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Western Australia

CERVANTES - JURIEN COASTAL ROAD

CONSULTATIVE ENVIRONMENTAL REVIEW

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CERVANTES - JURIEN COASTAL ROAD

CONSULTATIVE ENVIRONMENTAL REVIEW

APRIL 1997

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ENVIRONMENTAL CONSULTANTS

INVITATION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

The Consultative Environmental Review (CER) proposes the establishment of an alignment for the Cervantes - Jurien Coastal Road and environmentental management strategies for its construction. In accordance with the Environmental Protection Act 1986 a CER has been prepared which describes this proposal and its likely effects on the environment.

The CER is available for public review for up to four (4) weeks from 14 April closing on 12 May, 1997.

Comments from Government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to the 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 can suggest ways 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 each report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the work for an individual or group as well as increasing the pool of ideas and information.

If you form a small group (up to 10 people) please indicate the names of all 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 included in the CER 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 environmentally more acceptable.

When making comments on specific proposals in the review document:

- 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 CER;

- if you discuss sections of the CER, keep them distinct and separate, so there is no confusion about which section you are considering;

- attach any factual information you 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: **12 MAY 1997**

Submissions should be addressed to:

The Chairman
Environmental Protection Authority
'Westralia Square'
141 St Georges Terrace
Perth W.A. 6000

Attention: Wes Horwood

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INTRODUCTION

The Cervantes to Jurien Coastal Road proposed by the Shire of Dandaragan and managed by Main Roads Western Australia is a section of the planned coastal route between Lancelin and Dongara, as documented within the Central Coast Regional Strategy. Current access between Cervantes and Jurien is via Cervantes Road, Munbinea Road and Jurien East Road, a distance of 53 km. This proposal would reduce the travel distance by more than half.

The Brand Highway will remain as the primary route servicing the Central Coast Region, while the proposed coastal road linking Lancelin and Dongara forms part of the secondary road system within the region. The traffic service functions of the ultimate road between Lancelin and Dongara indicated in the Central Coast Regional Strategy are to:

- encourage traffic with an interest in the scenic characteristics of the region or the facilities of the coastal towns rather than heavy haulage traffic; and
- encourage intra-regional and local traffic including tourists travelling between towns.

The objective of this CER is to canvass the potential environmental impact of the proposal, and propose management strategies that will minimise any identified impacts.

PROJECT DESCRIPTION AND JUSTIFICATION

Project Description

The Cervantes - Jurien Road Coastal Road Project entails construction of a 7 m wide sealed carriageway, with 0.5 m sealed and 1 m of unsealed shoulder on each side, within a road reserve of 100 m. The proposal includes provision of a lookout facility at Molah Hill, which occurs adjacent to the proposed alignment, and a bridge across Hill River.

Project Justification

The Central Coast Regional Strategy provides for a continuous coastal route between Lancelin and Dongara, which will increase connectivity between the townships and will also produce the following benefits:

- the opportunity to enhance the level of control over access to sensitive coastal and other locations;
- stimulation of economic development by facilitating access between centres with different commercial and administrative functions;
- better access to and, therefore, utilisation of existing facilities, services and infrastructure;
- increased tourism and recreational activity;
- reduced travelling time for students attending local schools.

Substantial relative travel cost savings would obviously result from the construction of a direct link between Cervantes and Jurien. Benefits from the more direct route at a more localised scale include:

- enhanced connectivity between Cervantes and Jurien, promoting greater social and commercial interaction between the communities;
- formalisation of access in the coastal area which will facilitate coastal management initiatives; and
- enhancement of access to Jurien as a regional centre in keeping with the Central Coast Planning Strategy.

EVALUATION OF ALTERNATIVES

Alternative Alignments

Options for achieving a more direct road link between Cervantes and Jurien focus on an alignment consistent with the continuous coastal route indicated in the Central Coast Planning Strategy. Since the early 1980s identification of various alignments which provided for a direct road link between Cervantes and Jurien has occurred. Alternative routes were identified at two parts of a direct link between Cervantes and Jurien, these being at the southern entry into Jurien Township (three alignment options) and at the entry from the north into Cervantes township (two alignment options).

The Cervantes options were a bypass and an entry road to the north of the Cervantes townsite. During the public consultation process three options were developed for the entry point of the road to Cervantes.

Assessment of the alignment options determined that there were no biological environment or heritage factors that provided a basis for selection of any of the options for the Jurien and Cervantes entries. Selection of the preferred option has therefore been derived through consideration of land use and social factors.

No Development Option

Under the Central Coast Regional Strategy, Jurien will be promoted as a major service centre in the region. Services will therefore be available in Jurien that are not available elsewhere and hence accessibility to these services will be an important factor for the surrounding residents, including those in Cervantes.

The No Development option would have significant implications for the Central Coast Region as the land use and planning strategy has been developed incorporating the Lancelin to Dongara coastal road.

EXISTING ENVIRONMENT

Wetlands

The proposal crosses the Hill River, and is located in close proximity to Wealacutta Pool to the north of the Cervantes townsite. Wealacutta Pool is within the Cervantes Suite of wetlands and is listed under the Draft Environmental Protection (South West Agricultural Zone Wetlands) Policy 1995. The proposal is also located in close proximity to Dingo Swamp, which occurs as a series of small claypans in the south-east part of the study area.

Vegetation and Flora

A botanical survey of the proposed road alignment was undertaken in order to document the vegetation and flora for the purposes of environmental assessment. A total of 14 major vegetation types were determined:

(i) Scrub heath
(ii) Hill top heath
(iii) Low heath on coastal flats dominated by *Melaleuca scabra*
(iv) Coastal heath on coastal flats dominated by *Melaleuca acerosa*
(v) Coastal scrub on dunes
(vi) Coastal scrub disturbed
(vii) Samphire communities fringing playa lake
(viii) Low scrub fringing playa lake dominated by *Melaleuca hamulosa*
(ix) Thicket fringing playa lake dominated by *Melaleuca cardiophylla*
(x) Disturbed areas devoid of native species
(xi) Scrub dominated by *Allocasuarina lehmanniana*
(xii) Riverine thicket fringing the Hill River
(xiii) Mobile sand dunes
(xiv) Pasture

A total of 232 native and 43 introduced species were recorded during the study. No Declared Rare or Priority flora species listed in the Wildlife Conservation (Declared Rare Flora) Notice 1996, were located during the biological survey carried out for this project.

Fauna
The field survey recorded 44 species of bird, five native and two introduced mammal species, and seven reptile and four amphibian species. No species of rare and endangered fauna protected under the Wildlife Conservation (Specially Protected Fauna) Notice 1996 were recorded during the biological survey carried out for this project.

Conservation Reserves
There are a number of conservation areas in the Cervantes to Jurien area, including Drovers Cave National Park, Nambung National Park, Lesueur National Park, Coomallo Nature Reserve, Badgingarra National Park and Hill River Reserve. The proposal impacts on the "C" Class Southern Beekeepers Reserve (↑36053) reserve vested with the National Parks and Nature Conservation Authority.
Cervantes - Jurien region are shown in Figure 9.

The road alignment does not cross any areas listed under the System 5 (Northern Sandheaths) Conservation Reserves as recommended by the EPA.

Cultural Heritage
No archaeological sites have been registered with the Aboriginal Affairs Department for the project area and no archaeological sites were recorded during the systematic survey conducted for this project. No known sites of ethnographic importance were recorded during the ethnographic survey undertaken for this project.

Currently, there are no designated European Heritage Sites within the alignment corridor.

Visual Amenity
The study area lies within the Wheatbelt Plateau Landscape Character Type, and the Geraldton Plains Landscape Character Sub-Type as defined by the Department of Conservation and Land Management. The project area would be classified as having moderate scenic quality for landform, vegetation and waterform characteristics. The Hill River however is classified as a waterform with high scenic quality.

PUBLIC CONSULTATION

The Public Consultation programme for the Cervantes - Jurien Coastal Road occurred both to disseminate information on the project, as well as to assist in the definition of a preferred alignment from the range of options considered. In addition to mailouts of written material, a public open day was held for both Cervantes and Jurien, with an additional public meeting being held in Cervantes.

A total of 103 written submissions were received from the newsletter mailout and public information displays. Of these 38 expressed general approval for the proposal, with many indicating that the project should be implemented as soon as possible. One submission indicated disagreement with the road construction on the grounds of preserving the isolated nature of the region. Input from the public consultation was utilised to select and refine the preferred alignment for the Cervantes to Jurien coastal road.

ANTICIPATED ENVIRONMENTAL IMPACTS

During the early feasibility stages of the project, and utilising the CER guidelines issued by the EPA, the key factors identified are:

(1) Biophysical
- Regionally significant wetlands
- Locally significant wetlands
- Watercourses
- Conservation Areas
- Flora and Fauna
- Vegetation
- Vegetation Diseases
- Movement of Fauna
- Dune Protection
- Erosion
- Drainage Management

(2) Other
- Visual Impacts
- Aboriginal Heritage
- Source of road construction materials
- Noise
- Risk and Hazard

The most significant environmental impact which may arise from the proposal is the potential for the spread of dieback infection, particularly both from and to material source sites and surrounding areas. The proximity of the project area to the Drovers Cave and Nambung National Parks, and the Beekeepers Nature Reserve makes the introduction of dieback into the area a significant regional issue.

ENVIRONMENTAL MANAGEMENT STRATEGY

The aim of the Environmental Management Strategy is to document environmental management strategies to be applied to the proposal, to demonstrate that the environmental impacts are of an acceptable level and nature according to the assessment process under the Environmental Protection Act 1986.

There is considerable precedent to demonstrate that the environmental impacts of road projects can be managed. This section provides the general principles for management of potential impacts in the context of prevailing policy and practice.

Management of the following factors is required:

- Conservation areas: weed and dieback management measures, access and fire management strategies are necessary for management of the border of southern Beekeepers Reserve formed by the Cervantes to Jurien coastal road.

- Vegetation: includes management of clearing, weed eradication and dieback hygiene measures.

- Dieback; assessment and hygiene measures required for material source sites and construction activities.

- Drainage management: prevention of road runoff draining directly into the Hill River.

- Visual amenity: rehabilitation of disturbed areas to minimise impact of construction on the amenity of the site.

PROPONENT COMMITMENTS

Specific commitments have been made in reference to management strategies required to minimise environmental impact of the project. Commitments are made for:

- dieback identification and management;
- vegetation clearing;
- liaison with CALM concerning management of Beekeeper Reserve boundary;
- weed control;
- drainage management; and
- rehabilitation.

A summary of the commitments made for the project are provided in the following table.

