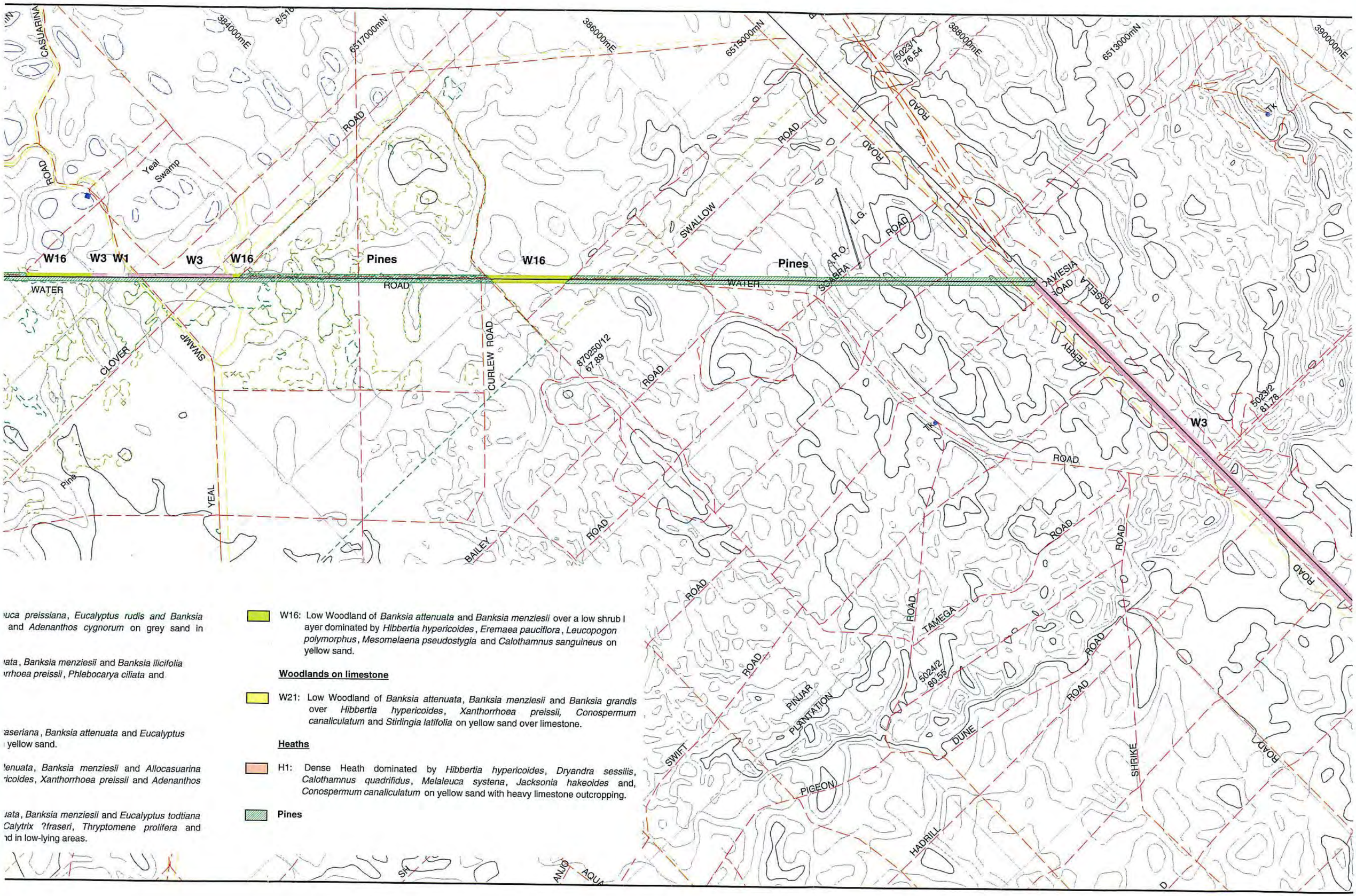
W3: Low Woodland of *Banksia attenuata*, *Banksia menziesii* and *Banksia ilicifolia* over *Eremaea pauciflora*, *Xanthorrhoea preissii*, *Phlebocarya ciliata* and *Verticordia nitens* on grey sand.

Woodlands on yellow sand

W9: Low Woodland of *Allocasuarina fraseriana*, *Banksia attenuata* and *Eucalyptus todtiana* over open low shrubs on yellow sand.

W10: Low Woodland of *Banksia attenuata*, *Banksia menziesii* and *Allocasuarina fraseriana* over *Hibbertia hypericoides*, *Xanthorrhoea preissii* and *Adenanthos cygnorum* on yellow sand.

W14: Low Woodland of *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* over *Xanthorrhoea preissii*, *Calytrix ?fraseri*, *Thryptomene prolifera* and *Stirlingia latifolia* on yellow sand in low-lying areas.



uca preissiana, *Eucalyptus rudis and Banksia* and *Adenanthos cygnorum* on grey sand in

ata, *Banksia menziesii* and *Banksia ilicifolia* *rrhoea preissii*, *Phlebocarya ciliata* and

aseriana, *Banksia attenuata* and *Eucalyptus* yellow sand.

enuata, *Banksia menziesii* and *Allocasuarina icoides*, *Xanthorrhoea preissii* and *Adenanthos*

ata, *Banksia menziesii* and *Eucalyptus todtiana* *Calytrix ?fraseri*, *Thryptomene prolifera* and nd in low-lying areas.

W16: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over a low shrub l ayer dominated by *Hibbertia hypericoides*, *Eremaea pauciflora*, *Leucopogon polymorphus*, *Mesomelaena pseudostygia* and *Calothamnus sanguineus* on yellow sand.

Woodlands on limestone

W21: Low Woodland of *Banksia attenuata*, *Banksia menziesii* and *Banksia grandis* over *Hibbertia hypericoides*, *Xanthorrhoea preissii*, *Conospermum canaliculatum* and *Stirlingia latifolia* on yellow sand over limestone.

Heaths

H1: Dense Heath dominated by *Hibbertia hypericoides*, *Dryandra sessilis*, *Calothamnus quadrifidus*, *Melaleuca systena*, *Jacksonia hakeoides* and, *Conospermum canaliculatum* on yellow sand with heavy limestone outcropping.

Pines

Western Power

PINJAR TO CATABY TRANSMISSION LINE
VEGETATION MAPPING
Sheet 1 of 5

WOODMAN ENVIRONMENTAL CONSULTING PTY LTD
A.C.N.088 055 903
4 Millcroft Elbow, Jandakot W.A. 6164
Tel: (08) 9414 1688 ~ Fax: (08) 9414 1699

Author: D. Woodman	Date: Feb 2001	Scale: 1:25,000
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202		Figure: **4.3**
CAD Ref: j562WV_1.dgn	Revision: A A3+	

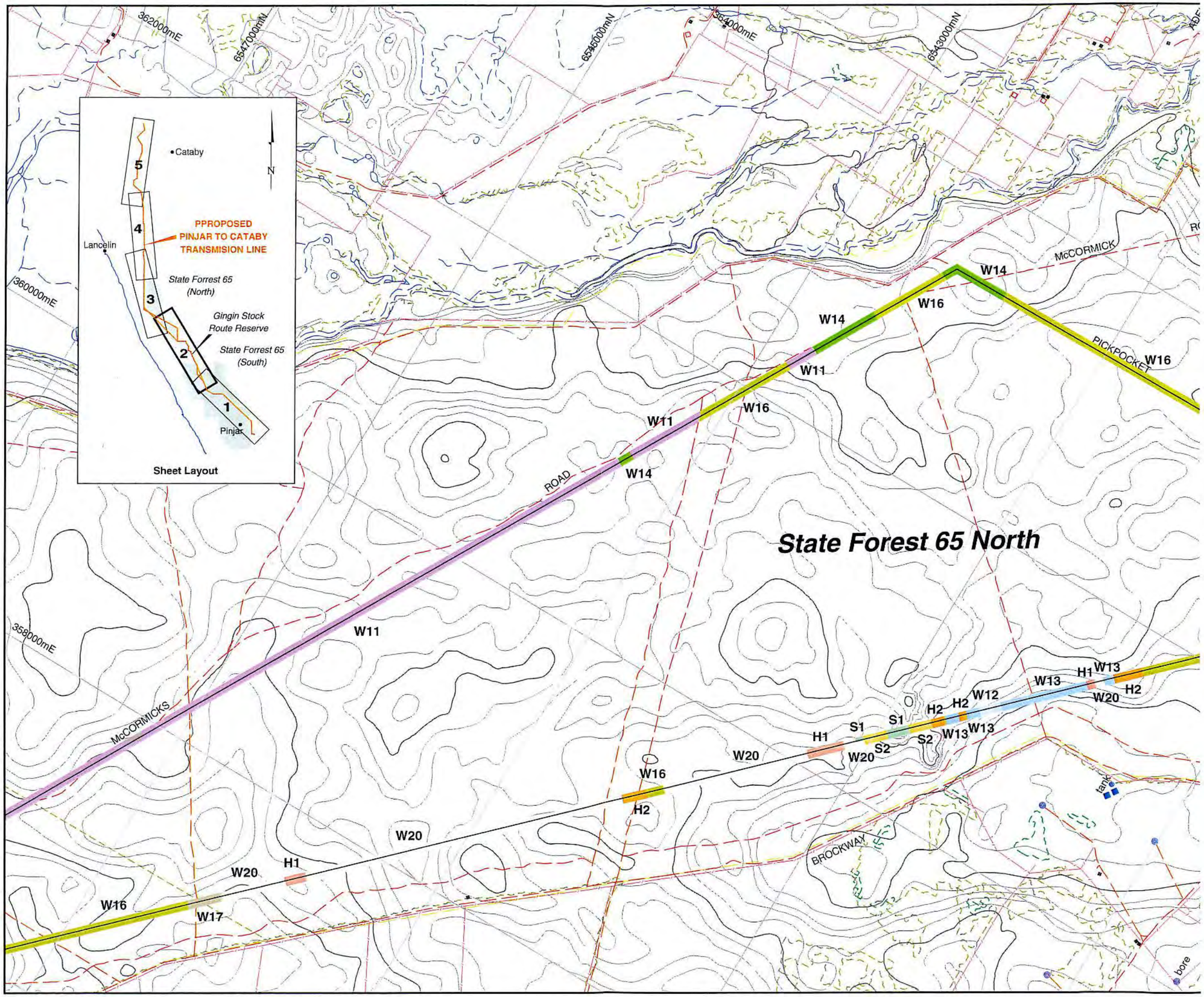
iesii over a low shrub l
ıciflora, *Leucopogon*
nnus sanguineus on

esii and *Banksia grandis*
preissii, *Conospermum*
r limestone.

les, *Dryandra sessilis*,
ksonia hakeoides and,
limestone outcropping.

0 0.5 1.0 1.5km
SCALE

State Forest 65 North



rest 65 North

Legend

Forests

F4: Dense Forest of *Eucalyptus rudis*, *Melaleuca rhaphiophylla* and *Banksia prionotes* over weed species, along the Moore River.

Woodlands on grey sand

W6: Open Low Woodland of *Banksia menziesii* and *Banksia attenuata* over a tall shrub layer dominated by *Adenanthos cygnorum* over *Hibbertia hypericoides* and *Eremaea pauciflora* on grey sand.

W6d: Areas of type W6 that have been modified through disturbances such as clearing, grazing or burning.

Woodlands on yellow sand

W10: Low Woodland of *Banksia attenuata*, *Banksia menziesii* and *Allocasuarina fraseriana* over *Hibbertia hypericoides*, *Xanthorrhoea preissii* and *Adenanthos cygnorum* on yellow sand.

W11: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over mixed shrubs dominated by *Xanthorrhoea preissii*, *Hibbertia hypericoides*, *Eremaea pauciflora*, *Stirlingia latifolia* and *Mesomelaena pseudostygia* on yellow sand.

W12: Low Woodland of *Eucalyptus todtiana*, *Banksia attenuata* and *Banksia grandis* over *Jacksonia sternbergiana*, *Hibbertia hypericoides* and *Xanthorrhoea preissii* on yellow sand.

W13: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over *Jacksonia sternbergiana*, *Hibbertia hypericoides* and *Xanthorrhoea preissii* on yellow sand.

W14: Low Woodland of *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* over *Xanthorrhoea preissii*, *Calytrix ?fraseri*, *Thryptomene prolifera* and *Stirlingia latifolia* on yellow sand in low-lying areas.

rudis, *Melaleuca rhaphiophylla* and *Banksia prionotes*
e Moore River.

Banksia menziesii and *Banksia attenuata* over a tall
Adenanthos cygnorum over *Hibbertia hypericoides* and
y sand.

e been modified through disturbances such as
g.

attenuata, *Banksia menziesii* and *Allocasuarina*
ypericoides, *Xanthorrhoea preissii* and *Adenanthos*

attenuata and *Banksia menziesii* over mixed shrubs
a preissii, *Hibbertia hypericoides*, *Eremaea pauciflora*,
melaena pseudostygia on yellow sand.

tus todtiana, *Banksia attenuata* and *Banksia grandis*
na, *Hibbertia hypericoides* and *Xanthorrhoea preissii*

attenuata and *Banksia menziesii* over *Jacksonia*
ypericoides and *Xanthorrhoea preissii* on yellow sand.

attenuata, *Banksia menziesii* and *Eucalyptus todtiana*
, *Calytrix ?fraseri*, *Thryptomene prolifera* and *Stirlingia*
w-lying areas.

W16: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over a low shrub layer dominated by *Hibbertia hypericoides*, *Eremaea pauciflora*, *Leucopogon polymorphus*, *Mesomelaena pseudostygia* and *Calothamnus sanguineus* on yellow sand.

W17: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over *Hibbertia hypericoides*, *Hakea costata*, *Hakea trifurcata* and *Mesomelaena pseudostygia* on yellow sand.

Woodlands on limestone

W20: Open Low Woodland of *Banksia attenuata* and *Banksia menziesii* over *Jacksonia hakeoides*, *Melaleuca systena*, *Acacia lasiocarpa*, *Calothamnus quadrifidus* and *Conospermum canaliculatum* on yellow sand with occasional limestone outcropping.

W21: Low Woodland of *Banksia attenuata*, *Banksia menziesii* and *Banksia grandis* over *Hibbertia hypericoides*, *Xanthorrhoea preissii*, *Conospermum canaliculatum* and *Stirlingia latifolia* on yellow sand over limestone.

Shrublands

S1: Shrubland of *Melaleuca systena* and *Melaleuca huegelii* subsp. *huegelii* on limestone ridges.

S2: Shrubland of *Dryandra sessilis*, *Melaleuca systena*, *Baeckea ?robusta* and *Diplolaena angustifolia* on yellow sand with limestone outcropping.

S4: Dense Shrubland of *Hakea trifurcata* over low shrubs and weeds on yellow sand with limestone outcropping.

Heaths

H1: Dense Heath dominated by *Hibbertia hypericoides*, *Dryandra sessilis*, *Calothamnus quadrifidus*, *Melaleuca systena*, *Jacksonia hakeoides* and, *Conospermum canaliculatum* on yellow sand with heavy limestone outcropping.

H2: Dense Heath dominated by *Jacksonia hakeoides* on yellow sand.

Disturbed

D2: Borrow Pit

Pines

Western Power

PINJAR TO CATABY TRANSMISSION LINE
VEGETATION MAPPING
Sheet 2 of 5

WOODMAN ENVIRONMENTAL CONSULTING PTY LTD
A.C.N.088 055 903
4 Millcroft Elbow, Jandakot W.A. 6164
Tel: (08) 9414 1688 ~ Fax: (08) 9414 1699

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CAD Ref: j562WV_2.dgn	Revision: A A3+	

and *Banksia menziesii* over a low shrub
oides, *Eremaea pauciflora*, *Leucopogon*
stygia and *Calothamnus sanguineus* on

and *Banksia menziesii* over *Hibbertia*
a trifurcata and *Mesomelaena pseudostygia*

ia attenuata and *Banksia menziesii* over
systena, *Acacia lasiocarpa*, *Calothamnus*
naliculatum on yellow sand with occasional

ata, *Banksia menziesii* and *Banksia grandis*
Xanthorrhoea preissii, *Conospermum*
on yellow sand over limestone.

and *Melaleuca huegelii* subsp. *huegelii* on

Melaleuca systena, *Baeckea ?robusta* and
nd with limestone outcropping.

a over low shrubs and weeds on yellow sand

Heaths

H1: Dense Heath dominated by *Hibbertia hypericoides*, *Dryandra sessilis*, *Calothamnus quadrifidus*, *Melaleuca systena*, *Jacksonia hakeoides* and, *Conospermum canaliculatum* on yellow sand with heavy limestone outcropping.

H2: Dense Heath dominated by *Jacksonia hakeoides* on yellow sand.

Disturbed

D2: Borrow Pit

Pines

State Forest 65 South

W14
W16
W16
W14
W16
Previous Route Option
Pines
W10
W21
W10
Pines
Current Route Option
Pines
W14
WANNEROO
ROAD
ROAD
ROAD
PINE
Pine
WABLING
WABLING HILL FIRETOWER
Firetower Lookout
HOMBRACHT
Quarry
Picnic Site
BM MSL33
BM MSL31
BM MSL30
BM MSL29
WILBIN
BARRACOON LAKE
COPPINO LAKE
7/5154
7/5155
6/5190
6531000mN
6529000mN
6527000mN
6525000mN
372000mE
374000mE

0 0.5 1.0 1.5km
SCALE

W19

W18

RD

GARAGAN LAKE

D3

RD

LAKES

E.W.

MAST

E.W.

E.W.

5

4

3

2

1

• Cataby

N

PPROPOSED
PINJAR TO CATABY
TRANSMISION LINE

Lancelin

State Forrest 65
(North)

Gingin Stock
Route Reserve

State Forrest 65
(South)

Pinjar

Sheet Layout

Legend

W11: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over mixed shrubs dominated by *Xanthorrhoea preissii*, *Hibbertia hypericoides*, *Eremaea pauciflora*, *Stirlingia latifolia* and *Mesomelaena pseudostygia* on yellow sand.

W16: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over a low shrub layer dominated by *Hibbertia hypericoides*, *Eremaea pauciflora*, *Leucopogon polymorphus*, *Mesomelaena pseudostygia* and *Calothamnus sanguineus* on yellow sand.

W17: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over *Hibbertia hypericoides*, *Hakea costata*, *Hakea trifurcata* and *Mesomelaena pseudostygia* on yellow sand.

W18: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over low shrubs dominated by *Eremaea pauciflora*, *Stirlingia latifolia*, *Xanthorrhoea preissii* and *Conospermum canaliculatum* on yellow sand.

W19: Open Low Woodland of *Banksia ilicifolia* over low shrubs dominated by *Xanthorrhoea preissii* on yellow sand in low-lying areas.

Woodlands on limestone

W20: Open Low Woodland of *Banksia attenuata* and *Jacksonia hakeoides*, *Melaleuca systena*, *Acacia quadrifidus* and *Conospermum canaliculatum* on yel limestone outcropping.

Shrublands

S1: Shrubland of *Melaleuca systena* and *Melaleuca hu* limestone ridges.

Heaths

H1: Dense Heath dominated by *Hibbertia hypericoi* *Calothamnus quadrifidus*, *Melaleuca systena*, *Jac* *Conospermum canaliculatum* on yellow sand with heav

Disturbed

D3: Banksia Woodland areas so disturbed by clearing, gr or none of the original understorey layer is remaining.

GARAGAN LAKE

DEBURGH RD

YANGTSE RD

BENNIES RD

GARBANUP RD

W17

W16

W17

H1

W17

E.W.

E.W.

E.W.

E.W.

E.W.

E.W.

BENNIES RD

RD

Woodlands on limestone

W20: Open Low Woodland of *Banksia attenuata* and *Banksia menziesii* over *Jacksonia hakeoides*, *Melaleuca systena*, *Acacia lasiocarpa*, *Calothamnus quadrifidus* and *Conospermum canaliculatum* on yellow sand with occasional limestone outcropping.

Shrublands

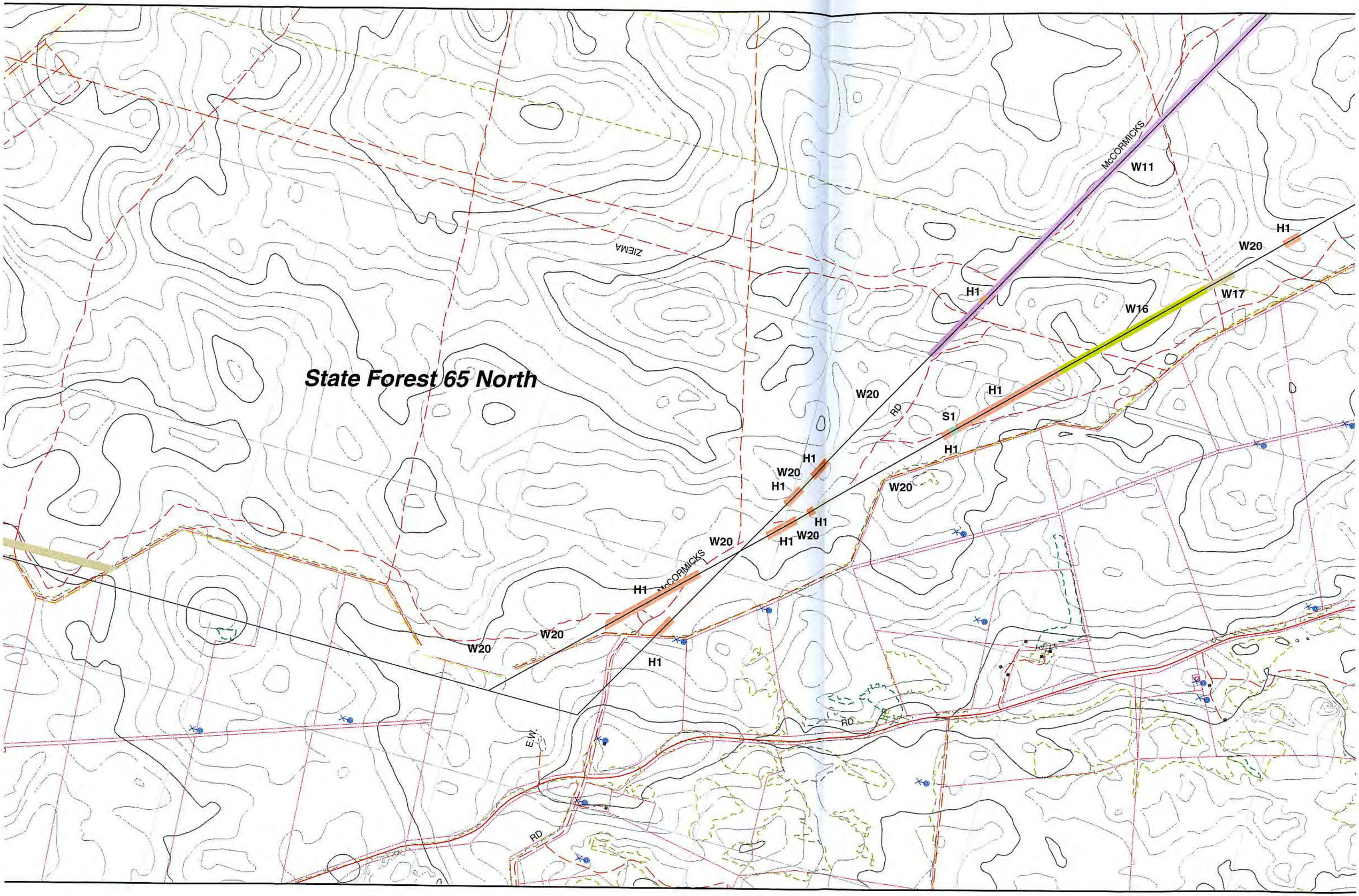
S1: Shrubland of *Melaleuca systena* and *Melaleuca huegelii* subsp. *huegelii* on limestone ridges.

Heaths

H1: Dense Heath dominated by *Hibbertia hypericoides*, *Dryandra sessilis*, *Calothamnus quadrifidus*, *Melaleuca systena*, *Jacksonia hakeoides* and, *Conospermum canaliculatum* on yellow sand with heavy limestone outcropping.

Disturbed

D3: Banksia Woodland areas so disturbed by clearing, grazing or burning that little or none of the original understorey layer is remaining.


State Forest 65 North
ZIEMA
McCORMICKS
W11
H1
W20
H1
W17
W16
W20
RD
S1
H1
H1
W20
H1
W20
H1
W20
H1
W20
H1
W20
H1
W20
RD
E.W.
RD

Western Power

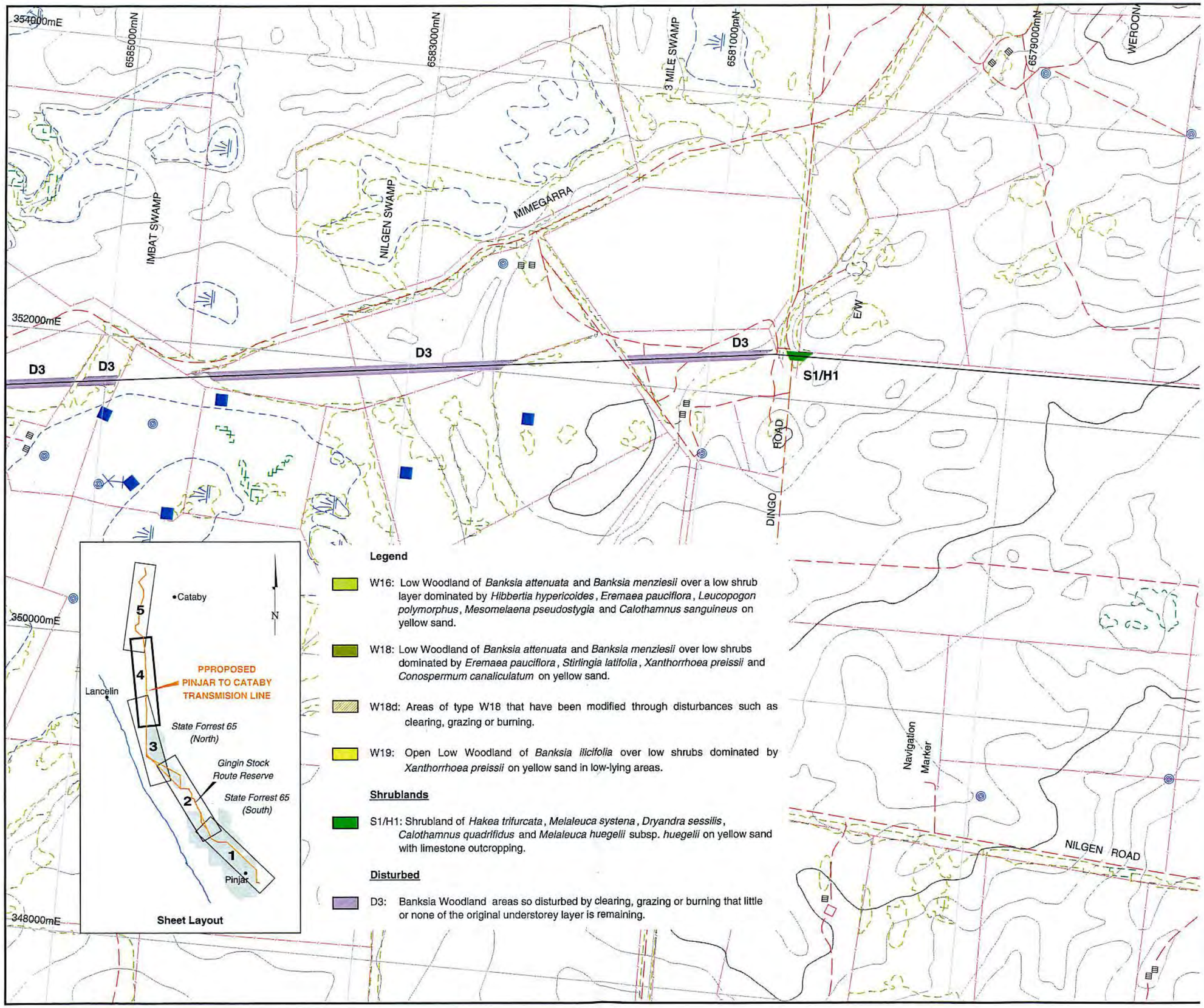
PINJAR TO CATABY TRANSMISSION LINE
VEGETATION MAPPING
Sheet 3 of 5

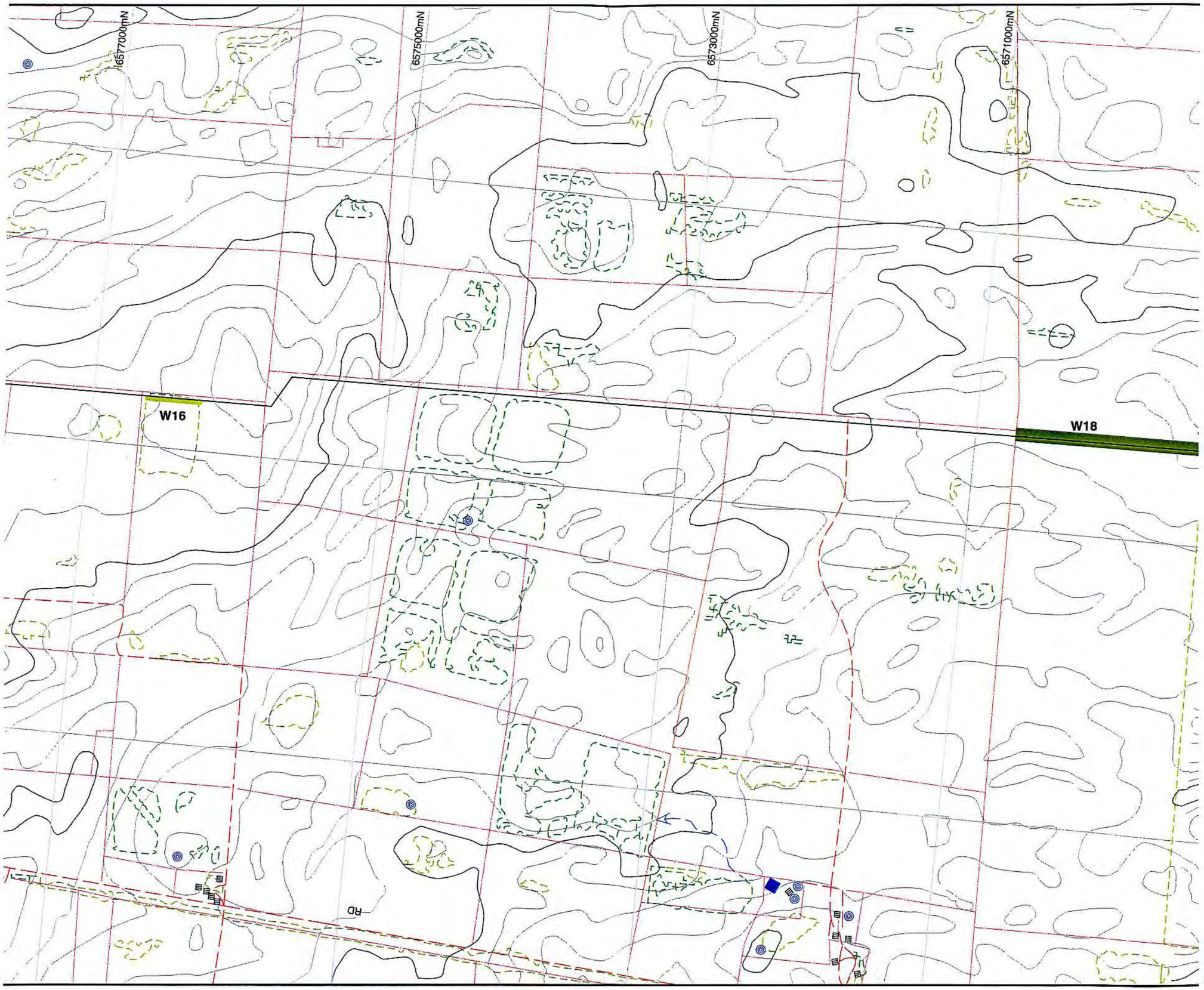
WOODMAN ENVIRONMENTAL CONSULTING PTY LTD
A.C.N.088 055 903
4 Millcroft Elbow, Jandakot W.A. 6164
Tel: (08) 9414 1688 ~ Fax: (08) 9414 1699

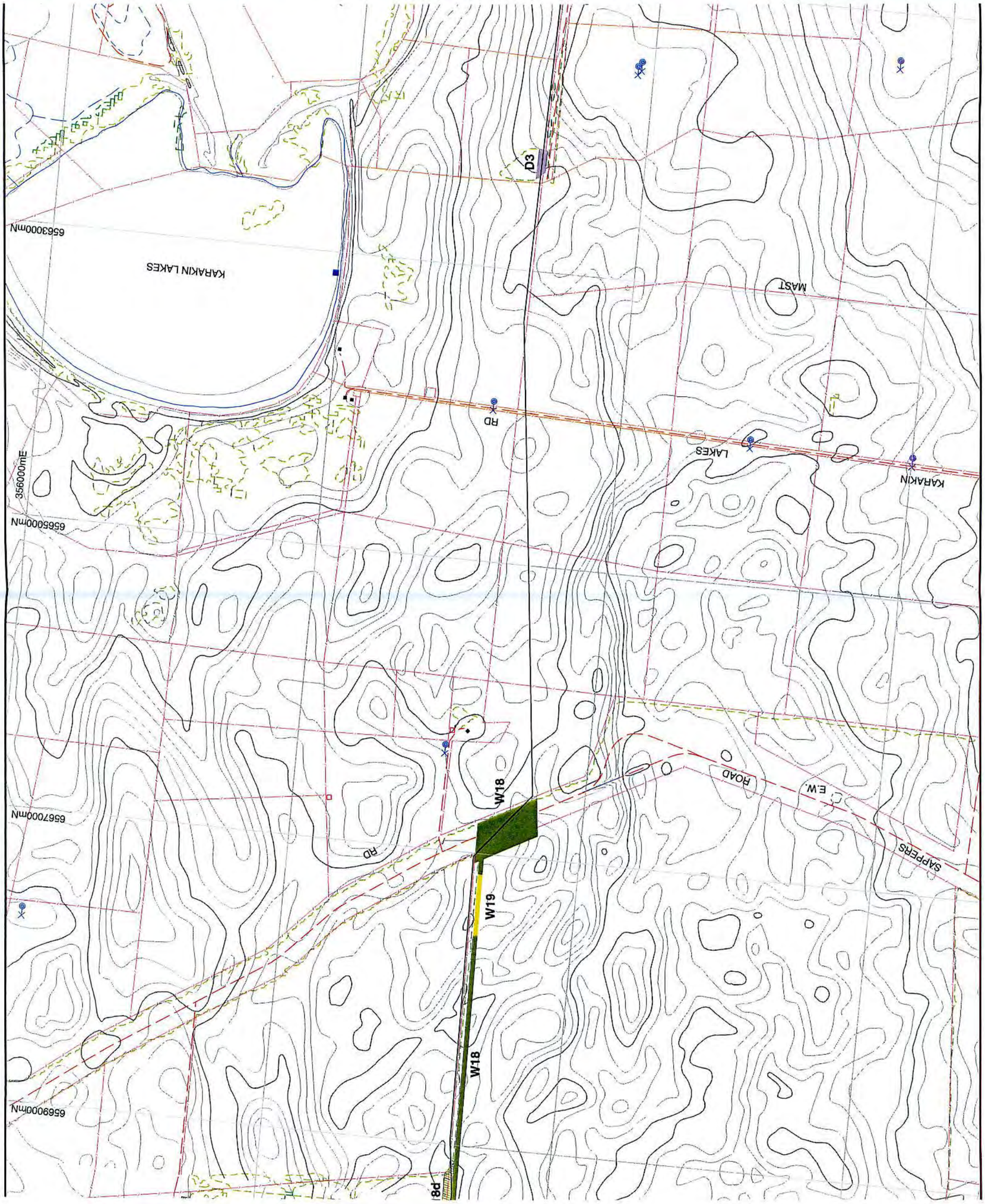
Author: D. Woodman	Date: Feb 2001	Scale: 1:25,000
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202		Figure: 4.5
CAD Ref: j562WV_3.dgn	Revision: A A3+	

McCORMICKS
ZIEMA
EDWARDS RD.
ROAD
EDWARDS
LANCELIN
E.W.
RD
W11
W16
W17
W20
H1
S1

0 0.5 1.0 1.5km
SCALE


354000mE
6585000mN
6583000mN
6581000mN
6579000mN
WEROONA
3 MILE SWAMP
IMBAT SWAMP
NILGEN SWAMP
MIMEGARRA
352000mE
D3
D3
D3
D3
S1/H1
E/W
ROAD
DINGO
Navigation Marker
NILGEN ROAD
350000mE
348000mE
Cataby
Lancelin
Pinjar
N
5
4
3
2
1
PPROPOSED
PINJAR TO CATABY
TRANSMISION LINE
State Forrest 65
(North)
Gingin Stock
Route Reserve
State Forrest 65
(South)
Sheet Layout
Legend
W16: Low Woodland of Banksia attenuata and Banksia menziesii over a low shrub layer dominated by Hibbertia hypericoides, Eremaea pauciflora, Leucopogon polymorphus, Mesomelaena pseudostygia and Calothamnus sanguineus on yellow sand.
W18: Low Woodland of Banksia attenuata and Banksia menziesii over low shrubs dominated by Eremaea pauciflora, Stirlingia latifolia, Xanthorrhoea preissii and Conospermum canaliculatum on yellow sand.
W18d: Areas of type W18 that have been modified through disturbances such as clearing, grazing or burning.
W19: Open Low Woodland of Banksia ilicifolia over low shrubs dominated by Xanthorrhoea preissii on yellow sand in low-lying areas.
Shrublands
S1/H1: Shrubland of Hakea trifurcata, Melaleuca systena, Dryandra sessilis, Calothamnus quadrifidus and Melaleuca huegelii subsp. huegelii on yellow sand with limestone outcropping.
Disturbed
D3: Banksia Woodland areas so disturbed by clearing, grazing or burning that little or none of the original understorey layer is remaining.