CONCLUSION

In conclusion, the alignment selected for the Cervantes to Jurien Coastal Road has been made to account for physical and social environmental factors, and has been endorsed by the results of the public consultation programme for the project. The impacts are typical of those resulting from a road project of this nature, for which environmental management practice is well established.

The most significant potential impact of the project is the spread of dieback disease into conservation areas. Consequently dieback hygiene management will be a crucial component of the environmental management strategy for the project.

Summary of Proponent Commitments

FACTOR	OBJECTIVE	IMPACTS OF THE PROPOSAL	NO.	COMMITMENT	PHASE	TO SATISFY
Environmental Management Programme (EMP)	Address the CER commitments	The key environmental factors requiring management strategies have been identified, and commitments made to ensure that project impacts are minimised.	1	Implementation and auditing of the environmental management strategies documented within the CER.	All Phases	DEP & CALM
BIOPHYSICAL ENVIRONMENT						
Conservation Areas	Ensure the project does not have a detrimental impact on the Southern Beekeeper's Nature Reserve	The proposal will result in a road forming the western boundary of the Southern Beekeeper's Nature Reserve, causing potential for introduction of weeds and dieback, and increased ease of access.	2	Liasion with CALM to determine requirements for fire management access tracks and firebreaks for the section of the southern Beekeepers Reserve where the coastal road forms the western boundary of the reserve.	Pre-construction	CALM
Vegetation and Management of clearing	Minimise clearing of remnant vegetation within the road reserve during construction	The proposal will require vegetation clearance which will destabilise the ground surface. Rehabilitation of disturbed ground will be required following road construction.	3	Clearing and stockpiling of vegetation shall occur in accordance with the procedures designated within the MRWA Environmental Management Manual and Roadside Flora Care Manual, and incorporated into the project EMP.	Construction	DEP
	Minimise clearing of remnant vegetation within the road reserve during construction	Clearing of native vegetation is a major impact of the proposal. Clearing can be minimised by management techniques implemented during the construction phase.	4	During construction, road verges shall not be cleared by beyond the corridor required for the road formation and earthworks.	Construction	DEP
	Prevent the introduction and spread of weeds.	Weeds can be introduced or spread due to increased vehicle movement through the project area. The extent to which this occurs requires management to minimise impact to conservation value vegetation in the region.	5	Weed control shall be included as a component of the rehabilitation strategy developed for the project and form an ongoing component of road reserve management.	Pre-construction and Construction	CALM
Vegetation Diseases	Prevent the introduction and/or spread of dieback.	The spread of dieback is a potential impact of the proposal due to construction activities and increased traffic on the road itself. The significance of this aspect results from the proximity to dieback susceptible vegetation types.	6	A Dieback Management Programme shall be developed and implemented to the requirements of CALM .	Pre-construction and Construction	CALM
Drainage Management	To prevent contamination of wetlands and watercourses	As the proposal crosses the Hill River, a potential impact is that of contaminated road runoff entering the watercourse.	7	An appropriate design be developed to prevent direct discharge of stormwater runoff to the Hill River.	Pre-construction	DEP & Water & Rivers Commission
OTHER FACTORS						
Visual Impacts	To minimise the impact of the proposal on visual amenity within the project area.	The proposal will alter the visual amenity of the area as there is currently no formal access and little development in the region.	8	Rehabilitation shall be incorporated into the project and is to be based upon procedures designated within the MRWA Environmental Management Manual and the Roadside Flora Care Manual.	Pre-construction	DEP & CALM
Material sourcing	To ensure that material source sites are subject to appropriate levels of environmental management.	The main impact from use of material source sites is that of potential for dieback contamination.	9	Sites utilised for acquisiton of construction materials will be subject to appropriate environmental assessment and management procedures commonly implemented for such sites	Post-construction	DEP
	To rehabilitate source material sites	Ground disturbance will result from obtaining construction materials.	10	On completion of construction, all borrow pits on private or public lands shall be reinstated or rehabilitated, in accordance with Main Roads policy and in consultation with owners or management agencies.	Post-construction	DEP
Noise	To avoid creating noise nuisance for local residents	Construction noise may disturb residents where the proposal enters the Cervantes and Jurien townsites.	11	Construction activities adjacent to residential areas will be limited to reasonable daylight hours to mitiate noise impact in adjacent localities	Construction	Shire of Dandaragan

1.0 INTRODUCTION

1.1 OBJECTIVE

Options for improving road access between the coastal communities of Cervantes and Jurien within the Shire of Dandaragan have been under consideration for several years. Community pressures resulting from social and economic requirements have been a significant component of development and scheduling of this proposal. Current access between Cervantes and Jurien is via Cervantes Road, Munbinea Road and Jurien East Road, a travel distance of 53 km. Construction of an improved road link between Cervantes and Jurien would reduce the current travel distance by greater than half; a potential saving of approximately 30 km.

The proposed Cervantes to Jurien Coastal Road is an integral part of the planned coastal route between Lancelin and Dongara, intended to service the growing Central Coast Region. Parts of the coastal route already exist or have been planned, and the Cervantes to Jurien section is now regarded as having priority within the overall Lancelin to Dongara route.

The proposal to move to construction of the Cervantes to Jurien Coastal Road has been referred to the Environmental Protection Authority (EPA) which has decided to formally assess the proposed road at Consultative Environmental Review (CER) level.

The objective of this CER is to canvass the potential environmental impact of the proposal, and propose management strategies that will minimise any identified impacts. The CER has been prepared in accordance with the guidelines issued by the EPA for the project (refer to Appendix A).

1.2 BACKGROUND

The development pattern within the Central Coast Region has largely evolved from a series of squatter settlements, and as development within the region has grown, so too has the demand for better road access. An improved regional road network is an important planning objective within the Central Coast Region. In this regard, the Central Coast Regional Strategy, prepared by the Western Australian Planning Commission (WAPC) provides for a continuous coastal road between Lancelin and Dongara. The proposed Cervantes to Jurien will form part of this route.

The ultimate route from Lancelin to Dongara may be perceived as a potential alternative route to the Brand Highway for inter-regional traffic. However, the Central Coast Regional Strategy (WAPC, 1996) indicates that this is not intended. The Brand Highway will remain as the primary route servicing the Central Coast Region, while the proposed coastal road linking Lancelin and Dongara forms part of the secondary road system within the region. The traffic service functions of the ultimate road between Lancelin and Dongara indicated in the Central Coast Regional Strategy are to:

- encourage traffic with an interest in the scenic characteristics of the region or the facilities of the coastal towns rather than heavy haulage traffic; and
- encourage intra-regional and local traffic including tourists travelling between towns (WAPC, 1996).

Current access between Cervantes and Jurien is a travel distance of 53 km. A more direct road link would reduce the current travel distance by about half and would facilitate all forms of interaction between the two communities. Substantial relative travel cost savings would result from construction of the proposed road and it would also produce the following benefits:

- enhanced control over access to sensitive coastal and conservation areas;
- enhanced social and economic interaction between the Cervantes and Jurien communities; and
- increased recreational and tourism opportunities.

Investigations that have been undertaken as part of the proposed Coastal Road - Cervantes to Jurien project and preparation of the Consultative Environmental Review have included:

- examination of alternative route options within the project area that would satisfy the objective of enhancing the level of road access;
- description of the existing biological and human environments within the area affected by the project, focusing on the area traversed by the preferred alignment, but also including the alternative routes considered; and
- assessment of potential environmental impacts arising from construction and operation of the proposed road and development of strategies for managing these impacts.

Detailed flora, fauna, archaeological and ethnographic studies have been undertaken and a thorough community consultation programme has been conducted. The consultation programme included information about the Environmental Protection Authority's environmental impact assessment process to facilitate community input to the Environmental Protection Authority on the project.

1.3 PROJECT LOCATION

The proposed Coastal Road between Cervantes and Jurien is located approximately 250 km north of Perth, Western Australia (Figure 1). The alignment is situated approximately 3 km from the coastline, to the east of both townships. The alignment will require a bridge crossing at the Hill River, and passes through the Southern Beekeeper's Nature Reserve (↑C36053).

The proposed road comprises a single sealed carriageway 7 metres wide, with 0.5 m of sealed shoulder and 1 m of unsealed shoulder on each side, within a 100 m road reserve.

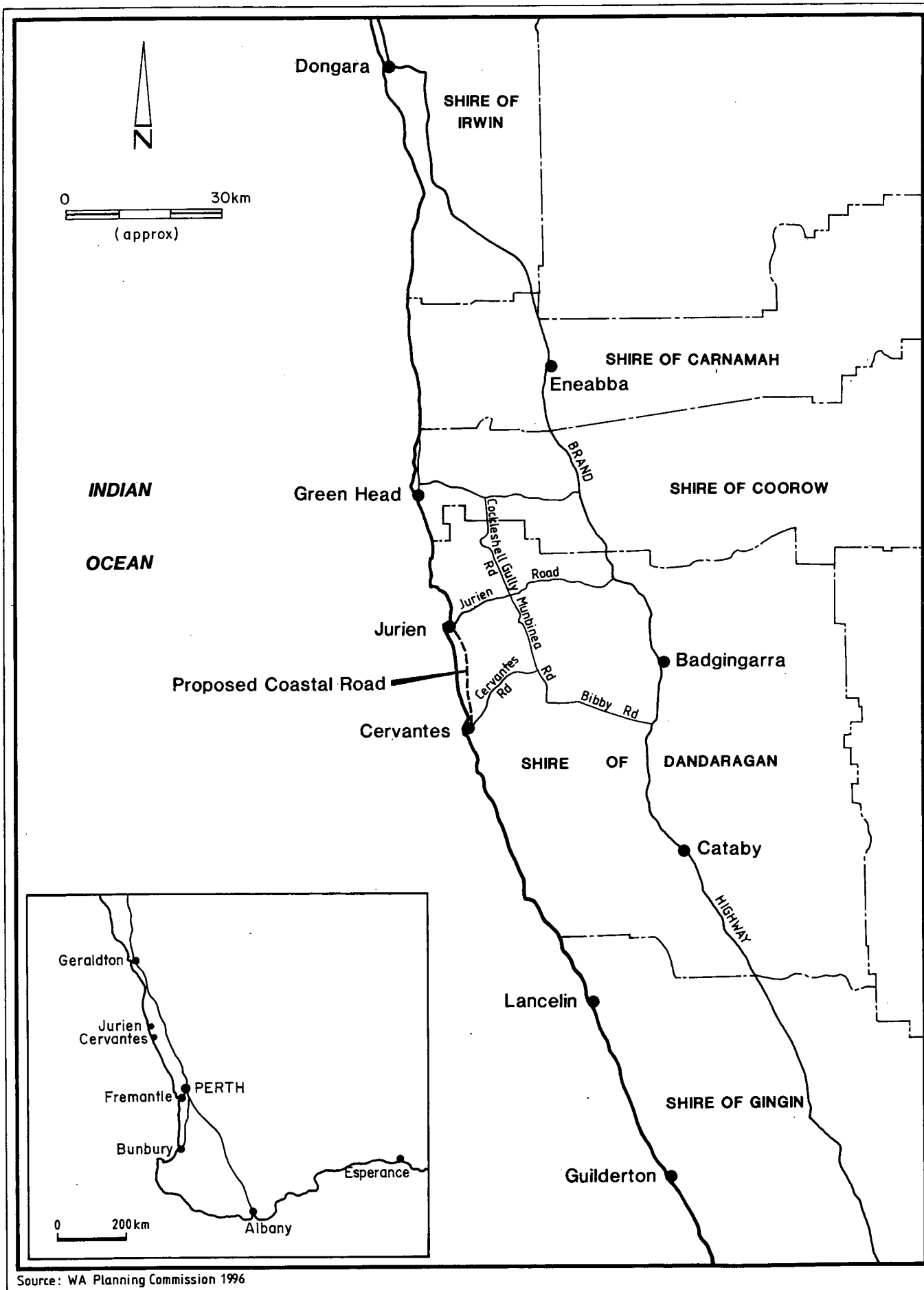
1.4 THE PROPONENT

The proponent for the Cervantes - Jurien Coastal Road is the Shire of Dandaragan. The proponent details are:

Name	Shire of Dandaragan
Address	Dandaragan Road DANDARAGAN WA 6507
Telephone Number	(096) 51 4010
Facsimile Number	(096) 51 4057

Main Roads Western Australia, through its Northam Divisional Office, is acting as the project manager for the proposed Cervantes - Jurien Coastal Road. Their particulars are as follows:

Name	Main Roads Western Australia Northam Division
Address	Yilgarn Avenue NORTHAM WA 6401
Postal Address	PO Box 333 NORTHAM WA 6401
Telephone Number	(096) 22 4777
Facsimile Number	(096) 22 3940



Source: WA Planning Commission 1996

Figure 1: Location Map

1.5 APPROVALS PROCESS

The EPA is required to assess all development proposals which may have a significant environmental effect. In this instance, the EPA has decided to formally assess the proposal pursuant to the provisions of Part IV of the Environmental Protection Act 1986.

The EPA's formal environmental impact assessment process allows members of the public to obtain details of the proposal being assessed and to comment on any matters of interest or concern to them. It also enables relevant Government authorities to consider the environmental and social implications of the proposal and provide comments as appropriate to the EPA. In assessing the proposal, the EPA considers all comments received.

In setting the level of formal environmental impact assessment for the proposed Cervantes to Jurien Coastal Road at CER level, the EPA has required that the document be released for a four (4) week public review period during which time any interested individual, community group or organisation, or Government agency can peruse the document and lodge a submission on the proposal with the EPA. This CER is a public document and is part of the statutory public environmental impact assessment process established by the Environmental Protection Act 1986.

Following completion of the public review period and receipt of public submissions, the EPA will complete its assessment of the proposal and submit its report to the Minister for the Environment. The EPA's report to the Minister provides advice to the State Government about the environmental acceptability of the proposal.

The Minister will release the EPA's Assessment Report for a two (2) week period during which the public can scrutinise the conclusions and, if considered warranted, appeal to the Minister against the recommendations made about the proposal. The Minister for the Environment will assess any appeals received and ultimately determine whether or not the proposal can proceed. If the Minister determines that the proposal can proceed, legally binding conditions dictating the environmental requirements with which the proponents have to comply will be set pursuant to Section 45 of the Environmental Protection Act 1986.

Thus, in order for the proposed Cervantes to Jurien Coastal Road project to proceed, the following requirements need to be completed:

- release of this CER for a four (4) week public review period;
- DEP prepare a summary of submissions received from Government Agencies and members of the public;
- proponents provide the EPA with written responses to all issues raised in submissions received during the public review period. Where appropriate, the proponent may amend the proposal and/or change the management commitments in response to comments raised during the public review period, provided such changes reduce environmental impacts;
- the DEP submits an evaluation of project impacts to the EPA, and any additional requirements to ensure that the proposal would satisfy environmental policies and objectives;
- the EPA provides its advice to Government on the proposal through its Assessment Report made to the Minister for the Environment. The Report and Recommendations are released to the public, and includes a 14 day appeal period;
- the Minister determines any appeals against the EPA's Report and if the proposal is regarded as environmentally acceptable, sets legally binding conditions on the proponent; and
- the project is commenced according to the Ministerial Conditions and Proponent Commitments set out in the Statement that a Proposal may be Implemented (Pursuant to the Provisions of the Environmental Protection Act 1986).

1.6 LEGAL FRAMEWORK

In addition to satisfying the provisions of the Environmental Protection Act 1986, requirements under the following legislation relevant to the proposal have been or will be considered:

Aboriginal Heritage Act 1972

Conservation and Land Management Act 1984

Heritage of Western Australia Act 1990

Land Act 1933

Local Government Act 1960

Main Roads Act 1930

National Trust of Australia Act 1964

Property Law Act 1969

Land Acquisition and Public Works Act 1902

Western Australian Planning Commission Act 1985

Town Planning & Development Act 1928 (as amended)

Wildlife Conservation Act 1950

1.7 MAIN ROADS ENVIRONMENTAL MANAGEMENT PRACTICE

Main Roads in co-operation with Local Government Authorities develops and manages the State's road network. This role includes responsibility for road planning, road construction, maintenance, and management of road reserves associated with State roads.

Main Roads has developed policies and procedures for environmental assessment and management of its activities. This includes an Environmental Management Manual (MRWA, 1996a) which documents:

(i) an Environmental Management Strategy which covers:

- an Environmental Code of Practice;
- Procedures for Environmental Assessment and Management; and
- Environmental Education and Training.

(ii) guidelines for the consideration of significant environmental issues in roadworks, which covers a range of issues including:

- Aboriginal sites;
- Aesthetics;
- Biological surveys;
- Clearing of vegetation;
- Cultural heritage places;
- Dieback;
- Drainage and hydrology;
- Noise;

- Rare flora and fauna;
- Rehabilitation; and
- Social effects.

1.8 SCOPE, PURPOSE AND STRUCTURE OF THE CER

The objective of the CER is to provide the EPA with information about the proposal as a basis for its assessment of the project, and to inform interested parties about the project so that they are in a position to contribute to the environmental impact assessment process if they so wish.

The structure of the CER is as follows:

Chapter 1 provides a background to the project and the environmental assessment process to gain project approval.

Chapter 2 of the CER describes the scope of the project, and the justification for the proposal to proceed, while Chapter 3 describes the existing biological and human environment within the project area. Chapter 4 summarises the public consultation programme undertaken for the project.

Chapter 5 canvasses potential environmental impacts associated with the proposed route, and details the environmental management plan developed to mitigate these impacts.

2.0 PROJECT DESCRIPTION AND JUSTIFICATION

2.1 PROJECT DESCRIPTION

Current access between Cervantes and Jurien is via Cervantes Road, Munbinea Road and Jurien East Road, a travel distance of 53 km. Clearly, the more direct road link between Cervantes and Jurien, consistent with the overall coastal route linking Lancelin and Dongara, would reduce the current travel distance by greater than half; a saving of approximately 30 km.

The Cervantes - Jurien Road Coastal Road Project entails construction of a 7 m wide sealed carriageway, with 0.5 m sealed and 1 m of unsealed shoulder on each side (Figure 2), on an "environmentally and socially acceptable" alignment linking the two town centres. A road reserve of 100 m is envisaged. The proposal includes provision of a lookout facility at Molah Hill, which occurs adjacent to the proposed alignment, and a bridge across Hill River. The bridge design is to be based upon a 3 x 12 m span and 11 m high structure.

The Coastal Road proposal includes an entry road into Cervantes and a bypass of Cervantes which deviate from the same point on the central section of the road. At the northern end, an entry road into Jurien deviates from the point where the Jurien bypass is proposed. This CER seeks approval for the main alignment, Cervantes and Jurien entries and the Cervantes bypass. The Jurien Bypass was approved as a component of the Jurien to Greenhead project.

2.1.1 Construction Standards

Standards to be adopted for construction of the Coastal Road - Cervantes to Jurien will be in accordance with AUSTROADS design guidelines. Relevant standards are briefly summarised as follows:

Horizontal Design Speed	110 km/hr minimum
Vertical Design Speed	90 km/hr minimum
Formation Width	10.0 m
Sealed Traffic Width	7.0 m (2 lanes @ 3.5 m)
Sealed Shoulder Width	2 x 0.5 m
Unsealed Shoulder Width	2 x 1.0 m
Road Reserve Width	100 m
Road Markings	Lane separation

All proposed intersections with the Coastal Road will be designed in accordance with AUSTROADS "Guide to Traffic Engineering Practice - Intersections at Grade".

Commencement of construction of the Coastal Road between Cervantes and Jurien is dependent on receiving environmental approval. However, the indicative schedule is for construction to commence in late 1997. The initial construction phase will not include the Cervantes or Jurien bypasses. It is likely that the bypasses will be constructed as a component of the Lancelin to Cervantes section of the overall coastal alignment.

2.1.2 Sources of Materials

The proposed road is anticipated to require 150 000 m^3 of sub-base and basecourse pavement material for construction. A specific study has been undertaken by Main Roads WA in order to identify suitable material source sites for construction of the proposed road (Main Roads WA, 1996). Sixteen potential source sites were investigated (Figure 3), with four sites proving unsuitable for materials supply. Of the twelve potential material source sites, five are existing pits or are adjacent to existing pits, one site is adjacent to a rubbish tip, and the remaining six sites are located on pastoral properties.

A summary of potential source site locations and details is provided in Table 1.

While the materials source sites form an integral component of the proposed road project, ultimate selection of source sites will occur when the final road design determines the amount and type of materials required. Approval is sought within this CER for access to utilise borrow pit sites on private and Crown Land not within conservation areas.

Table 1: Location and details of potential material source sites.