6577000mN
6575000mN
6573000mN
6571000mN
W16
W18
RD


KARAKIN LAKES
6563000mN
6565000mN
6567000mN
6569000mN
356000mE
D3
MAST
RD
LAKES
KARAKIN
W18
ROAD
E.W.
SAPPERS
W19
W18
P8

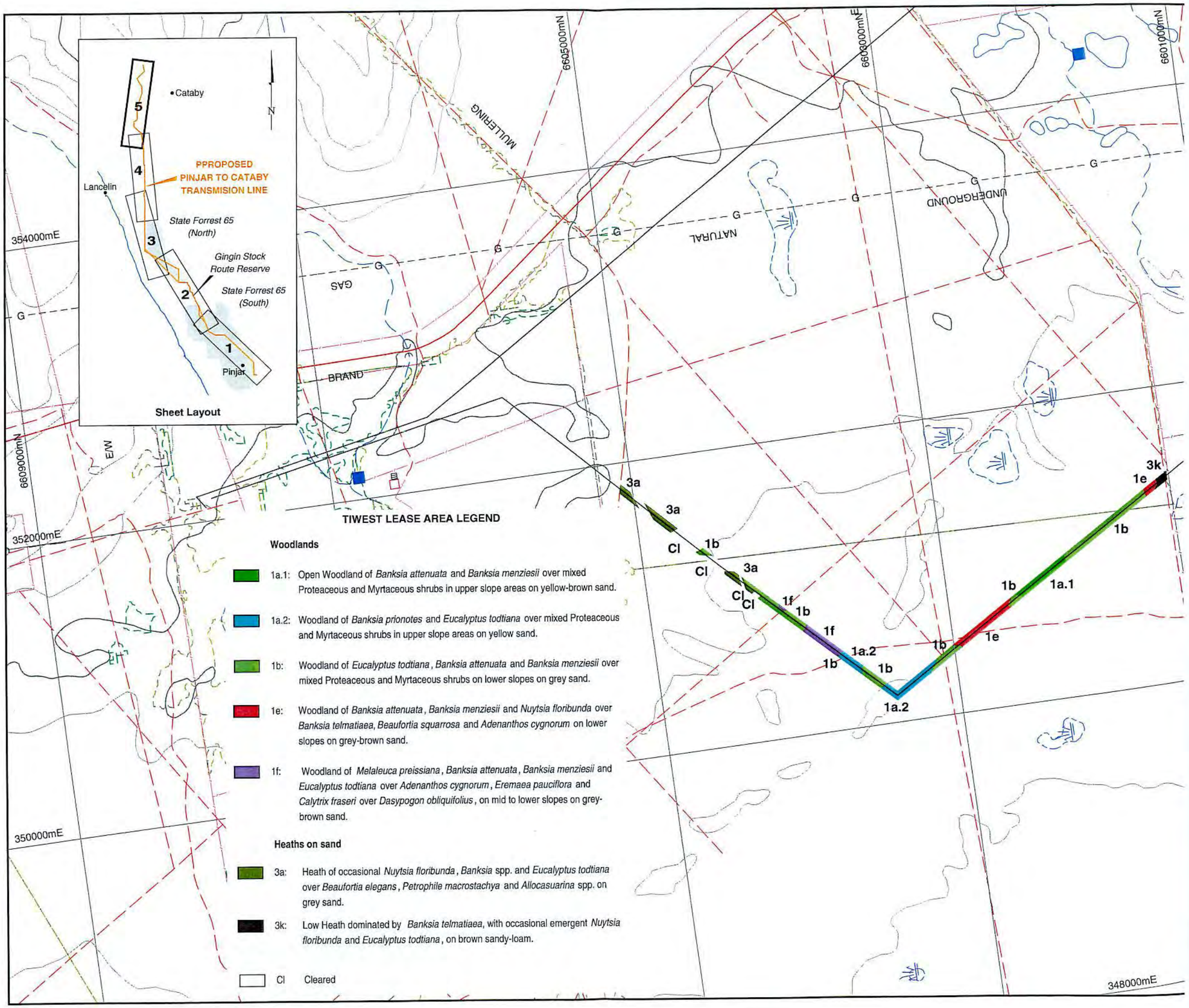
Western Power

PINJAR TO CATABY TRANSMISSION LINE
VEGETATION MAPPING
Sheet 4 of 5

WOODMAN ENVIRONMENTAL CONSULTING PTY LTD
A.C.N.088 055 903
4 Millcroft Elbow, Jandakot W.A. 6164
Tel: (08) 9414 1688 ~ Fax: (08) 9414 1699

Author: D. Woodman	Date: Feb 2001	Scale: 1:25,000
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202		Figure: 4.6
CAD Ref: j562WV_4.dgn	Revision: A	A3+

6567000mN
6565000mN
356000mE
6563000mN
6561000mN
6559000mN
KARAKIN LAKES
GARAGAN LAKE
KAR
N
RD
/19
W18
D3
RD
GARBANUP
ROAD
E.W.
SAPPERS
LAKES
MAST
KARAKIN
0
0.5
1.0
1.5km
SCALE



TIWEST LEASE AREA LEGEND

Woodlands

1a.1: Open Woodland of *Banksia attenuata* and *Banksia menziesii* over mixed Proteaceous and Myrtaceous shrubs in upper slope areas on yellow-brown sand.

1a.2: Woodland of *Banksia prionotes* and *Eucalyptus todtiana* over mixed Proteaceous and Myrtaceous shrubs in upper slope areas on yellow sand.

1b: Woodland of *Eucalyptus todtiana*, *Banksia attenuata* and *Banksia menziesii* over mixed Proteaceous and Myrtaceous shrubs on lower slopes on grey sand.

1e: Woodland of *Banksia attenuata*, *Banksia menziesii* and *Nuytsia floribunda* over *Banksia telmatiaea*, *Beaufortia squarrosa* and *Adenanthos cygnorum* on lower slopes on grey-brown sand.

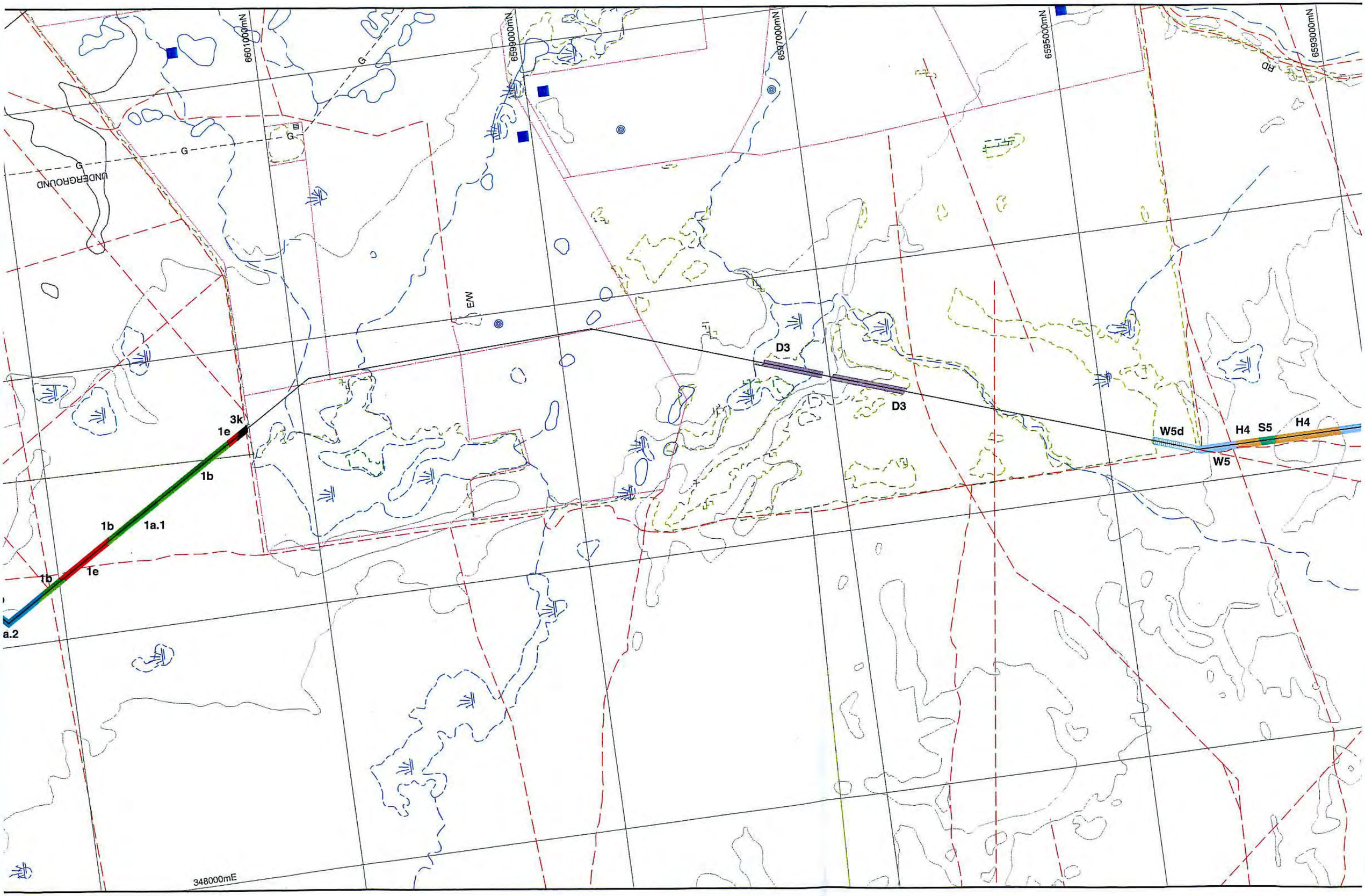
1f: Woodland of *Melaleuca preissiana*, *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* over *Adenanthos cygnorum*, *Eremaea pauciflora* and *Calytrix fraseri* over *Dasypogon obliquifolius*, on mid to lower slopes on grey-brown sand.

Heaths on sand

3a: Heath of occasional *Nuytsia floribunda*, *Banksia* spp. and *Eucalyptus todtiana* over *Beaufortia elegans*, *Petrophile macrostachya* and *Allocasuarina* spp. on grey sand.

3k: Low Heath dominated by *Banksia telmatiaea*, with occasional emergent *Nuytsia floribunda* and *Eucalyptus todtiana*, on brown sandy-loam.

Cl Cleared


6601000mN
6599000mN
6597000mN
6595000mN
6593000mN
G
UNDERGROUND
E/W
RD
D3
D3
3k
1e
1b
1b
1a.1
1b
1e
a.2
W5d
H4
S5
H4
W5
348000mE

6593000mN
6591000mN
6589000mN
6587000mN
6585000mN
RD
CARBA GAR
MIMEGARRA
D3
D3
D3
W5d
H4
S5
H4
W5
W5
H5
W5
F5
W5
F5
W5
F5
W5
W5
W5b
W5b
W5b
F6
W5b
W5b
W5
W5
W5
W5
W5b
DOUARABA SWAMP
WALYENGARRA LAKE
346000mE

Western Power

PINJAR TO CATABY TRANSMISSION LINE
VEGETATION MAPPING
Sheet 5 of 5

WOODMAN ENVIRONMENTAL CONSULTING PTY LTD
A.C.N.088 055 903
4 Millcroft Elbow, Jandakot W.A. 6164
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Author: D. Woodman | Date: Feb 2001 | Scale: 1:25,000
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CAD Ref: j562WV_5.dgn | Revision: B | A3+

Figure: **4.7**

6589000mN
6587000mN
6585000mN
6583000mN
CARBA GAR
MIMEGARRA
WALYENGARRA LAKE
346000mE

D3
W5
F5
W5b
F6
S5
H4
H5

N

Legend

Forests

F5: Low Forest of *Eucalyptus decipiens*, *Melaleuca preissiana* and *Banksia* spp. over tall shrubs on grey sand.

F6: Dense Low Forest of *Eucalyptus rudis*, *Melaleuca preissiana*, *Melaleuca rhaphiophylla* and *Banksia prionotes* on brown sand.

Woodlands on grey sand

W5: Low Woodland of *Banksia attenuata* and *Banksia menziesii* over mixed low shrubs dominated by *Eremaea pauciflora* on grey sand.

W5b: Low Woodland of similar understorey species composition to W5, but dominated by *Banksia prionotes*. These areas appeared to have been disturbed.

W5d: Areas of type W5 that have been modified through disturbances such as clearing, grazing or burning.

Shrublands

S5: Dense Shrubland of *Leptospermum erubescens*, *Calothamnus sanguineus* and *Banksia telmatiaea*, with occasional emergent *Banksia littoralis* and *Melaleuca rhaphiophylla,* on grey sandy-loam.

Heaths

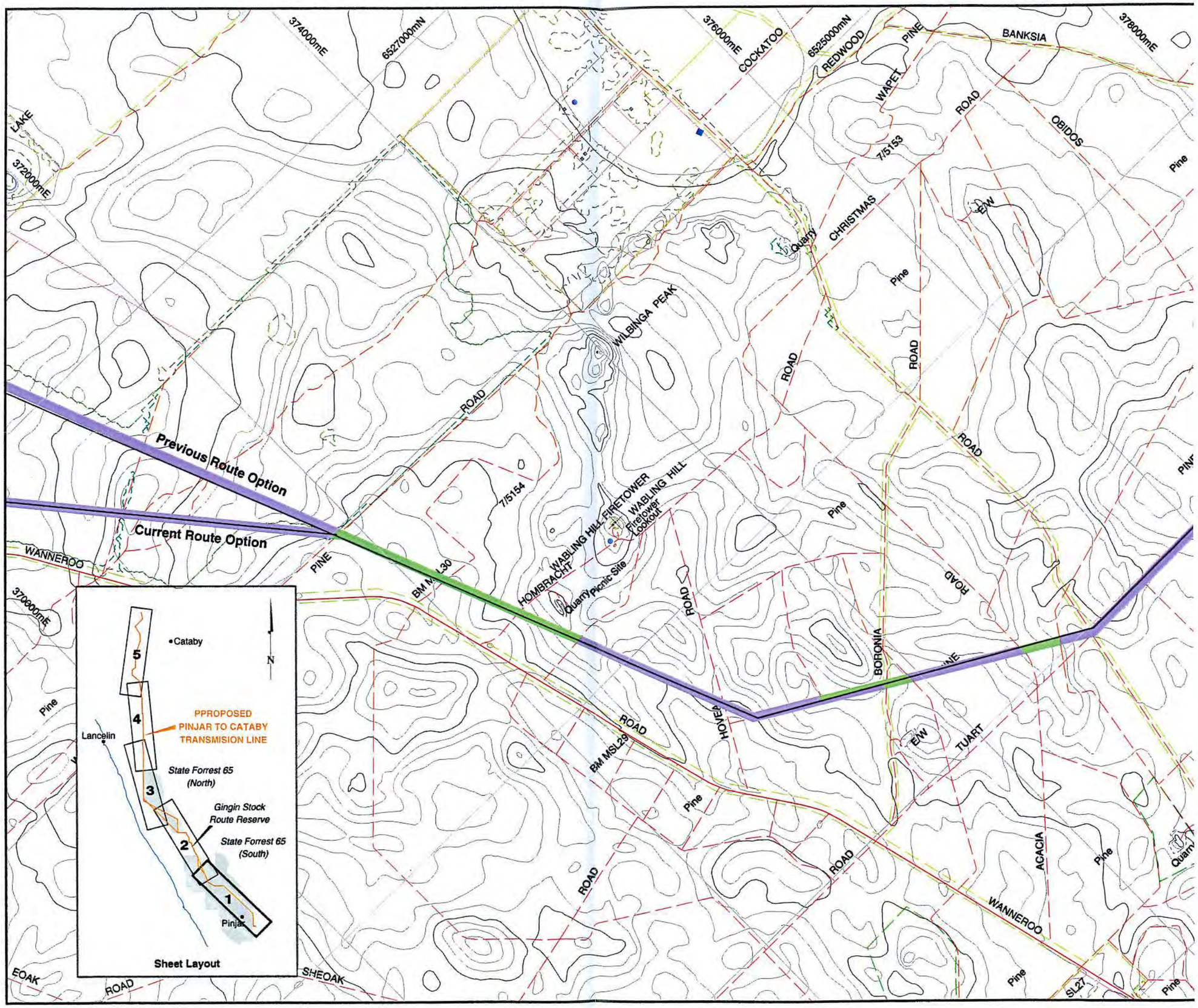
H4: Dense Heath of mixed low shrubs on grey sandy-clay.

H5: Low Heath dominated by *Xanthorrhoea preissii* and *Melaleuca ?trichophylla* on grey sand.

Disturbed

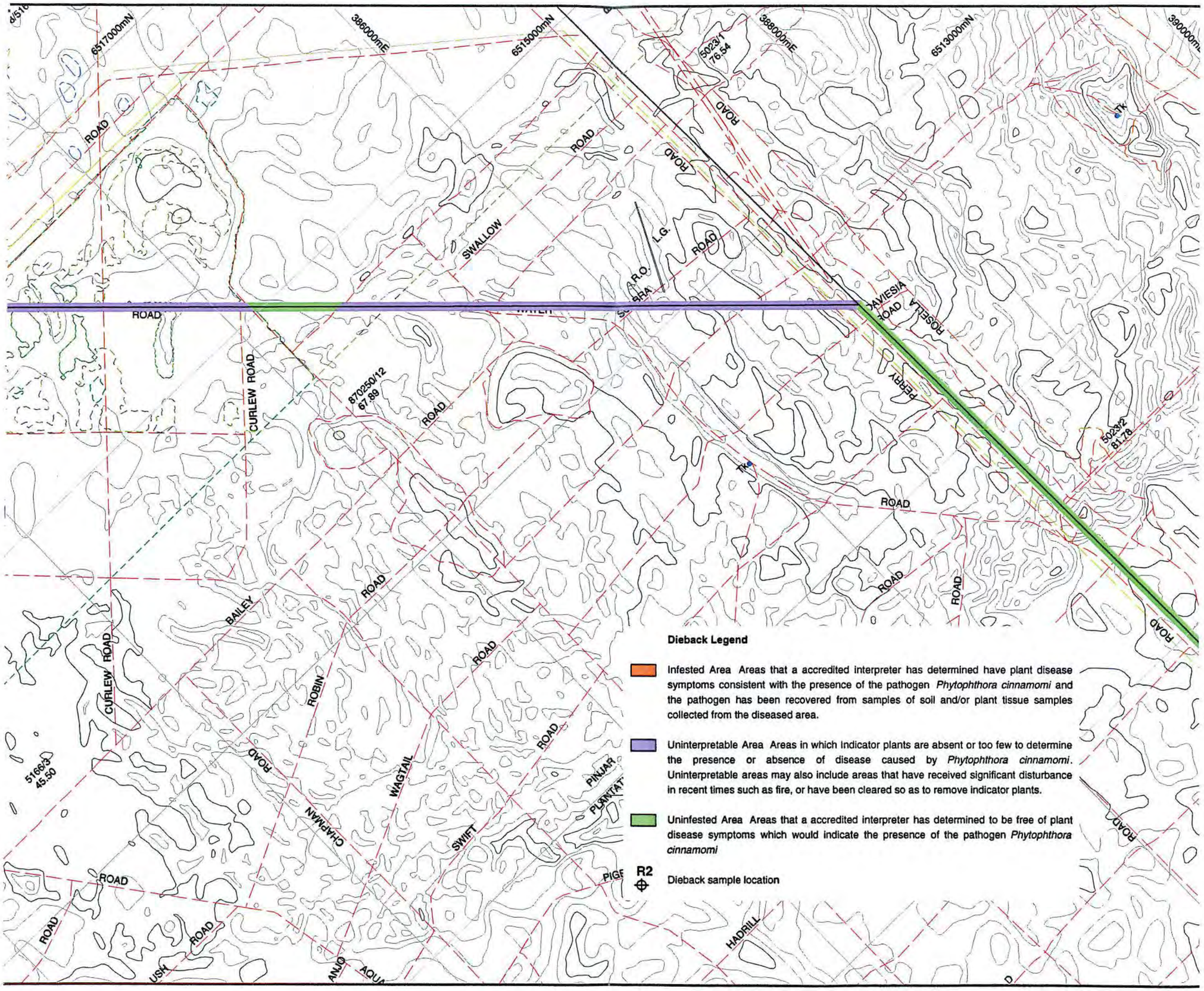
D3: Banksia Woodland areas so disturbed by clearing, grazing or burning that little or none of the original understorey layer is remaining.