PIT NO	LOCATION	TYPE	VOLUME	COMMENTS
1	Cervantes Rd 51.0 SLK 300 m N	Sub-Base	30,000	Adjacent to rubbish tip
2	Cervantes Rd 48.2 SLK 300 m N	Sub-base	15,000	Existing pit
3	Cervantes Rd 41.0 SLK 250 m SE	Fill	25,000	Currently paddock
4	Cervantes Rd 40.8 SLK 150 m W	Fill	20,000	Adjacent to existing pits
5	Jurien Rd 51.0 SLK 4.0 km S	Fill	Unproven	Existing pit / unsuitable
6	Jurien Rd 34.6 SLK 300 m SE	Sub-Base	50,000	Existing pit
7	Jurien Rd 34.5 SLK 1.3 km SE	Fill	45,000	N-W of existing pit
8	Jurien Rd 34.5 SLK 300 m S	Fill	10,000	N of existing pit
9	Jurien Rd 22.2 SLK	Sub-Base	20,000	S of existing pit
10	Munbinea Rd 1.6 km S, 1.5 km E Jurien Rd 23.0 SLK	-	-	Unsuitable
11	Munbinea Rd 2.3 km S, 0.4 km E Jurien Rd 23.0 SLK	Basecourse	20,000	Currently paddock
12	Munbinea Rd 2.3 km S, 0.4 km E Jurien Rd 23.0 SLK	Basecourse	20,000	Currently paddock, adjacent to Pit 11
13	Munbinea Rd 4.5 km S, 50 m E Jurien Rd 23.0 SLK	-	-	Unsuitable
14	Munbinea Rd 3.65 km S, 50 m E Jurien Rd 23.0 SLK	-	-	Unsuitable
15	Munbinea Rd 13.5 km S, 1.5 km E Jurien Rd 23.0 SLK	Fill	20,000	Currently paddock
16	Cervantes Rd 1.7 km E on Cadda Rd and 0.9 km N	Basecourse & Sub-Base	100,000	Currently paddock

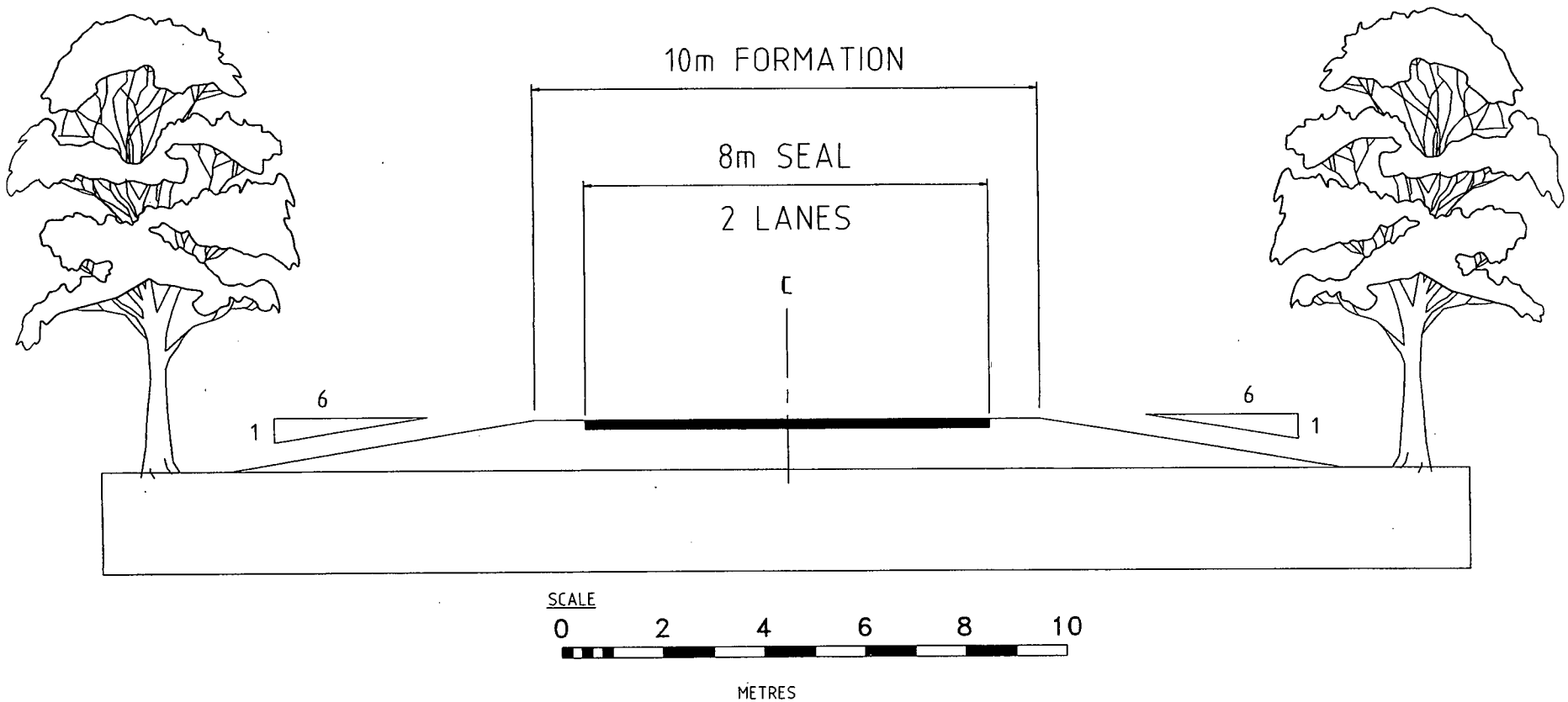
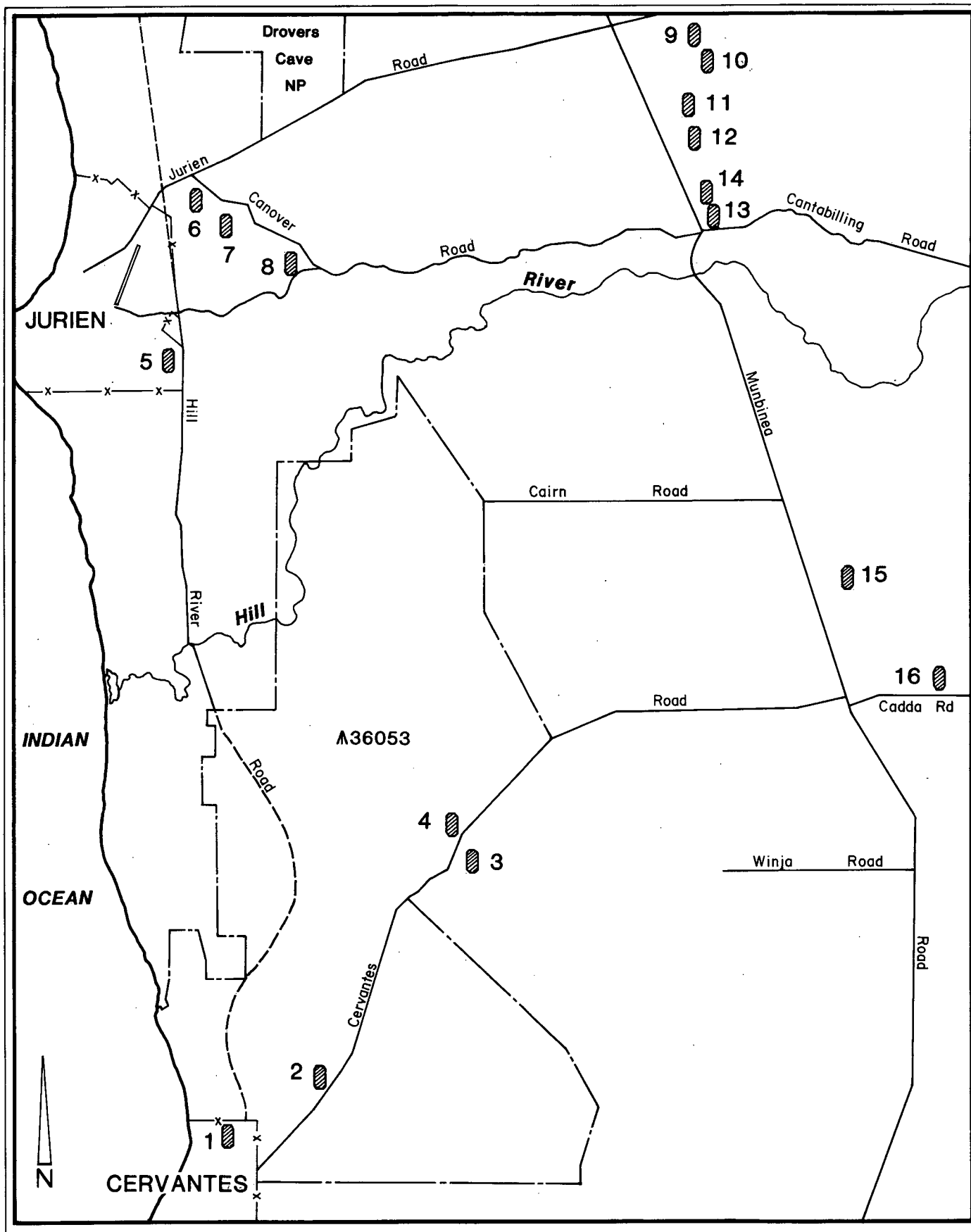


Figure 2: **Typical Cross Section of the Coastal Road Cervantes to Jurien**



PROPOSED CERVANTES TO JURIEN COASTAL ROAD

Potential Construction Material Source Sites

Figure 3

2.2 JUSTIFICATION FOR THE CERVANTES - JURIEN ROAD

2.2.1 Project History

Development within the coastal region of Western Australia extending generally from the Perth metropolitan area to Geraldton (known as the Central Coast Region) is characterised by small coastal townships derived largely from squatter settlements on Crown Land. The Central Coast Region has attracted increasing growth and development during the past decade, and a continuation of this trend is likely due to the region's proximity to the Perth metropolitan area (combined with the rate of growth within metropolitan Perth) and the attractions for tourism and recreational development the region offers.

The size of the Central Coast Region and the relative isolation of towns, means that roads are a crucial component of transport within the region. There are currently airstrips at Jurien and at Cervantes which are used for emergency and private purposes, however the majority of transport needs are serviced by the regional road network (Western Australian Planning Commission, 1996).

As the established coastal centres and informal squatter settlements within the Central Coast Region have grown, the demand for better road access has increased. Some road improvements have occurred and are perceived to have contributed to pressures for further development and access enhancement.

The consequent need for a regional framework to coordinate planning and development decision-making has been recognised, and the Central Coast Regional Strategy has been prepared by the Western Australian Planning Commission (WAPC, 1996) to achieve this. This strategy seeks to maintain the region's natural environmental values while providing for the establishment of facilities and infrastructure to service the growing regional population and accommodating development pressures that would benefit regional economic activity.