0 0.5 1.0 1.5km
SCALE


374000mE
6527000mN
376000mE
COCKATOO
6525000mN
REDWOOD
PINE
BANKSIA
378000mE
WAPET
ROAD
OBIDOS
LAKE
372000mE
7/5153
Pine
CHRISTMAS
Quarry
EW
Pine
WILBINGA PEAK
ROAD
ROAD
ROAD
ROAD
7/5154
Previous Route Option
Current Route Option
WANNEROO
PINE
WABLING HILL FIRETOWER
WABLING HILL
Firetower Lookout
HOMBRACHT
Quarry
Picnic Site
ROAD
Pine
370000mE
BM MSL30
BORONIA
HOVEA
ROAD
BM MSL29
EW
TUART
Pine
ROAD
ROAD
ACACIA
Pine
WANNEROO
EOAK
ROAD
SHEOAK
Pine
SL27
Pine
Cataby
N
5
4
PPROPOSED
PINJAR TO CATABY
TRANSMISION LINE
Lancelin
State Forrest 65
(North)
3
Gingin Stock
Route Reserve
2
State Forrest 65
(South)
1
Pinjar
Sheet Layout

State Forest 65 South

6523000mN
380000mE
FAR
6521000mN
382000mE
BINDIAR LAKE
6519000mN
CASUARINA
384000mE
Pine
ROAD
BM HZ808
WATER
SANTIAGO
Yeal Swamp
PINE
STIRLINGIA
STYGIA
E/W
BM HZ809
Quarry
L/G
8/5166
CLOVER
SWAMP
CALLITRIS
YEAL
OBIDOS
MOORT
MIRANDA
EMU
AMARAL
8/5165
HYDRO
AQUA
HERON
MILITARY
SMOKEBUSH HILL
MISTLETOE


6517000mN
386000mE
6515000mN
388000mE
6513000mN
390000mE
ROAD
SWALLOW
L.G.
R.O.
PERRY
ROSELLA
CURLEW ROAD
870250/12
67.89
5023/1
76.54
5023/2
81.78
TK
BAILEY
ROBIN
WAGTAIL
CHAPMAN
SWIFT
HADRILL
CURLEW
5166/3
45.50
USK
ANJO
Dieback Legend
Infested Area Areas that a accredited interpreter has determined have plant disease symptoms consistent with the presence of the pathogen Phytophthora cinnamomi and the pathogen has been recovered from samples of soil and/or plant tissue samples collected from the diseased area.
Uninterpretable Area Areas in which Indicator plants are absent or too few to determine the presence or absence of disease caused by Phytophthora cinnamomi. Uninterpretable areas may also include areas that have received significant disturbance in recent times such as fire, or have been cleared so as to remove indicator plants.
Uninfested Area Areas that a accredited interpreter has determined to be free of plant disease symptoms which would indicate the presence of the pathogen Phytophthora cinnamomi
R2
Dieback sample location

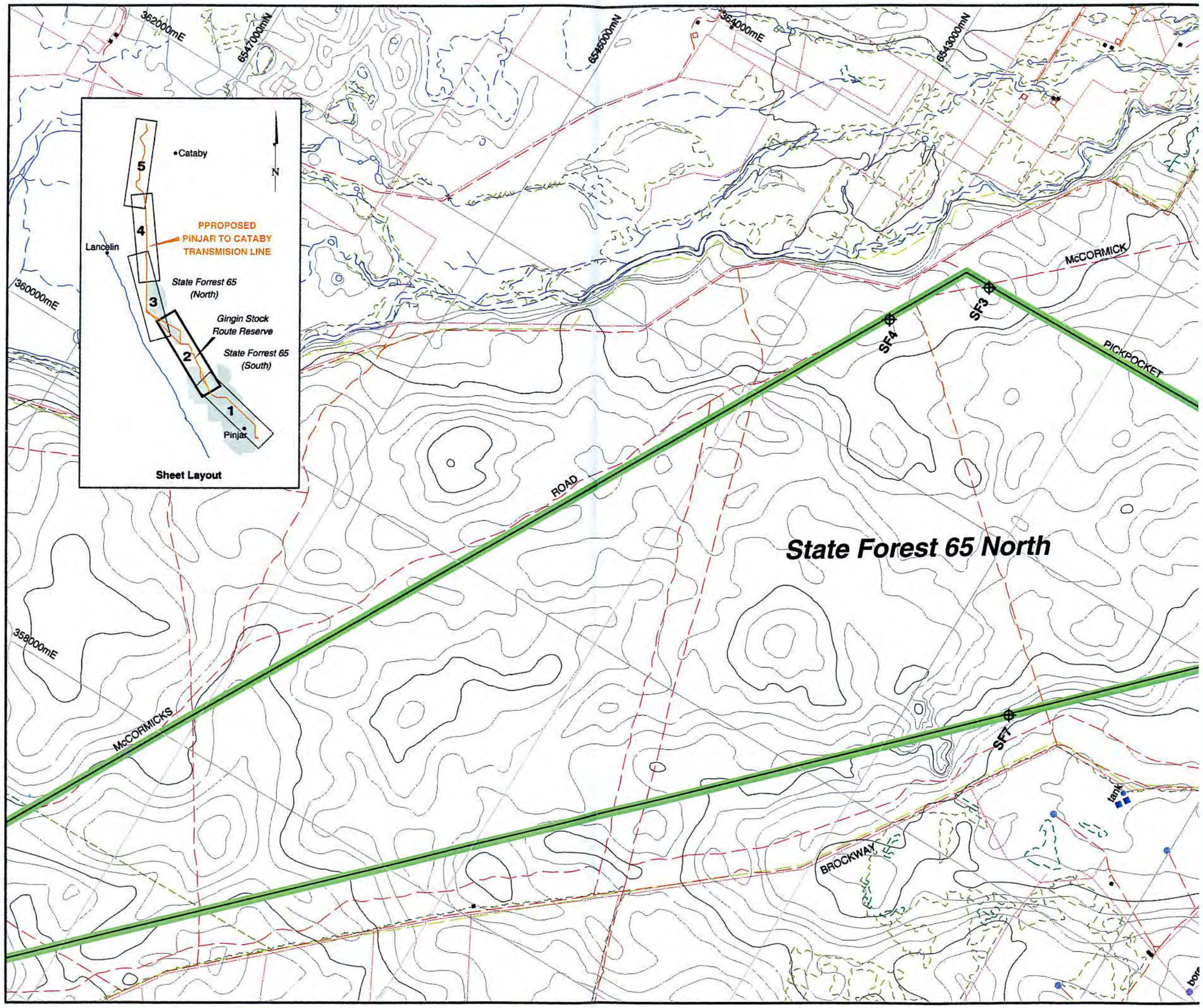
Western Power

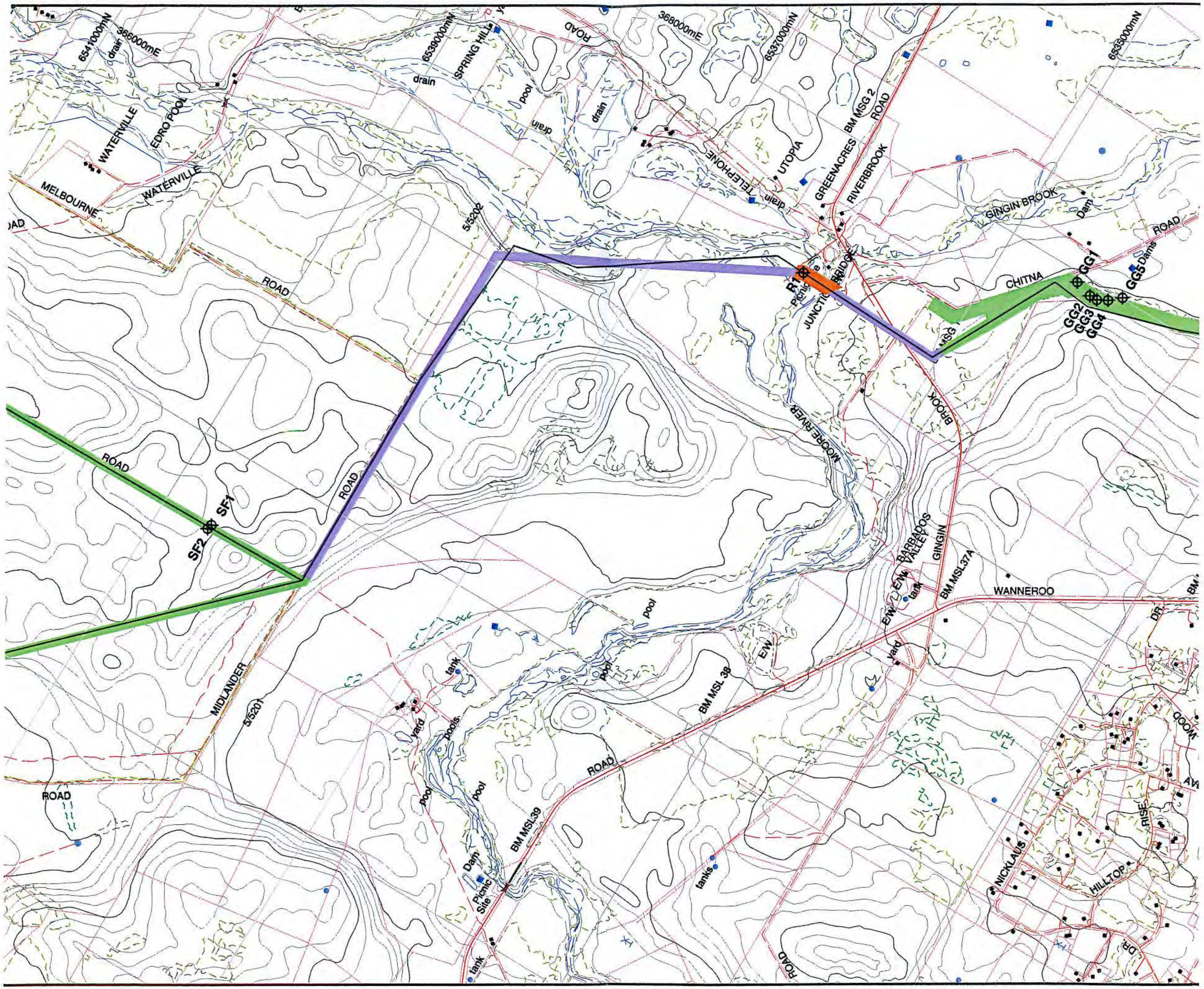
PINJAR TO CATABY TRANSMISSION LINE
DIEBACK MAPPING
Sheet 1 of 5

WOODMAN ENVIRONMENTAL CONSULTING PTY LTD
A.C.N.088 055 903
4 Millcroft Elbow, Jandakot W.A. 6164
Tel: (08) 9414 1688 ~ Fax: (08) 9414 1699

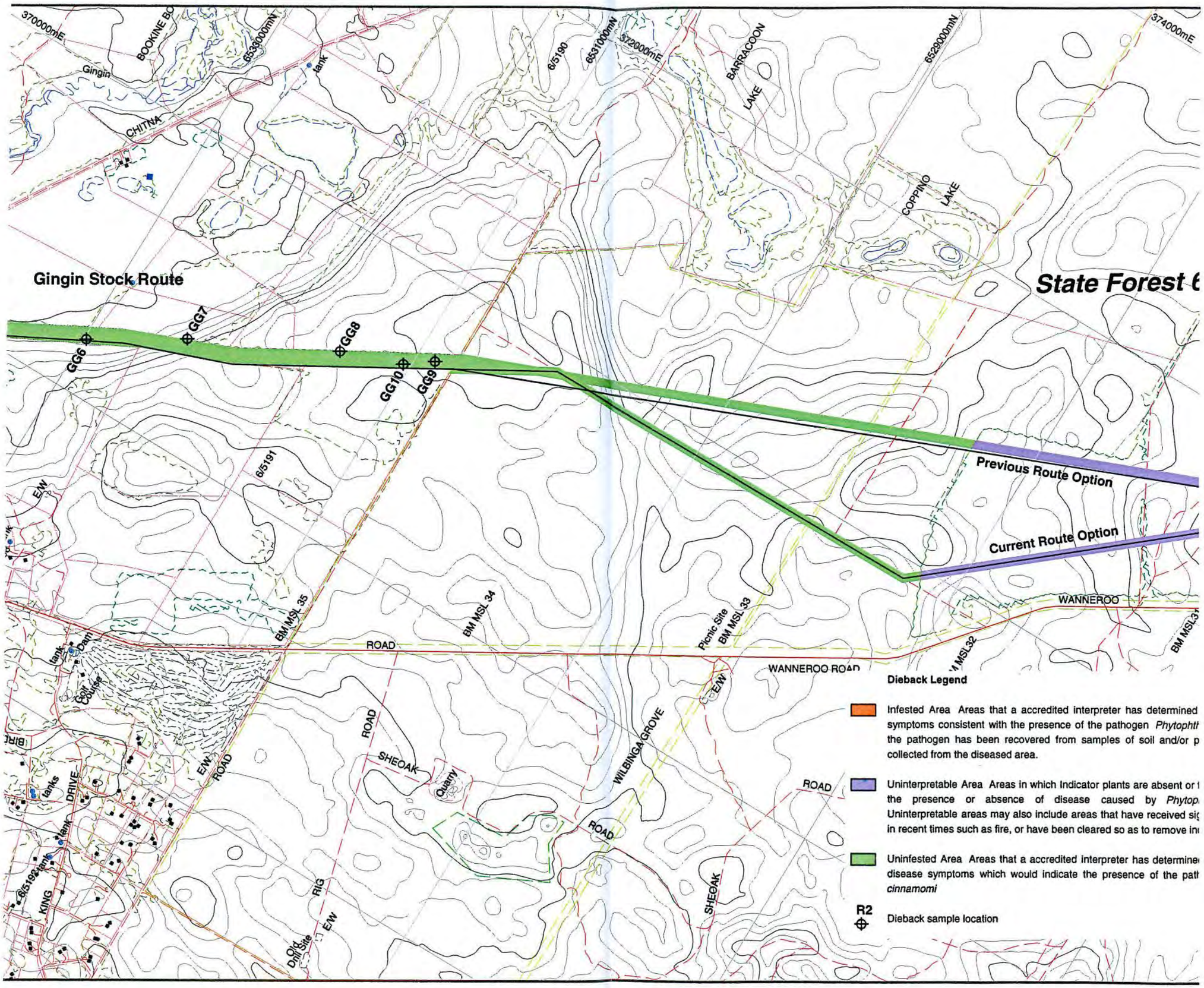
Author: D. Woodman	Date: Feb 2001	Scale: 1:25,000
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202		Figure: 4.8
CAD Ref: j562WD1A.dgn	Revision: A	A3+

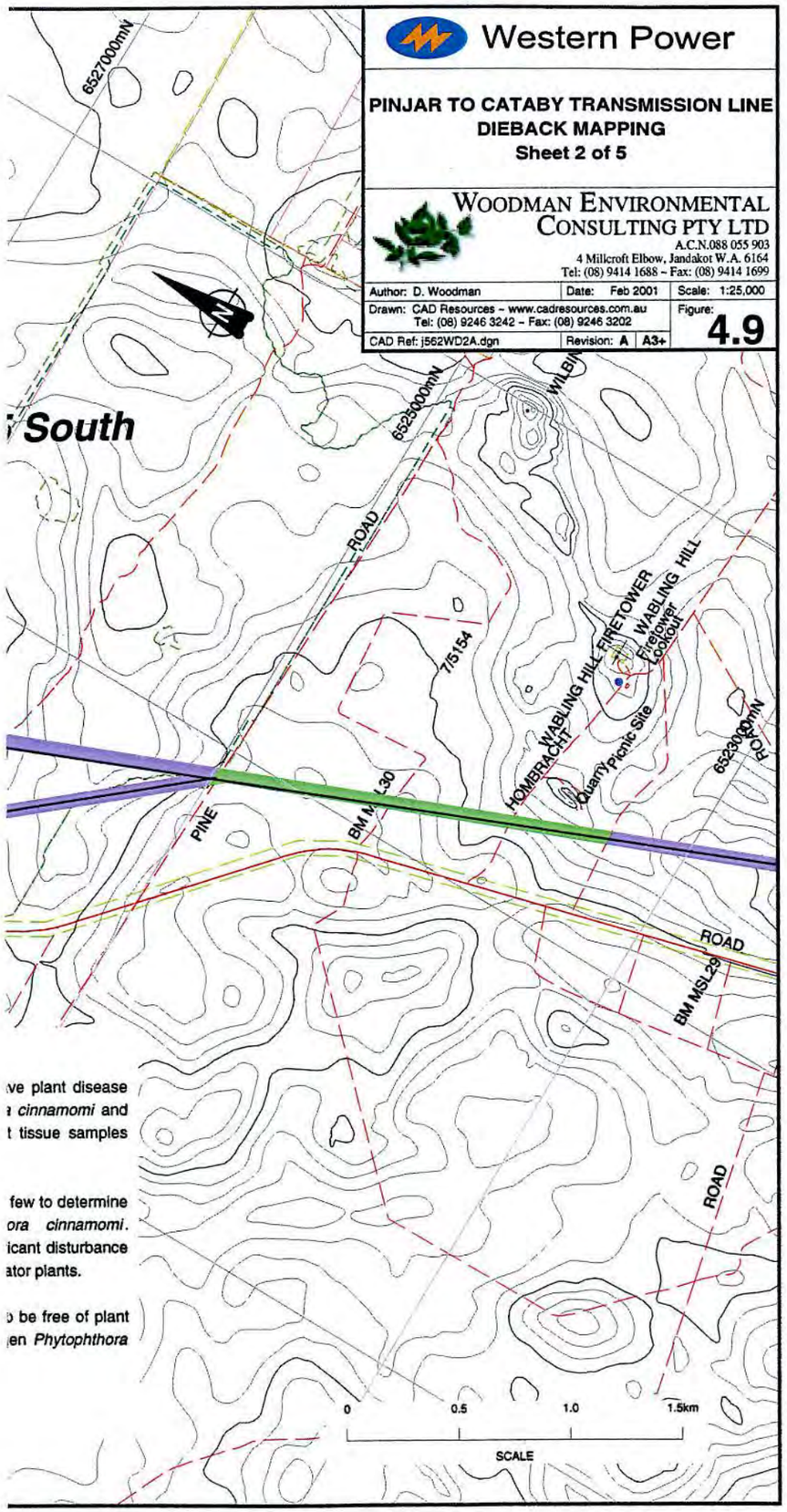
374000mE
6527000mN
376000mE
6525000mN
378000mE
6511000mN
6509000mN
6507000mN
5022/2 79.62
COCKATOO
REDWOOD
PINE
BANKSIA
WAPET
ROAD
OBIDOS
Pine
7/5153
CHRISTMAS
Quarry
EW
HILL
WILBINGA PEAK
ROAD
Pine
WABLING HILL FIRETOWER
WABLING HILL Firetower Lookout
7/5154
HOMBRACHT
Quarry
Picnic Site
BM MSL30
BORONIA
HOVEA
BM MSL29
TUART
WANNEROO
ACACIA
SHEOAK
SL27
Mast
Dam
Tk
2336/0 68.18
HZ 284 69.77
PERRY
McKINLEY
R.A.A.F
0 0.5 1.0 1.5km
SCALE


362000mE
6547000mN
6545000mN
364000mE
6543000mN
360000mE
358000mE
Cataby
N
PPROPOSED
PINJAR TO CATABY
TRANSMISION LINE
Lancelin
State Forrest 65
(North)
Gingin Stock
Route Reserve
State Forrest 65
(South)
Pinjar
Sheet Layout
McCORMICK
SF3
SF4
PICKPOCKET
ROAD
McCORMICKS
SF7
BROCKWAY
tank
State Forest 65 North



6541000mN
366000mE
6539000mN
368000mE
6537000mN
6535000mN
WATERVILLE
EDRO POOL
MELBOURNE
SPRING HILL
TELEPHONE
UTOPIA
GREENACRES
RIVERBROOK
BM MSG 2
GINGIN BROOK
CHITNA
R1
GG1
GG2
GG3
GG4
GG5
SF1
SF2
MOORE RIVER
BROOK
BARBADOS VALLEY
GINGIN
BM MSL37A
WANNEROO
MIDLANDER
5/5202
5/5201
BM MSL 38
BM MSL39
NICKLAUS
HILLTOP
RISE
ROAD
pool
drain
tank
yard
Dams