The Central Coast Regional Strategy provides for a continuous coastal route between Lancelin and Dongara. This route will increase connectivity between the respective coastal townships and will also produce the following benefits:

- the opportunity to enhance the level of control over access to sensitive coastal and other locations;
- stimulation of economic development by facilitating access between centres that provide different commercial and administrative functions;
- better access to and, therefore, utilisation of existing facilities, services and infrastructure, contributing to improved social and community development;
- increased tourism and recreational activity;
- reduced travelling time for students attending local schools.

The Green Head to Cliff Head section of the overall coastal route has already been constructed, while the Brand Highway provides an effective link between Cliff Head and Dongara. The Jurien - Green Head section has been completed and was opened for use in January 1997.

2.2.2 Need for The Proposal

Substantial relative travel cost savings would obviously result from the construction of a direct link between Cervantes and Jurien. The link would also produce benefits similar to those anticipated from the overall coastal route between Lancelin and Dongara, albeit at a more localised scale. Benefits from the more direct route would include:

- enhanced connectivity between Cervantes and Jurien, promoting greater social and commercial interaction between the communities;

- formalisation of access in the coastal area which will facilitate coastal management initiatives therein, including recreational and tourism development; and
- enhancement of access to Jurien as a regional centre in keeping with the Central Coast Planning Strategy.

While benefits from a more direct road link between Cervantes and Jurien can be demonstrated, such a link would traverse a biologically and geomorphologically diverse region, which has high conservation values. The evaluation of alternative alignments for the improved road link between Cervantes and Jurien is therefore an essential part of the process of selecting the option which achieves the best balance between the different environmental, social, economic and engineering considerations.

2.3 EVALUATION OF ALTERNATIVES

2.3.1 Introduction

The broad objective of the Cervantes - Jurien Road Project is to improve road access between the centres of Cervantes and Jurien. Considerable attention at both the regional and local scale has been given to the identification of options to best meet this objective.

One option is to upgrade the existing route between the centres. While this option would be environmentally beneficial, by confining construction-related impacts within an existing corridor of disturbance, benefits from a more direct route (as previously outlined) would not arise. Nevertheless, in any review of alternatives undertaken as part of an environmental impact assessment process, the minimal impact option (based on maintaining the status quo) must be addressed.

Options for achieving a more direct road link between Cervantes and Jurien focus on an alignment consistent with the continuous coastal route indicated in the Central Coast Planning Strategy. Interactions between Main Roads WA and, the then, Department of Conservation and Environment in the early 1980s led to identification of various alignments which provided for a direct road link between Cervantes and Jurien. Alternative routes were identified at two parts of a direct link between Cervantes and Jurien, these being at the southern entry into Jurien Township (three alignment options) and at the entry from the north into Cervantes township (two alignment options).

Therefore, the alternatives which will be evaluated in determining the preferred alignment option for the Cervantes - Jurien Road Project are illustrated in Figure 4 and described below:

2.3.2 Alternative Alignments

Northern 1: Northern Alignment

This alignment is the most northern of the three alignment options entering the Jurien townsite. It is approximately 3.0 km long, and runs in an approximately east-west direction for 1 km before turning to enter Jurien from the south. This option is located in closest proximity to the Jurien airstrip, and is intended to account for development options south of Jurien.

Opportunities and Constraints: No biological, social or planning constraints identified. Maximises opportunity for land development south of Jurien.

Northern 2: Central Alignment

The central alignment approaches Jurien from the south-east, and this option also is approximately 3.5 km long. Each of the northern options shares the southern approach into Jurien itself.

Opportunities and Constraints: No biological or social or constraints identified. Location would restrict land development south of Jurien.

Northern 3: Western Alignment

This is the longest of three northern alignment options, being 4 km in length, and is also the closest to the coast. This alignment enters Jurien from the south, although the approach from the Hill River Road is from the south-east. This option was developed to account for cadastral boundaries and land ownership current at the time of the option's development, but which has altered since the alignment was first proposed.

Opportunities and Constraints: No biological or social constraints identified. Location would restrict land development south of Jurien.

Southern 1: Coastal Alignment

The coastal route is aligned along the eastern edge of Wealacutta Pool and enters Cervantes from the north. The Southern 1 option is proposed to accommodate residential development north of the existing townsite and to improve access to the proposed Cervantes Quay development.

Southern 1 is approximately 3.5 km long and is constrained at the Cervantes entrance by the golf course and existing residential and road development. It is possible that this section would be constructed as a local access road, while Southern 2 forms the main Cervantes - Jurien Road, connecting through to the Pinnacles Access Road.

Three variations of the Southern 1 alignment were considered. Option One enters Cervantes by connection to Catalonia Street, Option 2 was proposed parallel to Brown Street to connect with Aragon Street and impinging on the golf course. The third option entered Cervantes by joining with Brown Street. The three options for the Southern 1 alignment are illustrated in Figure 5.

Opportunities and Constraints: Final location is restricted due to the presence of Wealacutta Pool and the Cervantes Golf Course. An appropriate alignment will provide opportunities to connect with the proposed marina development and the future northern Cervantes residential subdivision proposed by the Department of Land Administration (DOLA).

Southern 2: Inland Alignment

The inland alignment runs essentially in a north - south direction and is located to the east of the existing landing ground. Entry to Cervantes would remain via the Cervantes Road, with a near-perpendicular intersection between the Cervantes Road and the Cervantes - Jurien Road just south of the airstrip. This option connects with the Pinnacles Access Road, which also would include an additional feeder road into Cervantes.

Opportunities and Constraints: No biological or social constraints identified. Immediate construction not justified on economic grounds.

2.3.3 Selection of the Preferred Alignment

Assessment of the alignment options determined that there were no biological environment or heritage factors that provided a basis for selection of any of the options for the Jurien and Cervantes entries. Selection of the preferred option has therefore been derived through consideration of land use and social factors.

The Northern 1 entry to Jurien was selected in order to prevent restriction of the future expansion of the Jurien townsite, by accommodating residential and tourism related development south of Jurien. This entry will be constructed in conjunction with the Jurien bypass that will connect with the Jurien - Greenhead road.

The option for the southern end of the alignment was based upon an alignment which constitutes a bypass for Cervantes (S2) with the provision of a slip road into the northern end of the Cervantes townsite between Wealacutta Pool and the Cervantes golf course (S1).

Although there was public support for S1, the original alignment was constrained by the wetland and golf course location, and concern about the use of a residential street for the connection into Jurien. These constraints were overcome in the Option 1 variation for the S1 alignment, and the preferred alignment is based upon construction of the feeder road into Cervantes, with the "bypass" to be constructed at the time of the connection with Lancelin going through.

The initial construction of the S1 option is justified on the basis of providing suitable access to the fishing industry at the northern end of Cervantes for traffic going to and coming from Jurien. The northern entry option will prevent the industry traffic from coming through the Cervantes townsite. The alignment will facilitate access to the DOLA residential development, the design of which will be able to account for the Coastal Road alignment.

Although the CER seeks approval for both the S1 and S2 options, the latter is not scheduled for construction until the connection with Lancelin is constructed. This is due to traffic volumes not warranting the Cervantes bypass until the Lancelin connection is made, and a high level of community interest for construction of the S1 option.

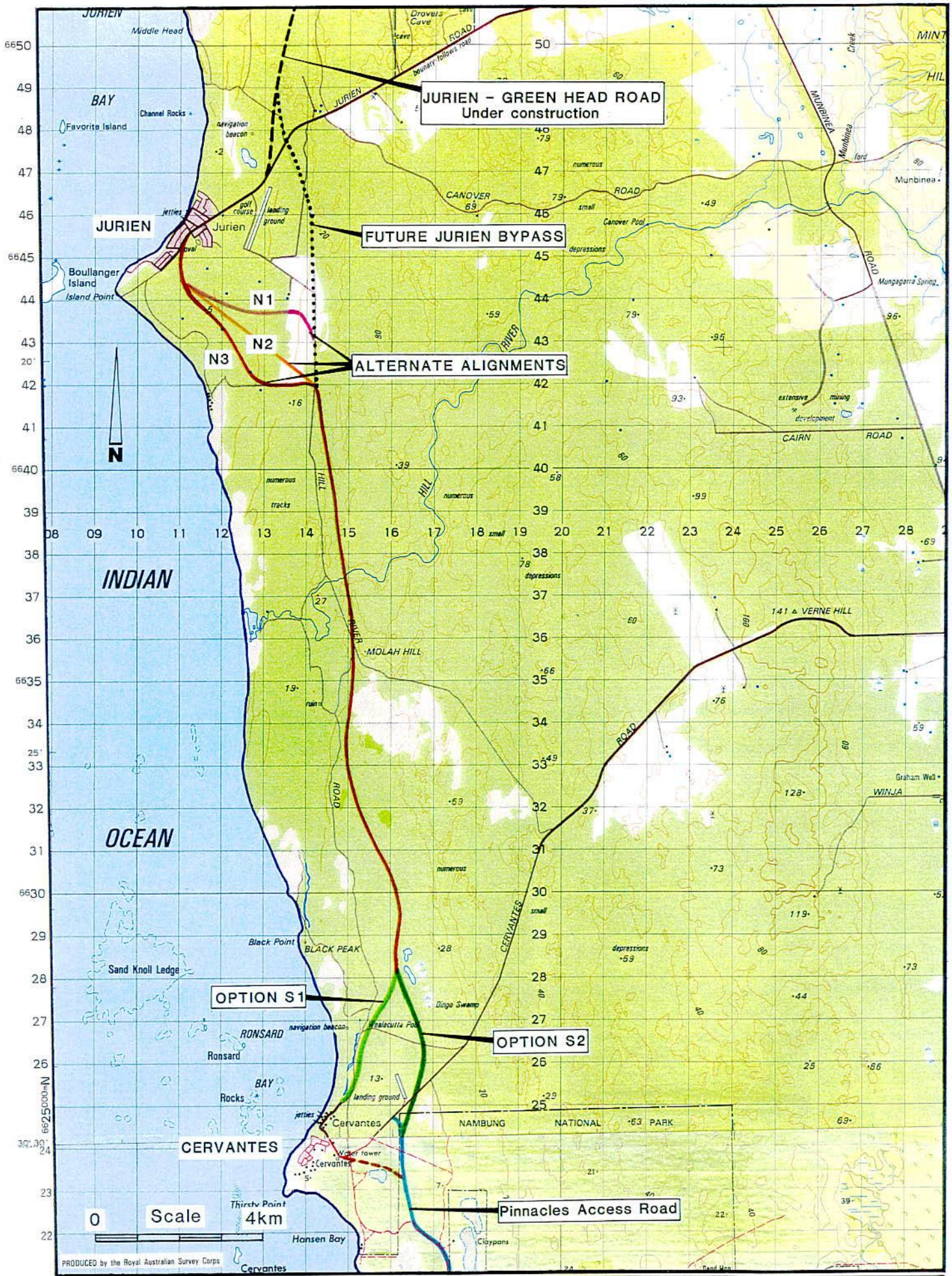
The preferred alignment on which this CER is based is illustrated in Figure 6.