370000mE
BOOKINE BO
6533000mN
Gingin
CHITNA
Tank
6/5190
6531000mN
372000mE
BARRACOON
LAKE
6529000mN
374000mE
COPPINO
LAKE
Gingin Stock Route
State Forest 6
GG6
GG7
GG8
GG9
GG10
6/5191
E/W
Previous Route Option
Current Route Option
WANNEROO
BM MSL 35
BM MSL 34
BM MSL 33
BM MSL32
BM MSL31
ROAD
Tank
Dam
Golf Course
Picnic Site
WANNEROO ROAD
SHEOAK
Quarry
WILBINGA GROVE
DRIVE
tanks
6/5192
KING
RIG
Old Drill Site
Dieback Legend
Infested Area Areas that a accredited interpreter has determined
symptoms consistent with the presence of the pathogen Phytophth
the pathogen has been recovered from samples of soil and/or p
collected from the diseased area.
Uninterpretable Area Areas in which Indicator plants are absent or t
the presence or absence of disease caused by Phytop
Uninterpretable areas may also include areas that have received sig
in recent times such as fire, or have been cleared so as to remove in
Uninfested Area Areas that a accredited interpreter has determine
disease symptoms which would indicate the presence of the patl
cinnamomi
R2
Dieback sample location

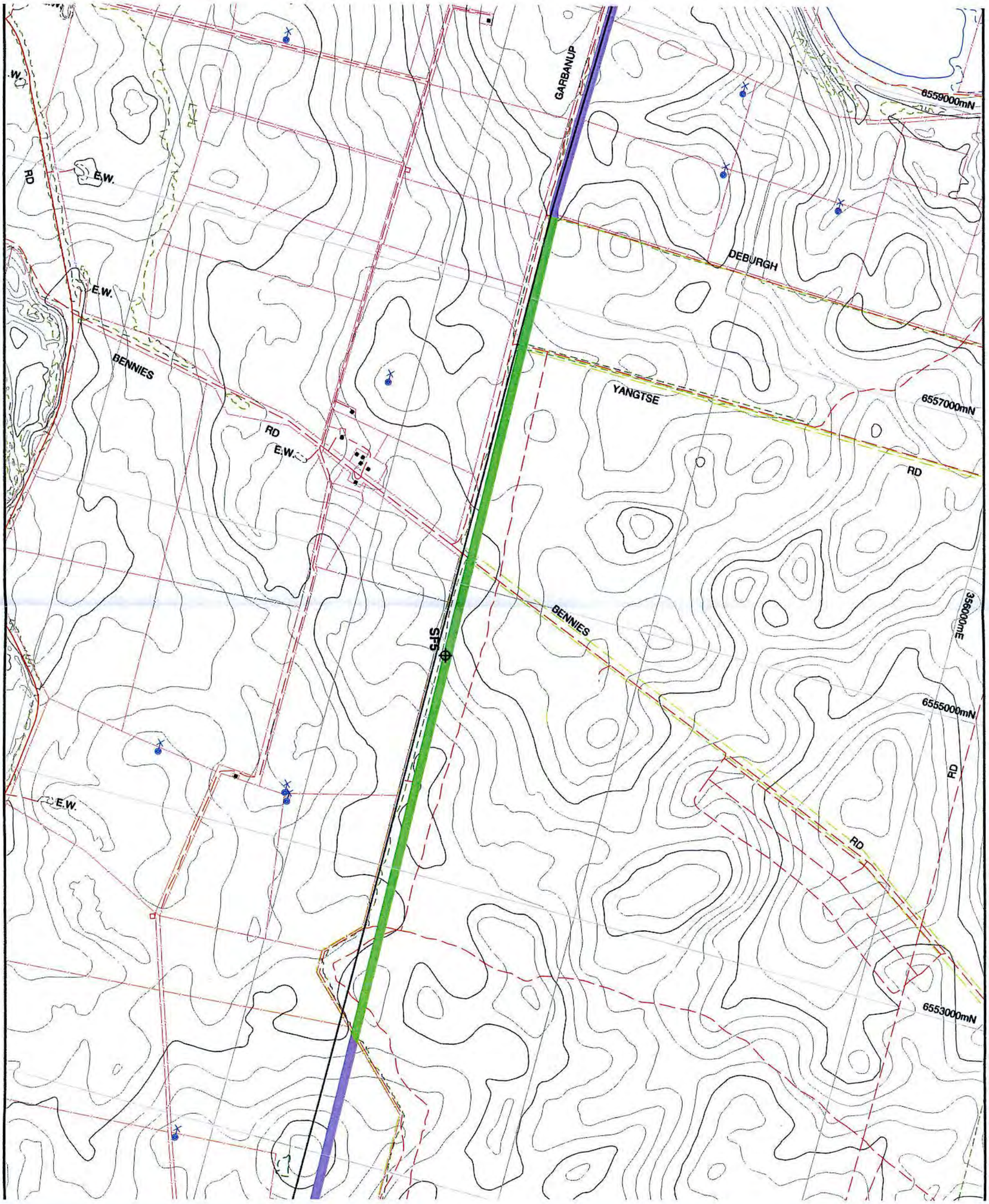


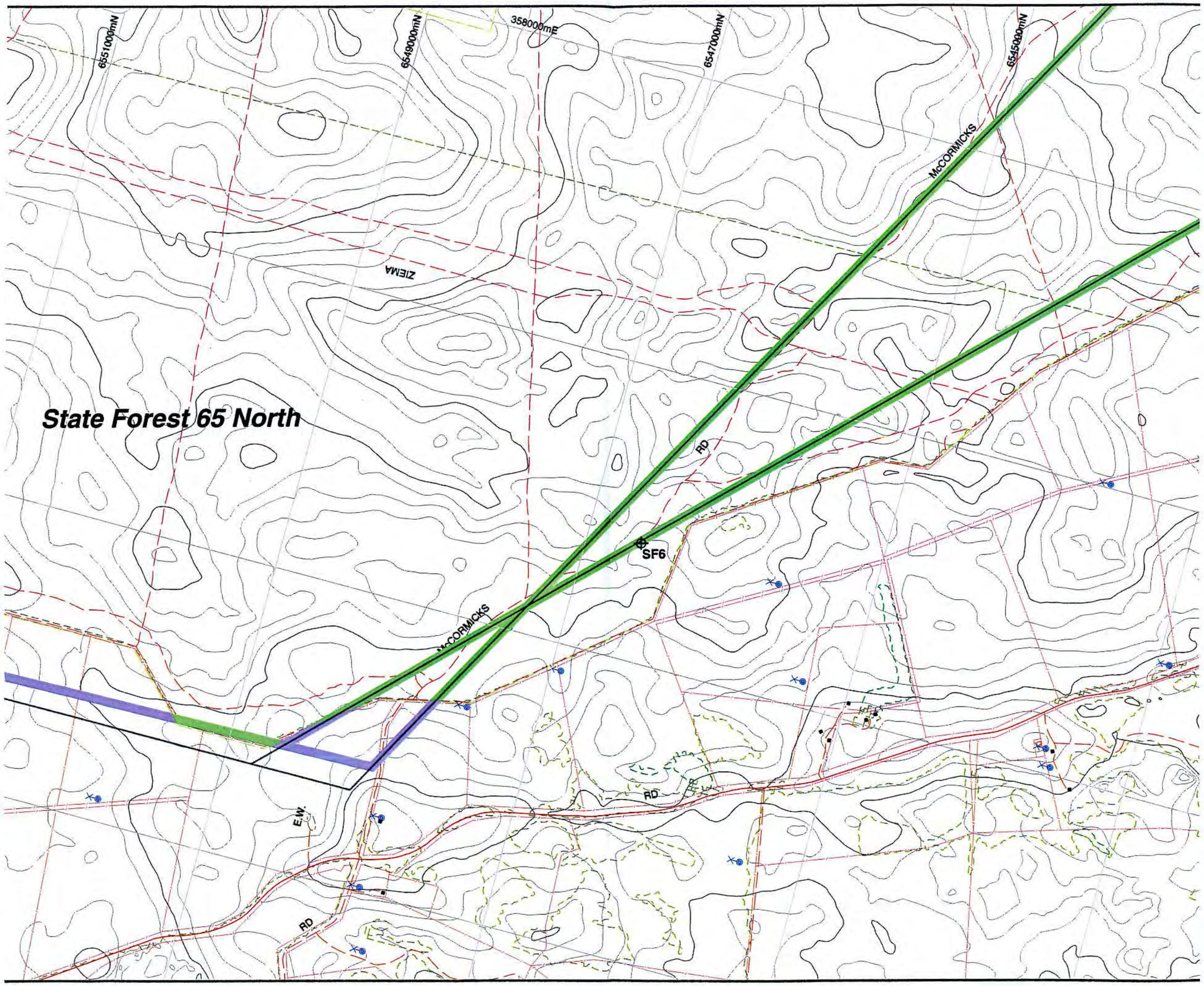
ve plant disease
cinnamomi and
t tissue samples

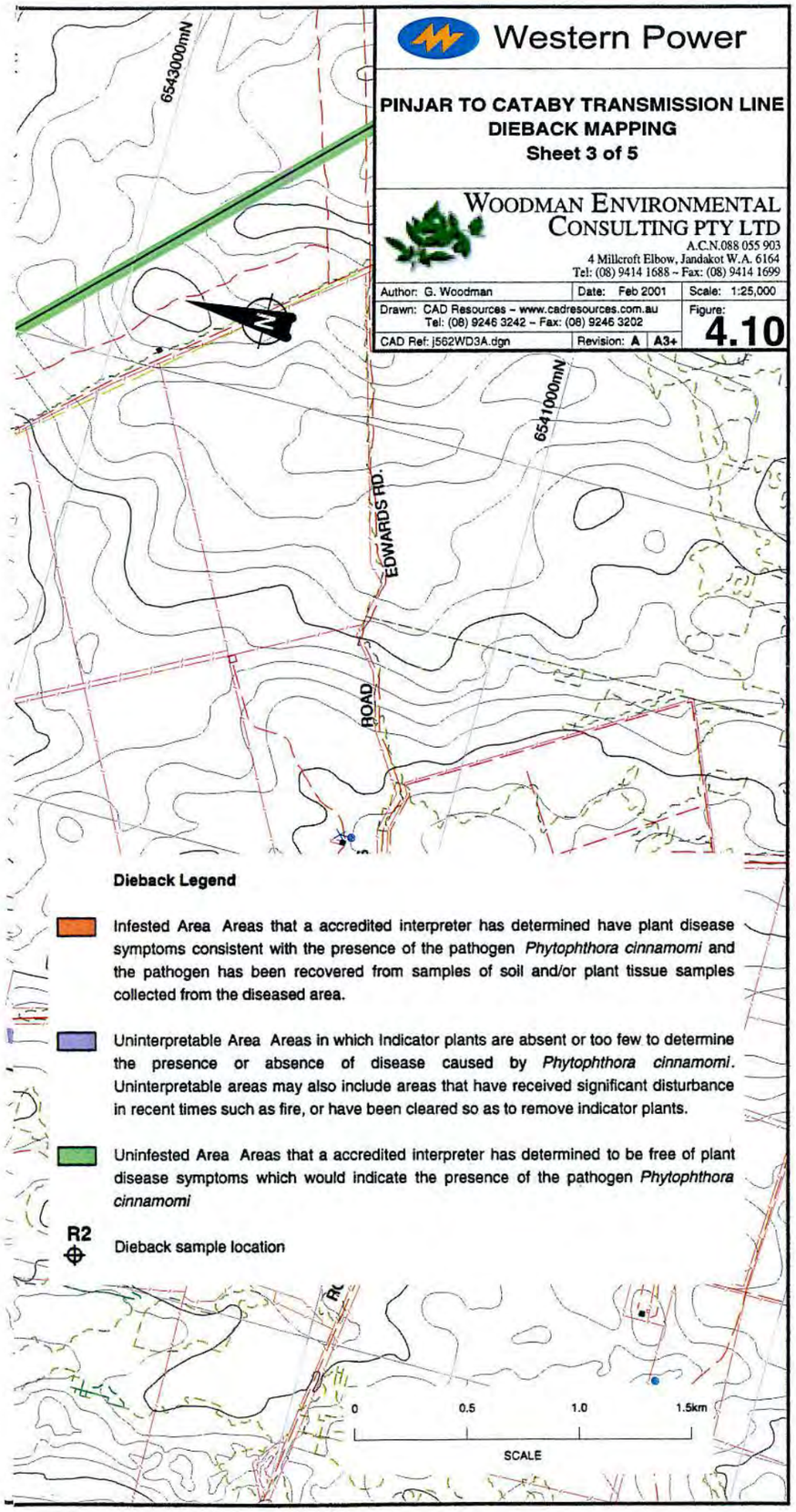
few to determine
ora cinnamomi.
icant disturbance
ator plants.

o be free of plant
en *Phytophthora*

6567000mN
6565000mN
6563000mN
6561000mN
354000mE
352000mE
350000mE
348000mE
RD
LAKES
MAST
E.W.
KARAKIN
GARAGAN LAKE
Cataby
N
5
4
3
2
1
Lancelin
Pinjar
PPROPOSED
PINJAR TO CATABY
TRANSMISION LINE
State Forrest 65
(North)
Gingin Stock
Route Reserve
State Forrest 65
(South)
Sheet Layout


GARBANUP
6559000mN
DEBURGH
YANGTSE
6557000mN
RD
BENNIES
SF5
356000mE
6555000mN
6553000mN
E.W.


6551000mN
6549000mN
358000mE
6547000mN
6545000mN
McCORMICKS
ZIEMA
State Forest 65 North
RD
SF6
McCORMICKS
RD
RD
E.W.


Western Power
PINJAR TO CATABY TRANSMISSION LINE
DIEBACK MAPPING
Sheet 3 of 5
WOODMAN ENVIRONMENTAL CONSULTING PTY LTD
A.C.N.088 055 903
4 Millcroft Elbow, Jandakot W.A. 6164
Tel: (08) 9414 1688 - Fax: (08) 9414 1699
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Scale: 1:25,000
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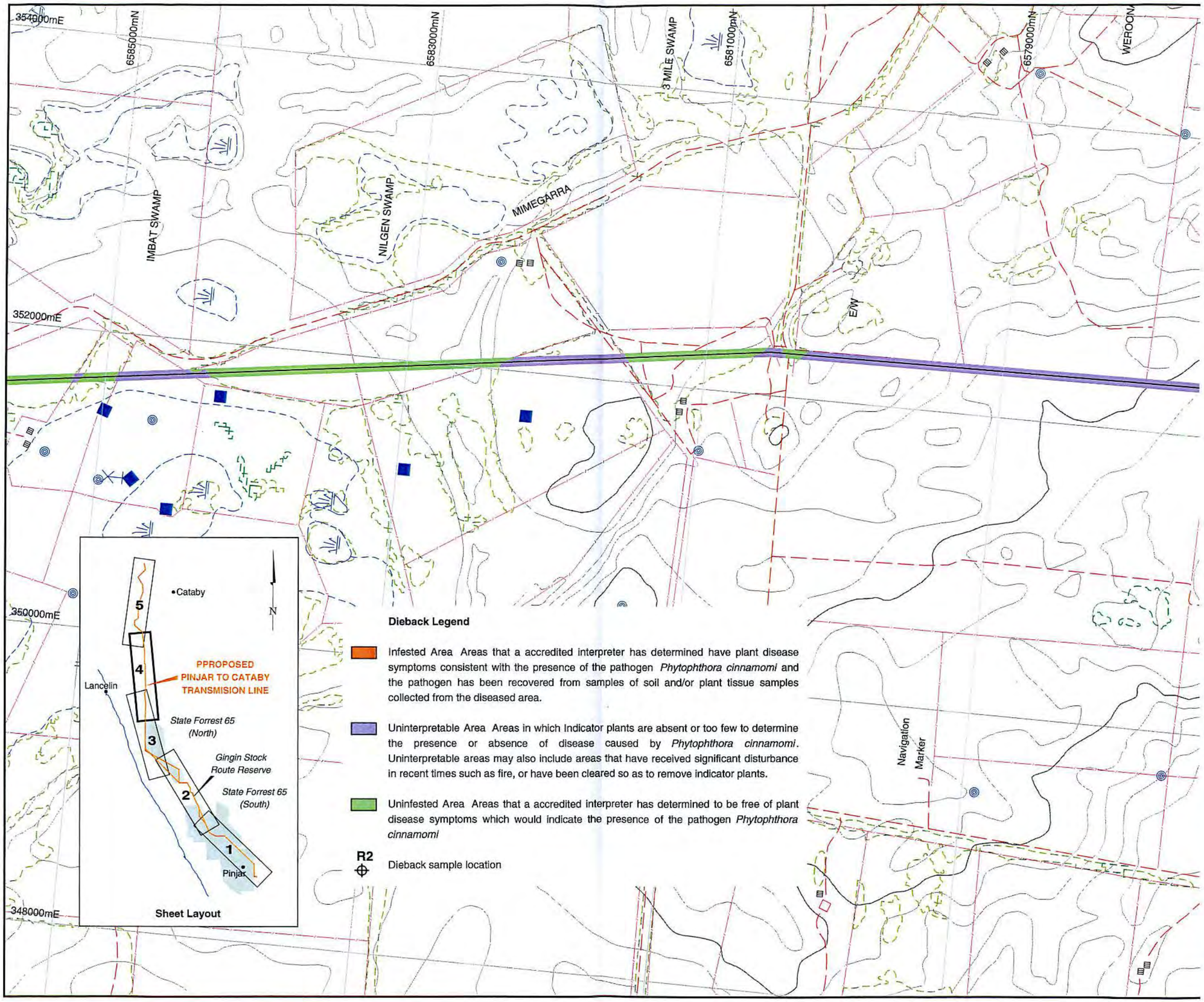
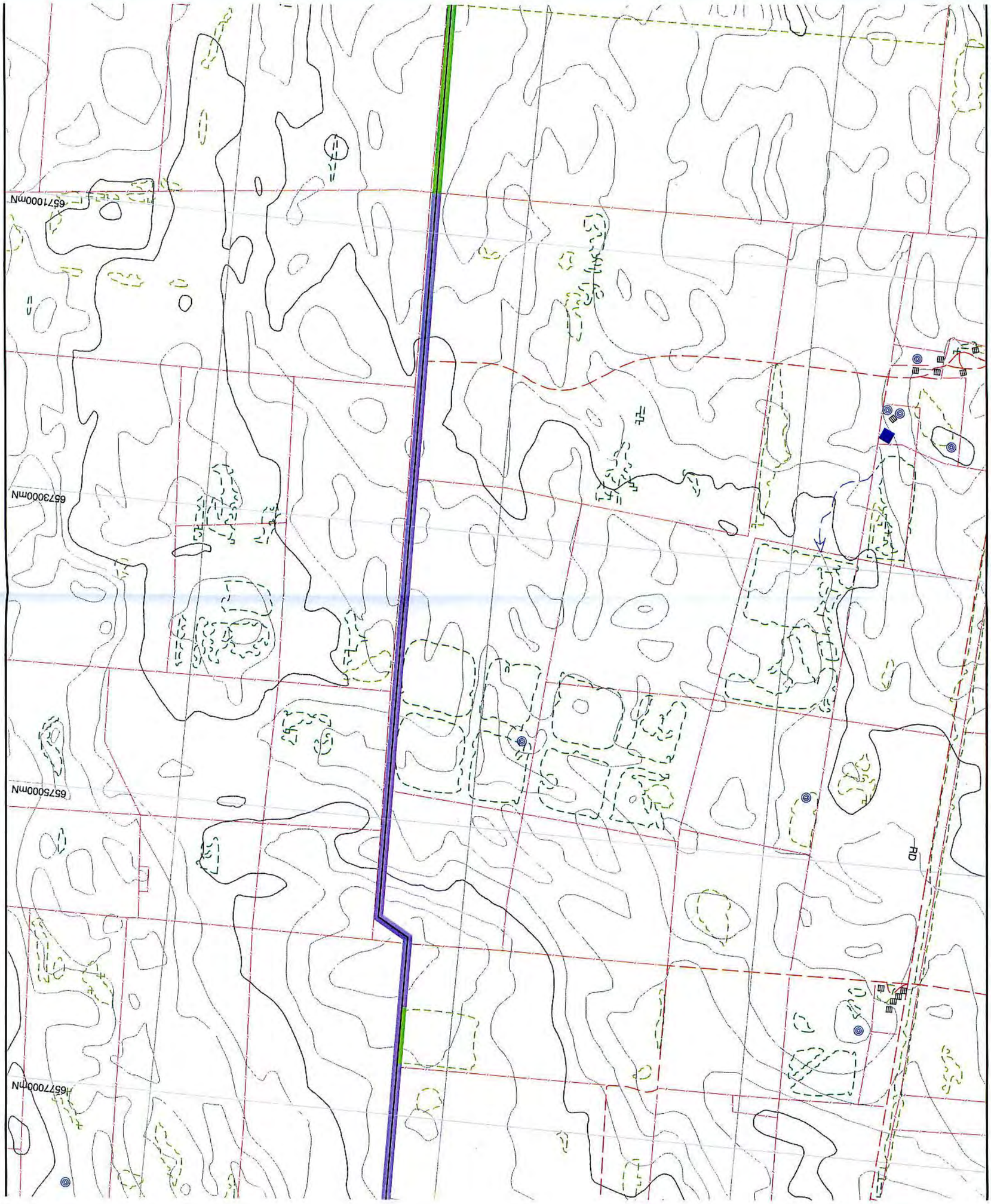
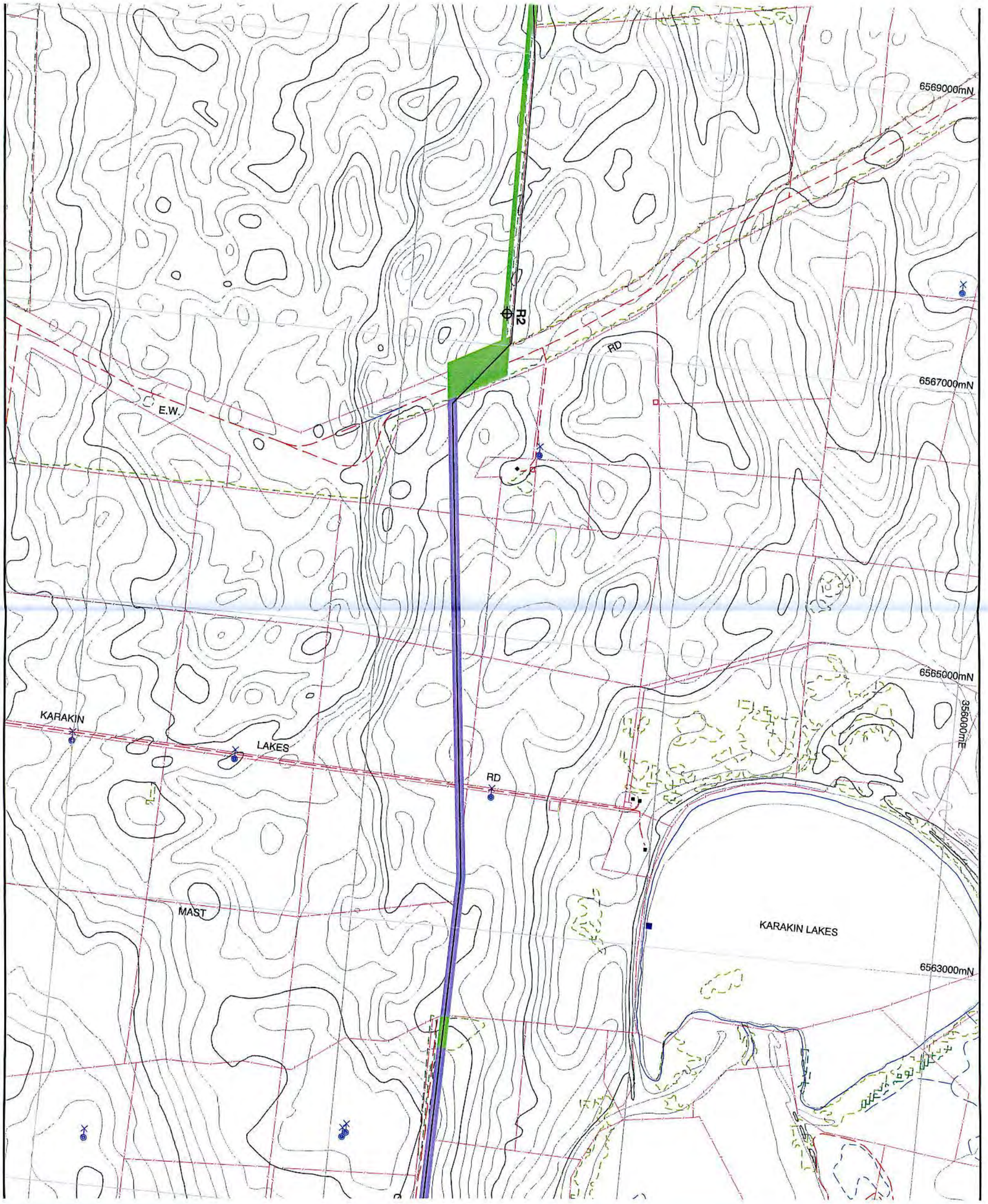
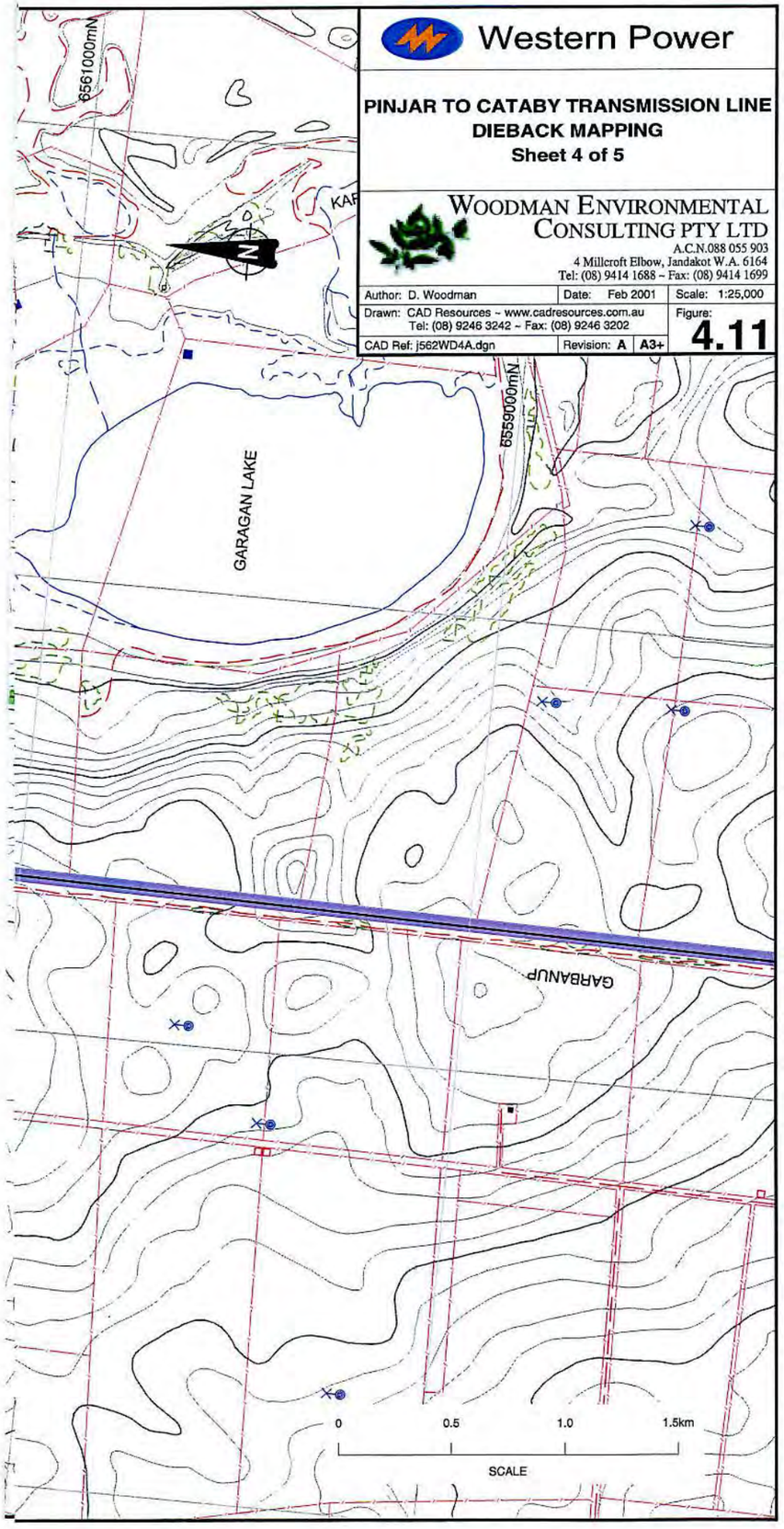
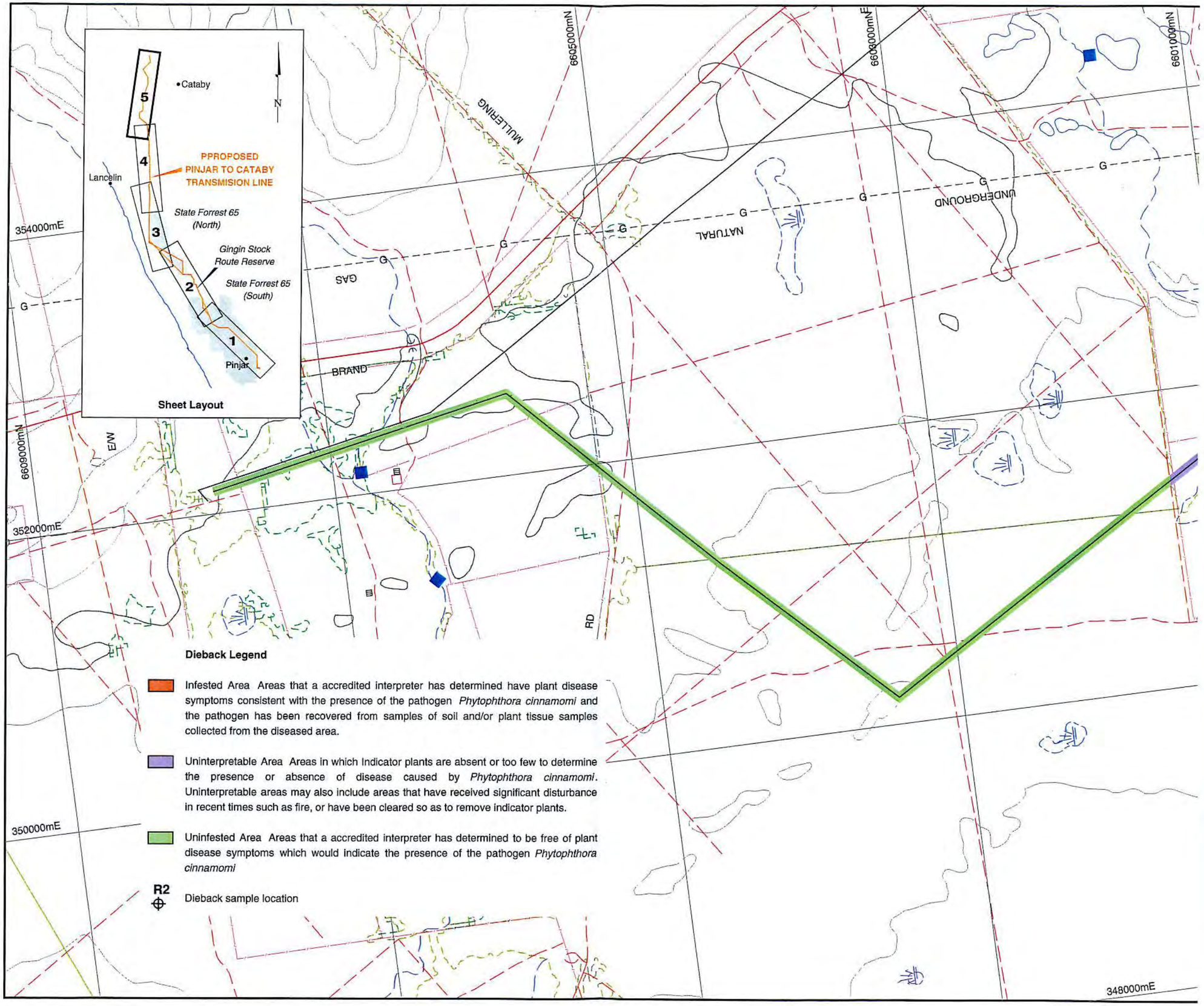
Tel: (08) 9246 3242 - Fax: (08) 9246 3202
Figure: 4.10
CAD Ref: j562WD3A.dgn
Revision: A
A3+
6543000mN
6541000mN
EDWARDS RD.
ROAD
Dieback Legend
Infested Area Areas that a accredited interpreter has determined have plant disease symptoms consistent with the presence of the pathogen Phytophthora cinnamomi and the pathogen has been recovered from samples of soil and/or plant tissue samples collected from the diseased area.
Uninterpretable Area Areas in which Indicator plants are absent or too few to determine the presence or absence of disease caused by Phytophthora cinnamomi. Uninterpretable areas may also include areas that have received significant disturbance in recent times such as fire, or have been cleared so as to remove indicator plants.
Uninfested Area Areas that a accredited interpreter has determined to be free of plant disease symptoms which would indicate the presence of the pathogen Phytophthora cinnamomi
R2
Dieback sample location
0
0.5
1.0
1.5km
SCALE


354000mE
6585000mN
6583000mN
6581000mN
6579000mN
3 MILE SWAMP
IMBAT SWAMP
NILGEN SWAMP
MIMEGARRA
E/W
352000mE
350000mE
348000mE
Navigation Marker
•Cataby
N
5
4
3
2
1
PPROPOSED PINJAR TO CATABY TRANSMISION LINE
Lancelin
State Forrest 65 (North)
Gingin Stock Route Reserve
State Forrest 65 (South)
Pinjar
Sheet Layout
Dieback Legend
Infested Area Areas that a accredited interpreter has determined have plant disease symptoms consistent with the presence of the pathogen Phytophthora cinnamomi and the pathogen has been recovered from samples of soil and/or plant tissue samples collected from the diseased area.
Uninterpretable Area Areas in which Indicator plants are absent or too few to determine the presence or absence of disease caused by Phytophthora cinnamomi. Uninterpretable areas may also include areas that have received significant disturbance in recent times such as fire, or have been cleared so as to remove indicator plants.
Uninfested Area Areas that a accredited interpreter has determined to be free of plant disease symptoms which would indicate the presence of the pathogen Phytophthora cinnamomi
R2
Dieback sample location


6571000mN
6573000mN
6575000mN
6577000mN
RD


6569000mN
R2
RD
6567000mN
E.W.
6565000mN
356000mE
KARAKIN
LAKES
RD
MAST
KARAKIN LAKES
6563000mN


Western Power
PINJAR TO CATABY TRANSMISSION LINE
DIEBACK MAPPING
Sheet 4 of 5
WOODMAN ENVIRONMENTAL CONSULTING PTY LTD
A.C.N.088 055 903
4 Millcroft Elbow, Jandakot W.A. 6164
Tel: (08) 9414 1688 ~ Fax: (08) 9414 1699
Author: D. Woodman
Date: Feb 2001
Scale: 1:25,000
Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202
Figure: 4.11
CAD Ref: j562WD4A.dgn
Revision: A
A3+
6561000mN
6559000mN
GARAGAN LAKE
GARBANUP
0
0.5
1.0
1.5km
SCALE