2.3.4 No Development Option

Under the Central Coast Regional Strategy, Jurien will be promoted as a major service centre in the region (WAPC, 1996). Services will therefore be available in Jurien that are not available elsewhere and hence accessibility to these services will be an important factor for the surrounding residents, including those in Cervantes.

The Cervantes - Jurien road is a component of the Lancelin to Dongara coastal road, which is documented within the Central Coast Regional Strategy as being required to improve economic and social development within the overall Central Coast Region, and provide opportunities to improve physical management of the coast. In addition, the route will provide social benefits for residents of Jurien and Cervantes by reducing travel time.

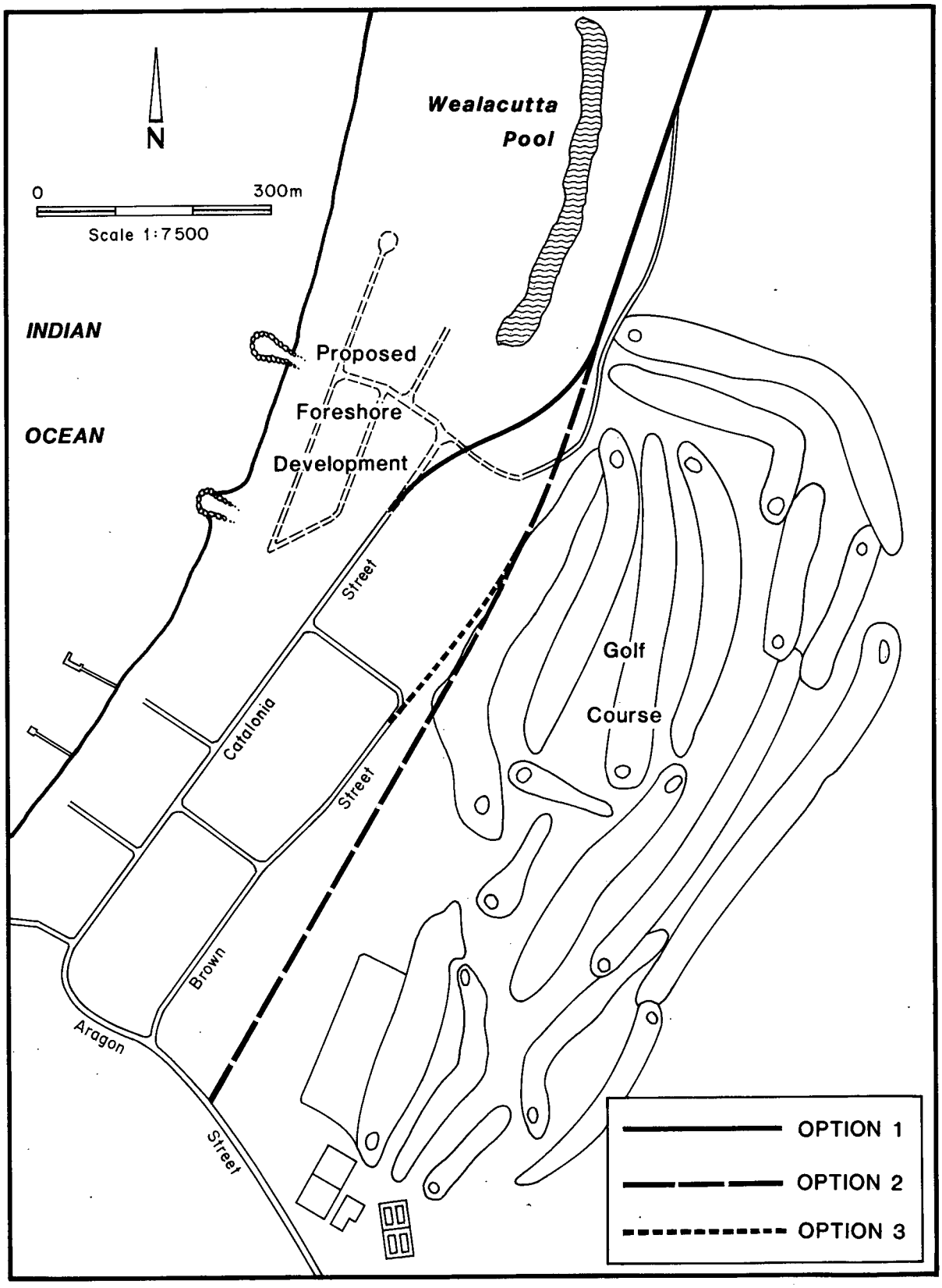
The No Development option would have significant implications for the Central Coast Region as the land use and planning strategy has been developed incorporating the Lancelin to Dongara coastal road.



Options for the Proposed Route of the Cervantes to Jurien Coast Road

Figure 4

ecologia



CERVANTES TO JURIEN COASTAL ROAD

Options for Entry Road to Cervantes

Figure 5

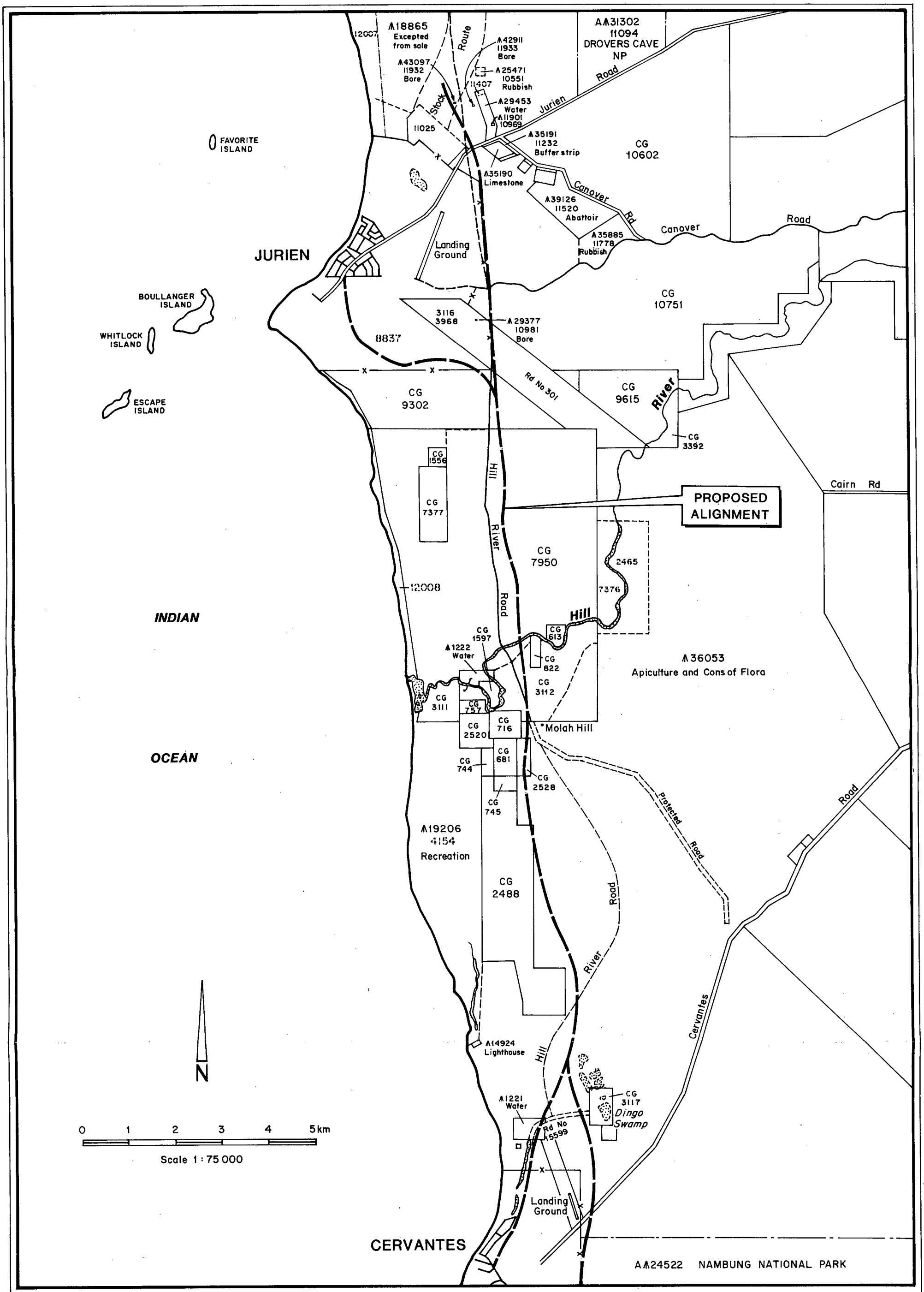


Figure 6: Proposed Alignment for the Cervantes to Jurien Coastal Road

3.0 EXISTING ENVIRONMENT

3.1 CLIMATE

The climate of the Swan Coastal Plain is equivalent to that found in the Mediterranean Basin with a hot, dry summer and mild wet winter (Seddon, 1972). The area is influenced by alternating high and low pressure systems arising from the south-west and producing winter rainfall systems.

The mean daily maximum temperature ranges from 19.4 °C in July to 30.7 °C in February. August has the lowest mean daily minimum temperature at 9.3 °C while February has the highest at 17.7 °C. Average yearly maximum and minimum temperatures are 24.6 °C and 12.9 °C respectively (Bureau of Meteorology, 1995). Temperatures are less extreme at Jurien than inland as temperatures in coastal areas are moderated due to the proximity to the ocean (Beard, 1979).

The rainfall pattern over the Swan Coastal Plain contains two gradients; a north-south gradient reflecting increasing rainfall to the south away from the arid zone and a west-east gradient with a decrease from the coast to the interior. Thus the average yearly rainfall ranges from 801 mm at Perth, to 560 mm per year at Jurien from a total of 103 rain days. Major falls occur between May and August and approximately 90% of the total rainfall occurs between April and October (Figure 7).

The seasonal nature of the rainfall is of biological significance, with ombrothermic relationships for the Jurien region indicating a "dry" period between October and March where temperature exceeds precipitation and is considered inadequate for plant growth (Bagnouls & Gaussen, 1957).

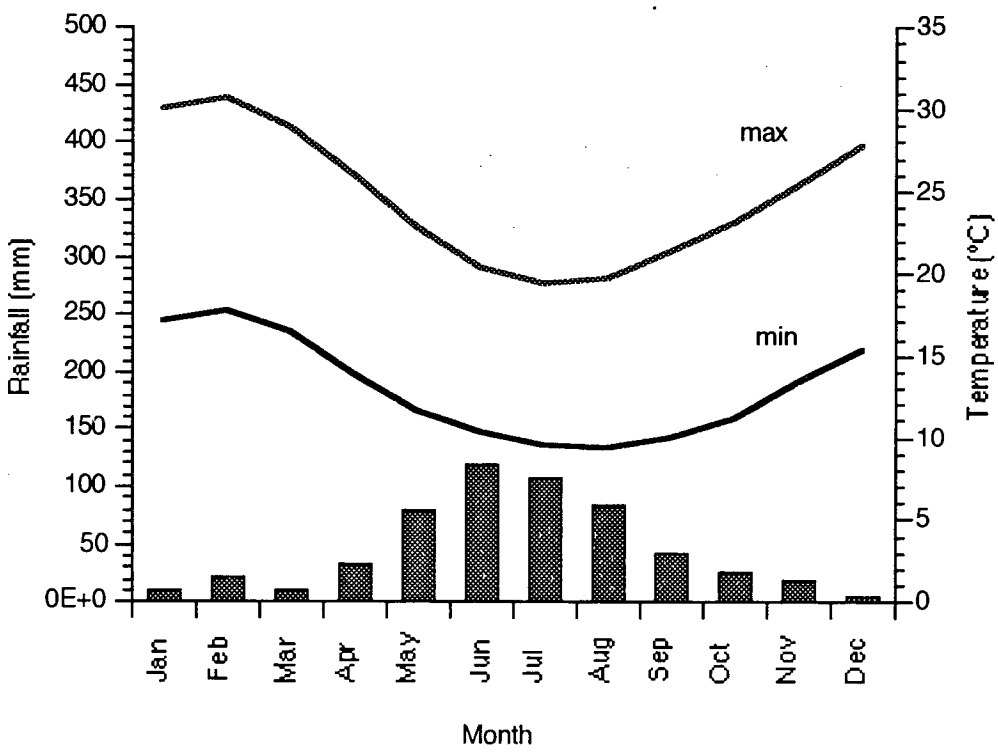


Figure 7: Mean monthly maximum and minimum temperatures and rainfall for Jurien.

3.2 GEOLOGY AND HYDROLOGY

Within the Darling System the geological structure largely determines the land form of the region. The study area is part of the northern Perth Basin geological province, separated from the Yilgarn Block to the east by the Darling Fault (Beard, 1979). Playford et al. (1976) described the geology and geomorphology of the Perth Basin, while the surface geology of the Hill River region in particular is detailed in Lowry (1974).

The Perth Basin is comprised of the Beagle Ridge and the Dandaragan Trough. The Beagle Ridge is formed of relatively shallow basement rocks and the Dandaragan Trough contains primarily Permian and Mesozoic sedimentary rocks (DPUD, 1994). The Beagle Fault system separates the Beagle Ridge from the Dandaragan Trough and from the adjacent Triassic Lesueur Sandstone, evident in Mt. Lesueur and Mt. Peron (Beard, 1979) to the north of Jurien. The majority of the surface outcrop is Pleistocene and Holocene sedimentary deposits.

Hydrogeologically, the study area falls entirely within the Kockatea Shale (Aquitard), and is bordered to the east by the Lesueur Sandstone (Aquifer) and the Woodada Formation (Aquitard) (DPUD, 1994). Only one surface drainage system is associated with the immediate study area. Hill River is the major drainage system for the surrounding areas, with a major tributary in Munbinea Creek which drains the Gairdner Range. Flow in the drainage lines is seasonally intermittent but permanent water is present in pools (Griffin & Burbidge, 1989).

The hydrology of the region is reported to consist of an unconfined groundwater aquifer within the superficial geological formations (V & C Semeniuk Research Group, 1994). Within the Safety Bay Sand or Quindalup Dune zone, most recharge occurs by direct infiltration of rainfall, with discharge to the ocean and evapo-transpiration.

Groundwater contours in the region are sub-parallel to the coast, and the direction of groundwater flow is to the west. Fresh groundwater discharges to the shoreline over a saltwater wedge, and may be lost through evaporation from wetlands (Kern, 1993).

3.3 GEOMORPHOLOGY

The study area lies within the Coastal Foreplain physiographic unit, and contains the Quindalup and Spearwood Dune geomorphological units. The younger Quindalup Dune System covers the majority of the study area. The south-eastern part of the study area lies within the older Spearwood Dune System (McArthur & Bettenay, 1960).

The Quindalup Dune System extends nearly 15 km inland from the coast in the southern portion of the study area, and comprises Holocene shorelines and both fixed and mobile calcareous sand dunes which trend north-south (Lowry, 1974). The Quindalup Dunes may reach a height of 200 m and are generally aligned parallel to the coast. The Quindalup Dunes are prone to wind erosion following damage to vegetation (DPUD, 1994).

The Spearwood Dune System is carbonate-rich and probably of marine origin, and contains dunes lithified to limestone (Lowry, 1974). The vegetated dunes are less prone to erosion due to the formation of soil over the dune sands. Aeolianite of the dune system may be exposed as cliffs at the coast, but generally forms low hills along the lines of old dune topography (DPUD, 1994).

The boundary between the two dune systems is marked by salt-lake complexes, which are generally saline but also include gypsiferous and calcareous deposits. On their eastern margins, freshwater springs and swamps occur (Griffin & Burbidge, 1989).

The townsites of Jurien and Cervantes are situated on cuspate forelands comprising beach ridge plains that have developed in concert with changes in sea level throughout the Holocene (last 10,000 years).

The Jurien cuspate foreland is a significant geomorphological feature of scientific interest as it provides a stratigraphic record of shoreline and sea level change in the Holocene period (DPUD, 1994).

In reference to landform stability, the Central Coast Regional Study classified the coastline and dunes as to their apparent stability. The proposed Cervantes to Jurien coastal road crosses a region of fully vegetated, stable dunes at the southern extent. The northern section of the route crosses an area which has been mapped as active sand sheet or blow outs attached to the shoreline. However, the aerial photography indicates that the alignment is within vegetated dune areas, with a single mobile dune occurring south of Molah Hill and to the east of the proposed road.

3.4 SOILS

As part of the Quindalup Dune System, the majority of the area features calcareous sands of minimal development. The section of the study area lying within the Spearwood Dune System comprises silicious sands leached of calcium carbonate but unbleached (Beard, 1979).

Most of the area west of the proposed road appears to be Safety Bay Sand, which features aeolian and beach sands, mainly calcareous with minor quartoze sand. The eastern portion is Tamala limestone; primarily calcarenite, kankar and leached residual quartz sand.

The wetland systems formed at the interface of the two dune systems may include swamp and lacustrine deposits of diatomite, clay, loam, silt and sand.

3.5 WETLANDS

Wetlands are located within the Coastal Foreplain in the study area, in the Quindalup and Spearwood Dune systems. These wetlands have been assessed during an evaluation of the wetlands in the System 5 region (V & C Semeniuk Research Group, 1994). Three consanguineous suites were identified within the region between Cervantes and Jurien:

(i) Hill River Suite: microscale creeks, floodplains and palusplains, including the river itself;

(ii) Hill River Estuary: a barred and infilled lagoon system, into which the Hill River discharges; and

(iii) Cervantes Suite: microscale linear irregular sumplands located in coastal limestone near Cervantes.

Lagoonal depressions in the area may be filled with a variety of materials (*e.g.* gypsum) or may remain as swamps and salt lakes. The vegetation of the winter wet areas is poorly known but highly variable (Griffin, 1992). Saline areas support saltbush and samphire communities, alone or with eucalypts, sheoak or teatree *(Melaleuca thuyoides)* and there are considerable areas of unvegetated drift sand (Beard, 1979).

The proposal crosses the Hill River, and is located in close proximity to Wealacutta Pool to the north of the Cervantes townsite. The Hill River suite of wetlands is maintained by water inflow from direct precipitation and runoff (V & C Semeniuk Research Group, 1994).

Wealacutta Pool is within the Cervantes Suite of wetlands and is listed under the Draft Environmental Protection (South West Agricultural Zone Wetlands) Policy 1995. The Cervantes Suite of wetlands is noted for hypersaline to mesosaline water, which is maintained through ponding and groundwater rise (V & C Semeniuk Research Group, 1994).

The proposal is also located in close proximity to Dingo Swamp, which occurs as a series of small claypans in the south-east part of the study area.

The locations of Wealacutta Pool and Dingo Swamp are illustrated in Figure 8.

3.6 VEGETATION AND FLORA

3.6.1 Vegetation

The Moora-Hill River area lies within the South-west Botanical Province (Diels, 1906; Gardner, 1942) and at the junction of three Botanical Districts, the Irwin, Avon and Darling Districts (Beard 1979). This transitional location between a number of botanical districts and subdistricts results in an unusually diverse area with a large number of distinct communities (Beard 1979). The majority of the study area lies in the coastal Guilderton System, while the central portion of the study area lies within the Jurien System (Beard 1979).

The predominant vegetation of the region is known as "kwongan"; low heath or scrub-heath on lateritic soil or sandplains (Beard, 1976). Kwongan vegetation has long been recognised as being of outstanding conservation value because of its rich (supporting a large number of species) and diverse flora, and because many of the species occurring there are endemic or geographically restricted (Diels, 1906). In particular, the vegetation of the Lesueur region has been noted for its richness and unique character (Speck, 1958; Conservation Through Reserves Committee, 1974; Griffin, Hopkins & Hnatiuk, 1983; Hopkins, Keighery & Marchant, 1983; Froend, 1987).

The Guilderton System occupies the recent dunes and sands of the coastal belt. It is similar to the Cliff Head System of the Irwin District and represents the northward extension of the Quindalup Dune System of the Swan Coastal Plain (McArthur & Bettenay, 1960). Sandplain heath vegetation has been regularly burnt in European times and appears able to regenerate well after fire (Gardner, 1957; van der Moezel, Loneragan & Bell, 1987).

The central portion of the proposed Cervantes - Jurien Road falls within the Jurien System which occupies the older coastal dunes and is an extension northwards of the Spearwood Dune System (McArthur & Bettenay, 1960) under different vegetation (Beard, 1979). It is similar to the Illyarrie System of the Irwin District (Beard, 1979). The vegetation is a mosaic dominated by scrub-heath on limestone, with *Banksia prionotes* common among the taller shrubs and *Dryandra sessilis* and *Calothamnus quadrifidus* dominating the lower heath layer (Beard, 1979). Scrub-heaths and thickets are associated with sandplains with sandy yellow earths to earthy sands (Beard, 1981).