Cataby
N
5
4
3
2
1
Lancelin
Pinjar
PPROPOSED
PINJAR TO CATABY
TRANSMISION LINE
State Forrest 65
(North)
Gingin Stock
Route Reserve
State Forrest 65
(South)
Sheet Layout
6605000mN
6603000mE
6601000mN
6609000mN
354000mE
352000mE
350000mE
348000mE
MULLERING
NATURAL
GAS
UNDERGROUND
BRAND
E/W
RD
Dieback Legend
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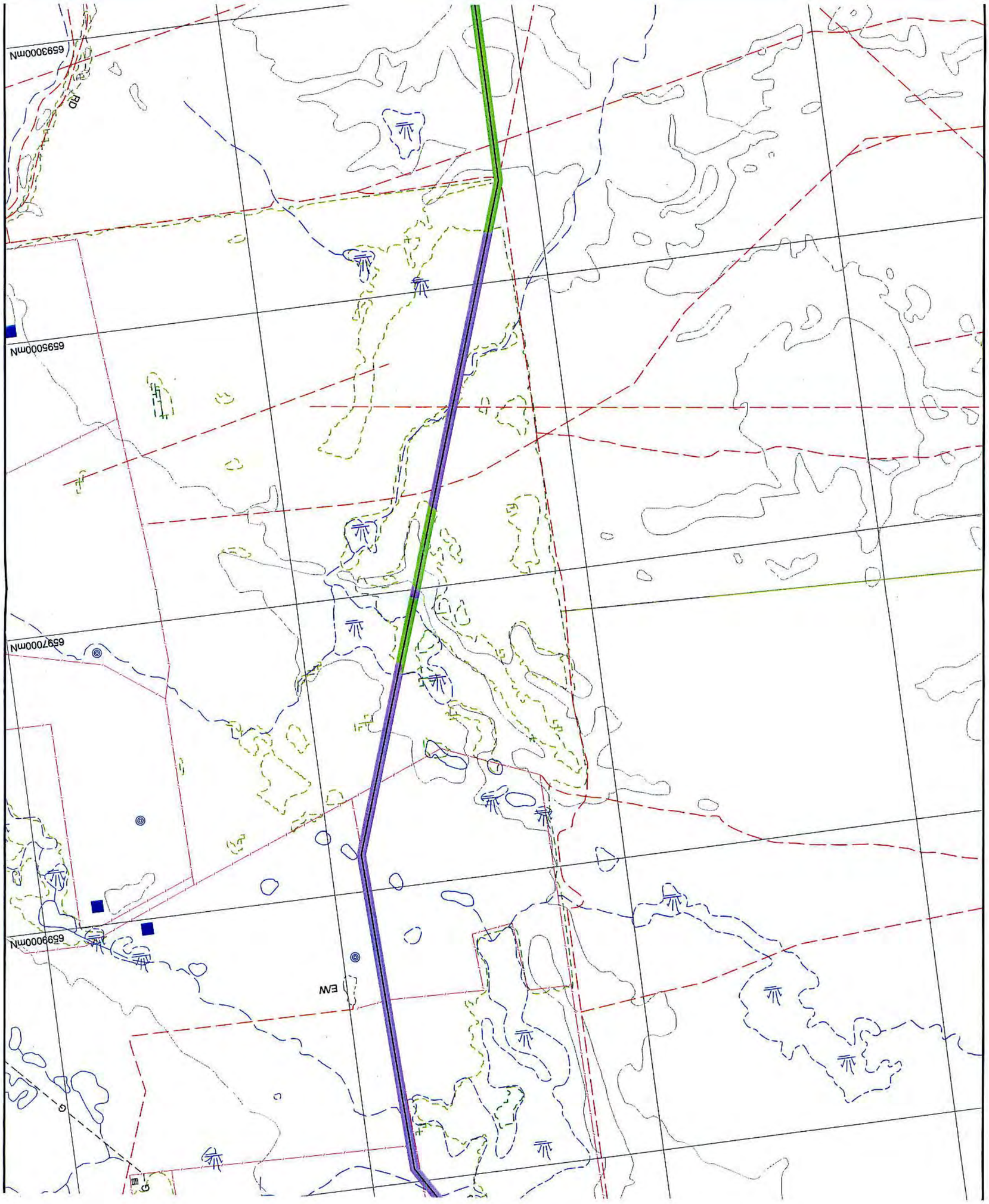
Uninfested Area Areas that a accredited interpreter has determined to be free of plant disease symptoms which would indicate the presence of the pathogen Phytophthora cinnamomi
R2
Dieback sample location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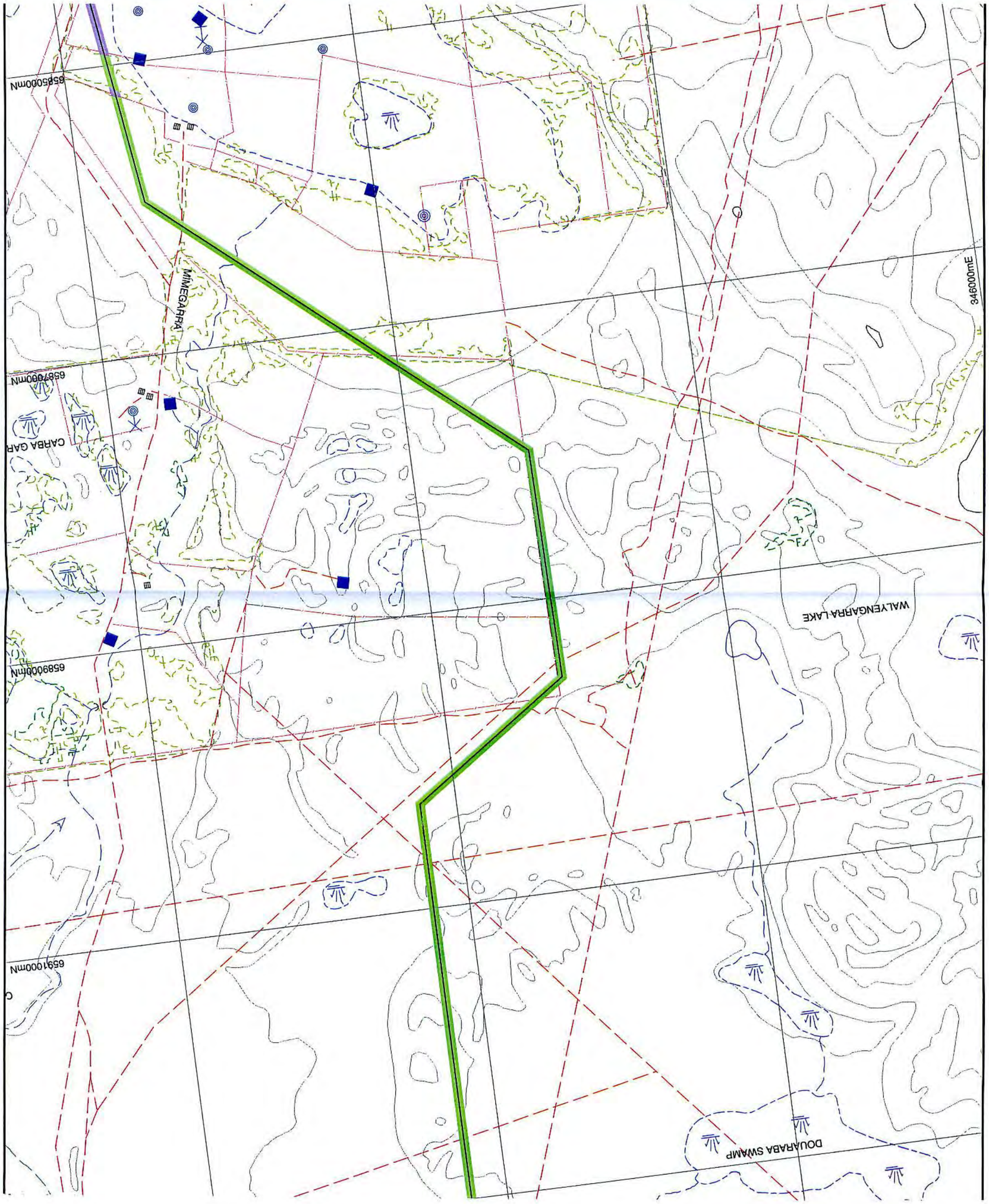
6597000mN
6599000mN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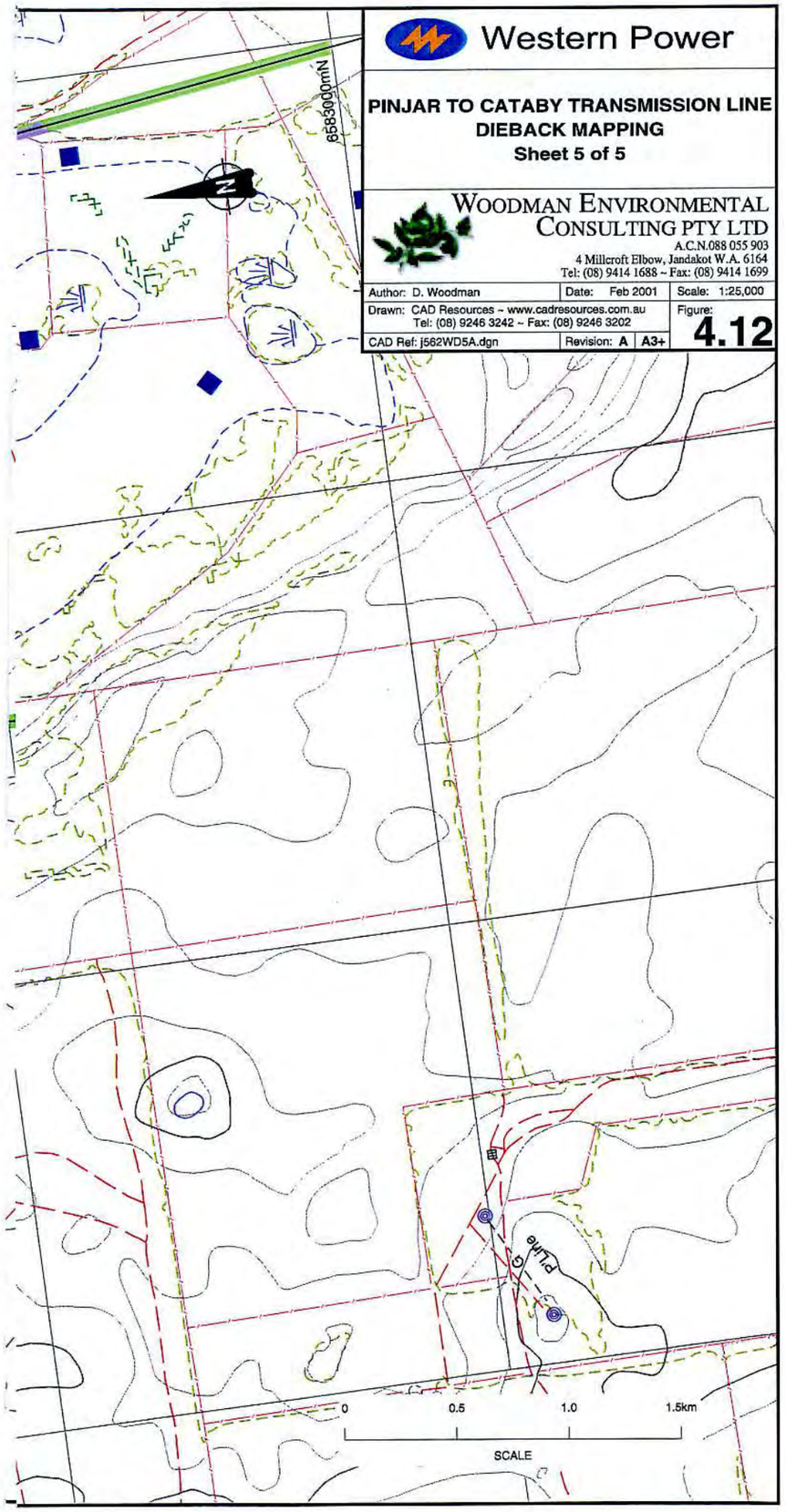
MIMEGARRA
346000mE
6587000mN
CARBA GAR
WALYENGARRA LAKE
6589000mN
6591000mN
DOUARABA SWAMP


Western Power
PINJAR TO CATABY TRANSMISSION LINE
DIEBACK MAPPING
Sheet 5 of 5
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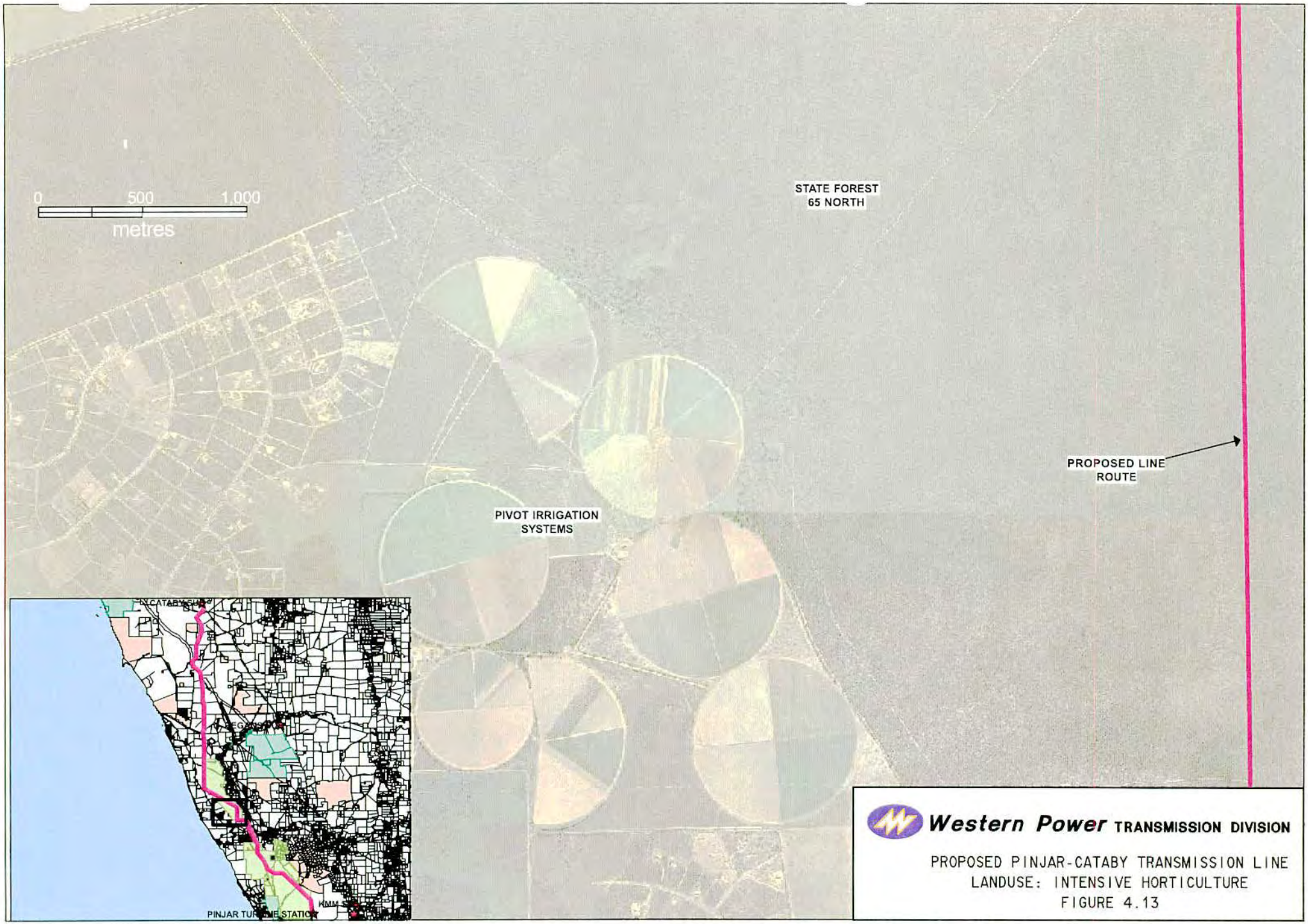
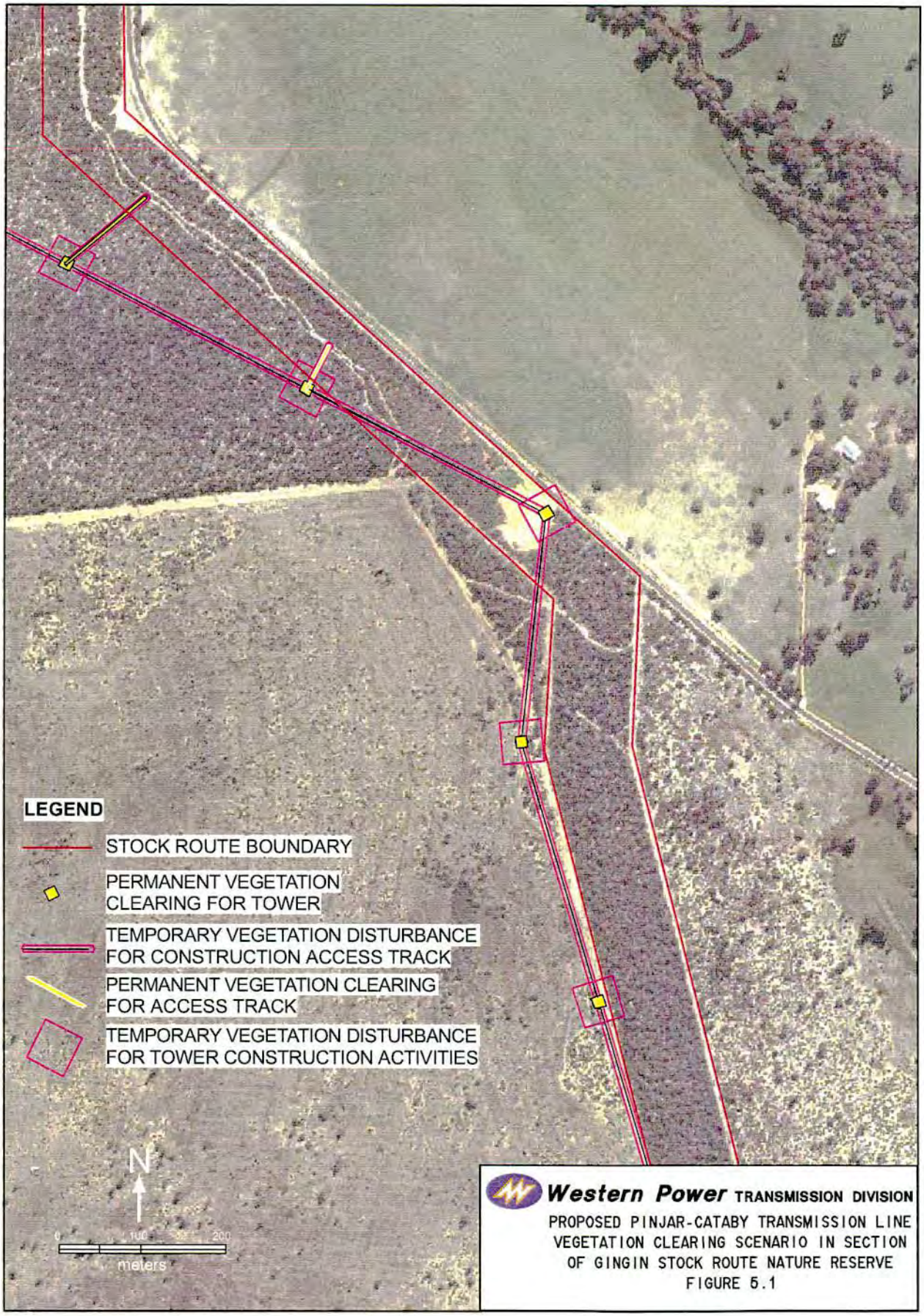
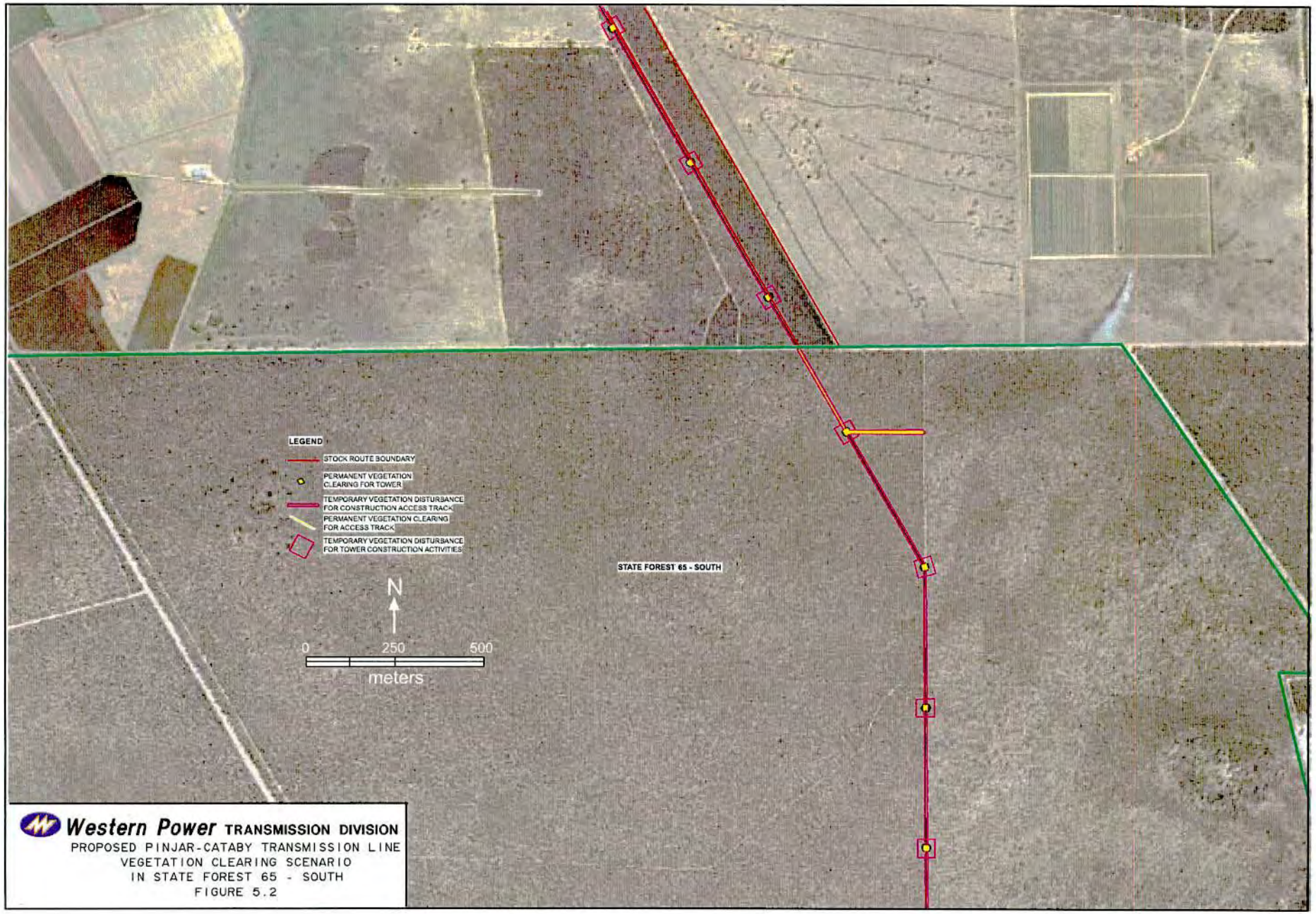
Scale: 1:25,000
Drawn: CAD Resources ~ www.cadresources.com.au
Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202
Figure: 4.12
CAD Ref: j562WD5A.dgn
Revision: A
A3+
6588000mN
N
Pinjar
0
0.5
1.0
1.5km
SCALE



Western Power TRANSMISSION DIVISION

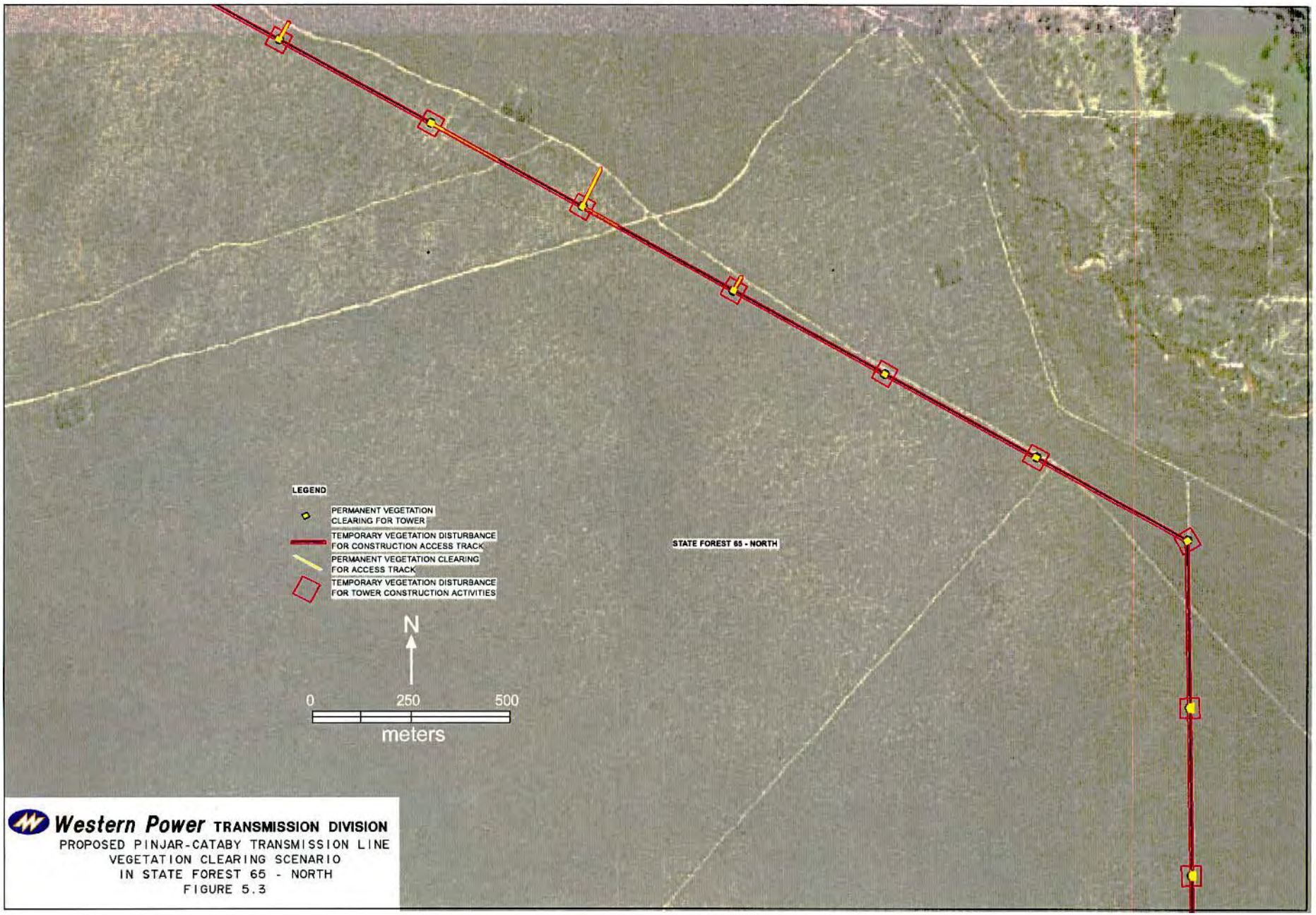
PROPOSED PINJAR-CATABY TRANSMISSION LINE
LANDUSE: INTENSIVE HORTICULTURE
FIGURE 4.13


LEGEND
STOCK ROUTE BOUNDARY
PERMANENT VEGETATION CLEARING FOR TOWER
TEMPORARY VEGETATION DISTURBANCE FOR CONSTRUCTION ACCESS TRACK
PERMANENT VEGETATION CLEARING FOR ACCESS TRACK
TEMPORARY VEGETATION DISTURBANCE FOR TOWER CONSTRUCTION ACTIVITIES
N
0
100
200
meters
Western Power TRANSMISSION DIVISION
PROPOSED PINJAR-CATABY TRANSMISSION LINE
VEGETATION CLEARING SCENARIO IN SECTION
OF GINGIN STOCK ROUTE NATURE RESERVE
FIGURE 5.1



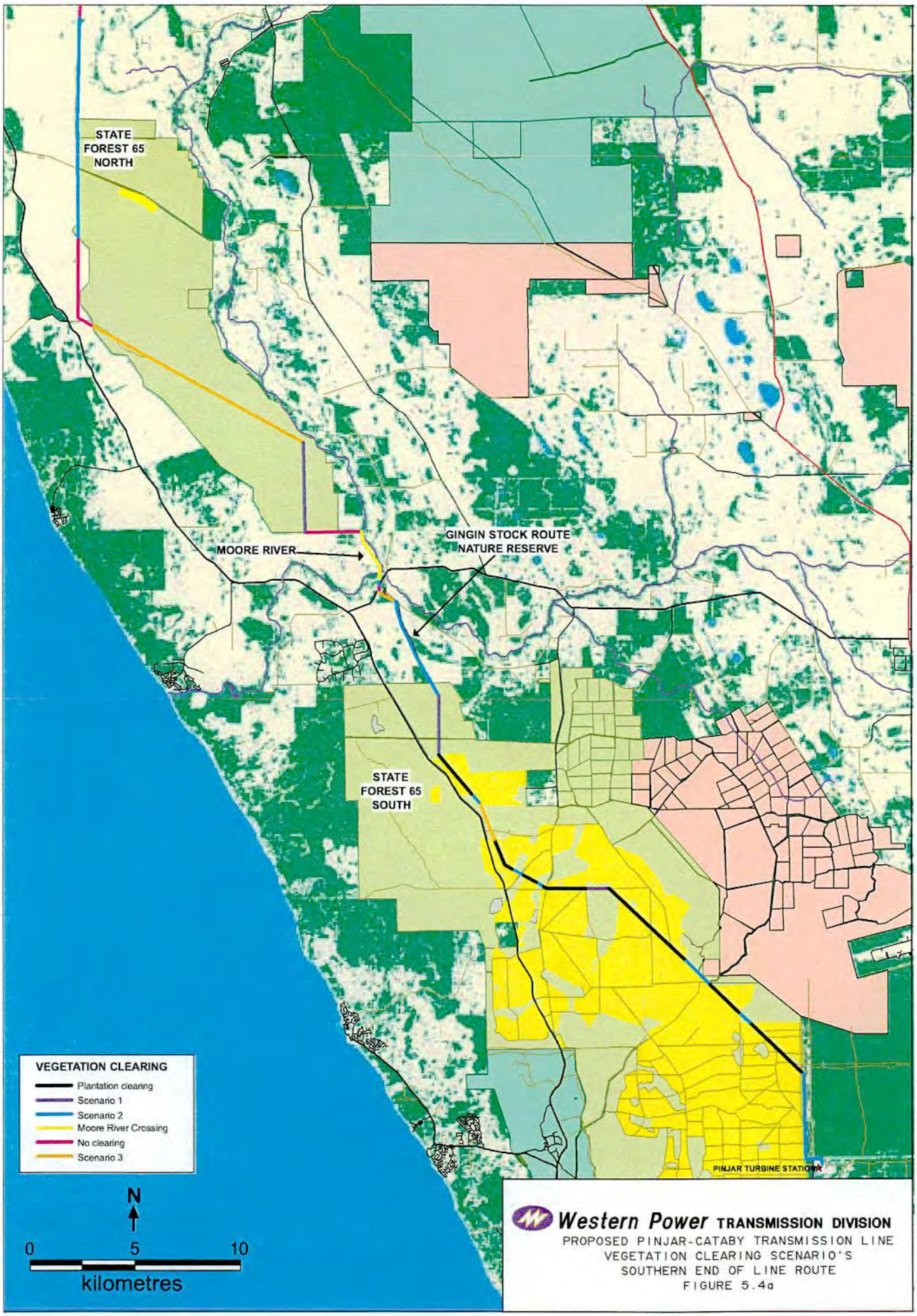
Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
VEGETATION CLEARING SCENARIO
IN STATE FOREST 65 - SOUTH
FIGURE 5.2



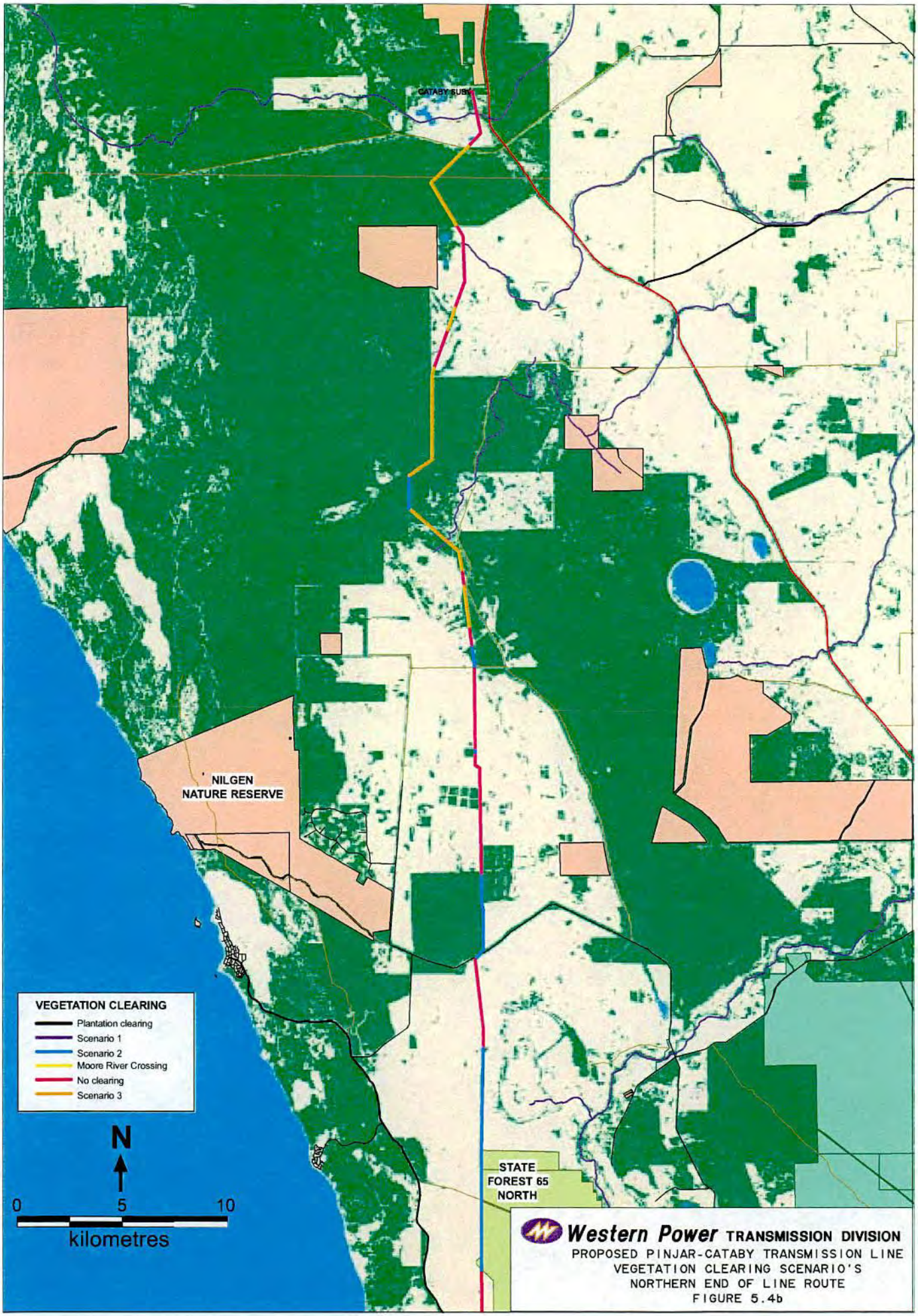
Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
VEGETATION CLEARING SCENARIO
IN STATE FOREST 65 - NORTH
FIGURE 5.3



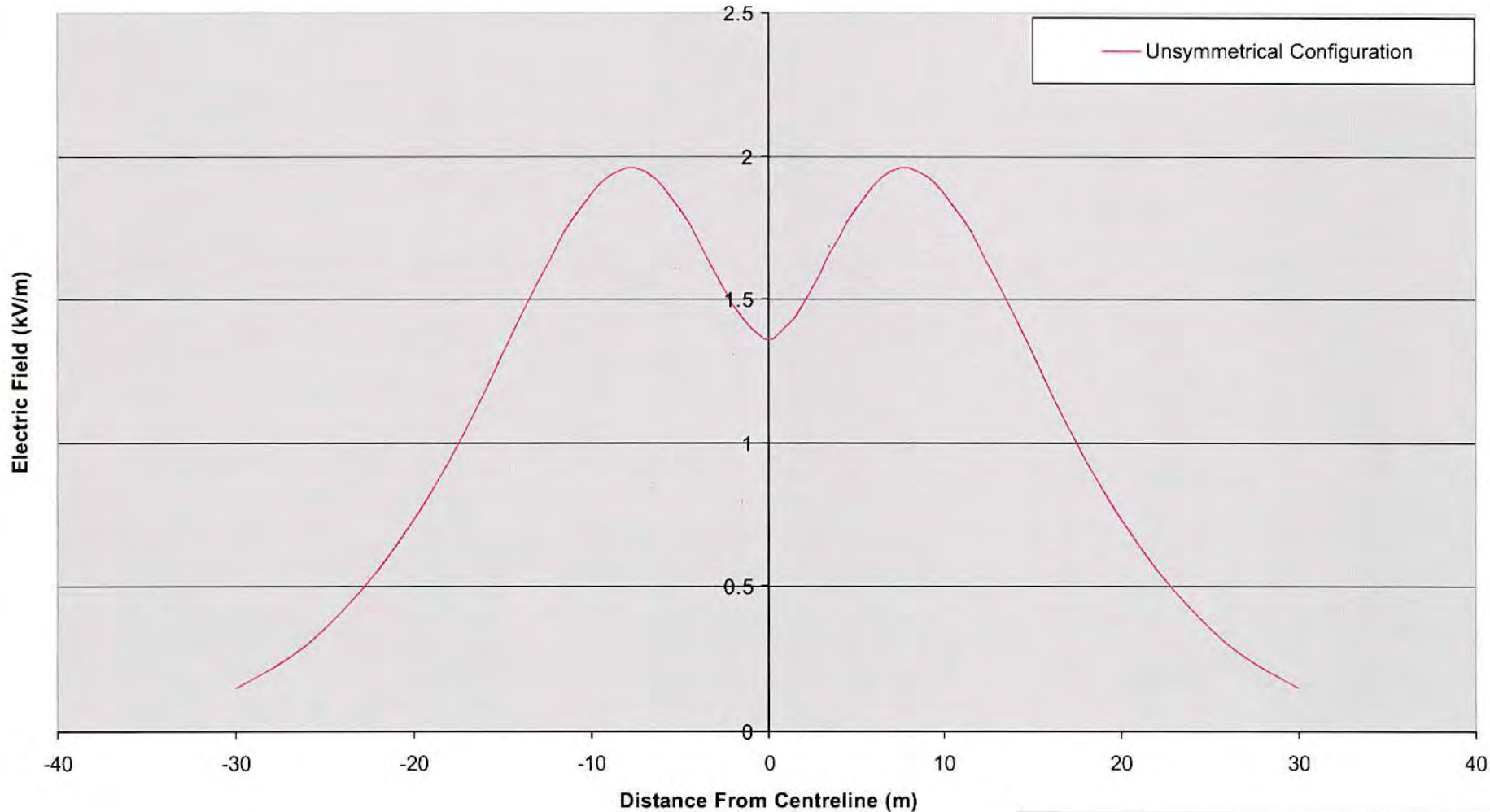
Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
VEGETATION CLEARING SCENARIO'S
SOUTHERN END OF LINE ROUTE
FIGURE 5.4a



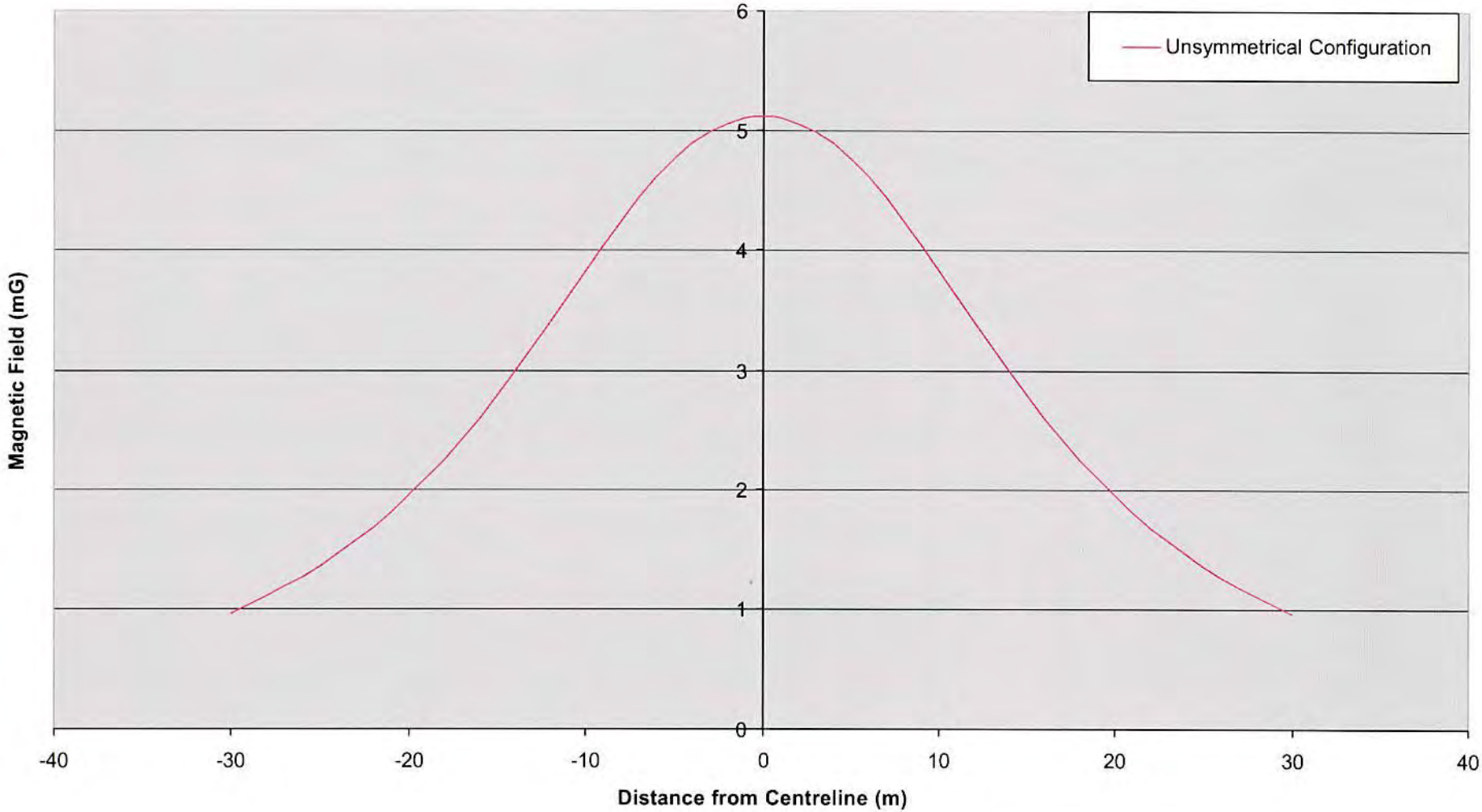
Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
VEGETATION CLEARING SCENARIO'S
NORTHERN END OF LINE ROUTE
FIGURE 5.4b



Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
ELECTRIC FIELD LEVELS
FIGURE 5.5a



Western Power TRANSMISSION DIVISION

PROPOSED PINJAR-CATABY TRANSMISSION LINE
MAGNETIC FIELD LEVELS
FIGURE 5.5b