A number of flora studies have been conducted in the Jurien area; these support the view that due to the location in a region transitional between three botanical districts, the Mt. Lesueur / Jurien region features a high level of diversity and species richness and constitutes the extreme limit of distribution for a number of species (Hopkins, Keighery & Marchant, 1983; Griffin & Hopkins, 1985; Froend, 1987). A number of genera including *Astroloma, Conostylis, Lechenaultia* and *Verticordia* have higher species richness at Lesueur than in other areas of the northern kwongan (Burbidge, Hopper & van Leeuwen, 1989).

Griffin (1992) found that flora of interest in the immediate project area appeared restricted to Pleistocene limestone with residual yellow sand. Similarly, a study of the Southern Beekeeper's Nature Reserve found that the coastal heath associations were relatively floristically depauperate when compared with the more complex heaths on the limestone in the eastern section of the reserve (Burbidge & Boscacci, 1989).

3.6.2 Results of the Botanical Survey

A botanical survey of the proposed road alignment was undertaken during September 1996 in order to document the vegetation and flora for the purposes of environmental assessment. A total of 32 sites were surveyed for the purposes of this project.

A total of 14 major vegetation types were determined:

(i) Scrub heath (SH)
(ii) Hill top heath (Molah Hill)
(iii) Low heath (LH) on coastal flats dominated by *Melaleuca scabra*

(iv) Coastal heath (CH) on coastal flats dominated by *Melaleuca acerosa*
(v) Coastal scrub on dunes (CS)
(vi) Coastal scrub disturbed (disturbed CS)
(vii) Samphire communities fringing playa lake (wetland)
(viii) Low scrub fringing playa lake dominated by *Melaleuca hamulosa* (wetland)
(ix) Thicket fringing playa lake dominated by *Melaleuca cardiophylla* (wetland)
(x) Disturbed areas devoid of native species (unmapped)
(xi) Scrub dominated by *Allocasuarina lehmanniana* (SA)
(xii) Riverine thicket fringing the Hill River (Riverine)
(xiii) Mobile sand dunes
(xiv) Pasture

The distribution of these associations is illustrated in Figure 8. Descriptions of each association are provided in Appendix B. A total of 232 native and 43 introduced species were recorded during the study and a complete flora list is provided in Appendix C.

Condition of Vegetation

The overall condition of the vegetation was good to very good with minimal disturbance to most sites. Those sites that had been heavily disturbed were restricted to the farm areas, heavily trafficked areas (Molah Hill) or areas subject to repeated disturbance (Hill River banks).

Sites that had a high weed species count (11 for both) were Hill River and Molah Hill, both areas subject to extreme human impact. In areas not badly disturbed the most common species was *Anagallis averensis*, while *Ehrharta longiflora* was common in more heavily disturbed areas.

3.6.3 Declared Rare Flora and Priority Species

Priority Species are those species not designated Declared Rare Flora (DRF), yet whose conservation status appears to warrant some special legal protection. The priority species are maintained on a "Reserve List" and assigned to one of five priority categories, explained below.

Code:

R: DRF	Declared Rare Flora - Extant Taxa. Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection.
1: Priority One	Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
2: Priority Two	Poorly Known Taxa. Taxa which are known from one or a few (generally <5) population, at least some of which are not believed to be under immediate threat.
3: Priority Three	Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.
4: Priority Four	Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare , are not currently threatened by any identifiable factors.

(From Atkins, 1996)

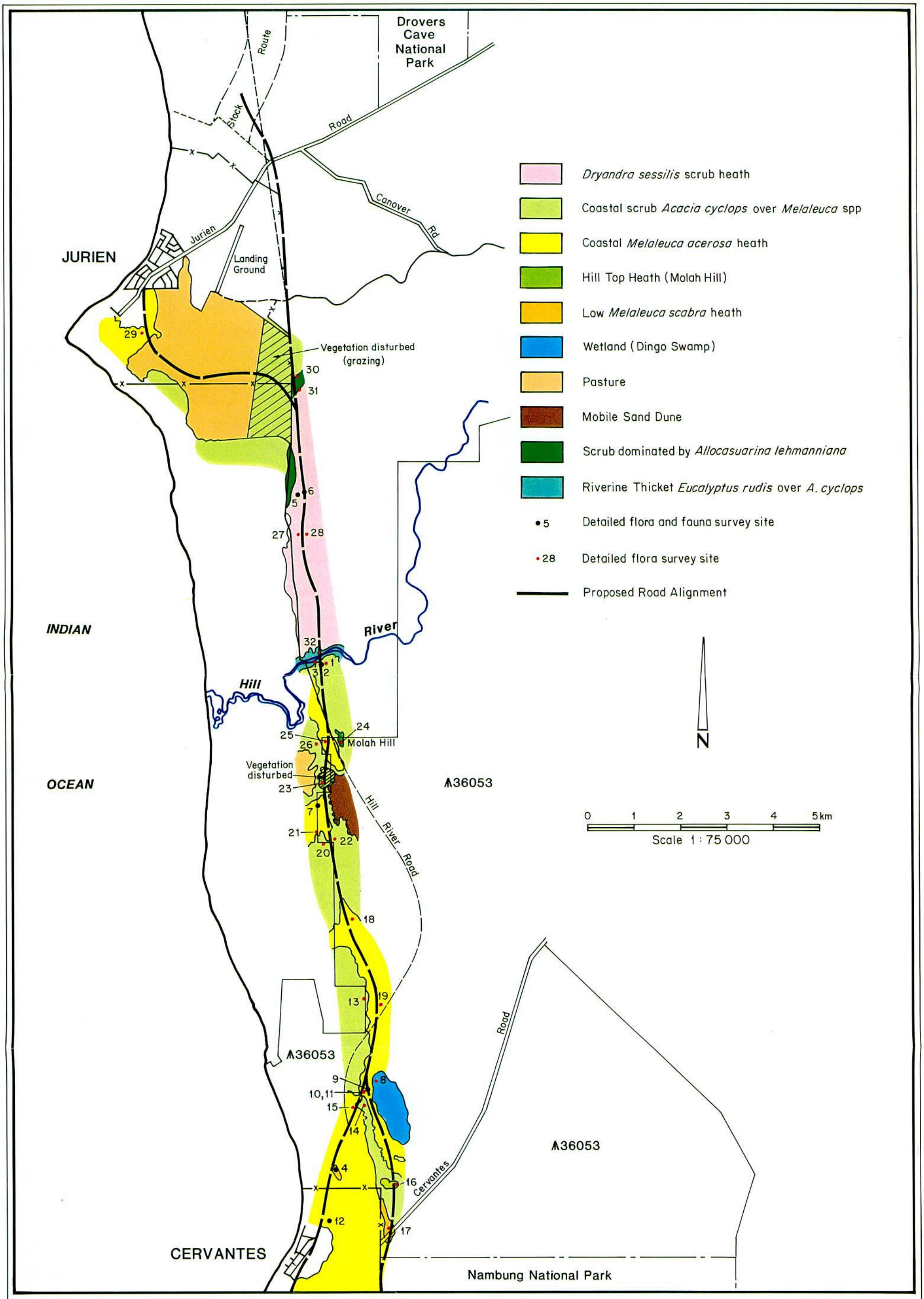


Figure 8: Vegetation Associations of the Proposed Cervantes to Jurien Coastal Road

Griffin (1992) found that rare or priority flora in the immediate project area appeared to be largely confined to areas of Pleistocene limestone with residual yellow sand. Similarly, a study of the Southern Beekeeper's Nature Reserve found that the coastal heath vegetation associations were relatively floristically depauperate when compared with the more complex heaths occurring on the limestone in the eastern section of the reserve (Burbidge & Boscacci, 1989). Thus the limestone of the Jurien System supports more complex vegetation formations than the relatively depauperate coastal formations of the Guilderton System.

The area within a 50 kilometre radius of Hill River contains 114 species of flora listed as priority taxa, however the majority of these species are restricted to the shallow sand over limestone of the Jurien System vegetation complex, which constitutes a small proportion of the study area.

No Declared Rare or Priority flora species listed in the Wildlife Conservation (Declared Rare Flora) Notice 1996, were located during the biological survey carried out for this project.

3.7 FAUNA

The project area lies within the boundary of the major zoogeographic region of the mesic South West. The field survey recorded 44 species of bird, five native and two introduced mammal species, and seven reptile and four amphibian species.

On the basis of literature searches and known habitat preferences, the project area may support approximately 148 bird, 20 native and 7 introduced mammal, 51 reptile and 10 amphibian species (Appendix D).

3.7.1 Mammals

Seven species of mammal from four families were recorded during the field survey, of which five species were native and two were introduced (Table 1, Appendix D1). On the basis of known habitat preferences and species distributions the project area may support 20 native and seven introduced species of mammal (Appendix D1). Burbidge and Boscacci (1989) recorded six native and five introduced mammal species at the Southern Beekeeper's Nature Reserve. The additional native species recorded by these workers were bats, which were not sampled during the present survey.

The Bush Rat *Rattus fuscipes* is relatively abundant within the project area with a total of 45 trap records from three of the six trapping sites (Table 2). The Ash-grey Mouse *Pseudomys albocinereus* was surprisingly common in the project area, with 14 captured individuals from three sites. Finally, a relatively uncommon species, the Honey Possum *Tarsipes rostratus,* was captured at two sites in dense heath.

Table 2: Native and introduced mammal species recorded at the Cervantes to Jurien biological survey sites.

Common name	Species	Sites						
		1	2	3	4	5	6	Opp.
Brush Wallaby	*Macropus irma*	-	-	-	-	-	-	1
Western Grey	*Macropus fuliginosus*	-	-	-	s	-	s	2
Ash-grey mouse	*Pseudomys albocinereus*	3	9	-	2	-	-	-
Bush Rat	*Rattus fuscipes fuscipes*	-	-	15	3	27	-	-
Honey Possum	*Tarsipes rostratus*	-	-	1	-	1	-	-
House Mouse	*Mus musculus*	6	1	4	4	-	3	-
European Rabbit	*Oryctolagus cuniculus*	-	s	-	s	s	s	3

Opp. = Opportunistic sightings, s = signs of presence recorded: scats, tracks, diggings etc.

Seven species of introduced mammal potentially occur in the project area. All are widespread in distribution. Several rabbits were observed during the survey, which are particularly common in disturbed habitats, and evidence of their activity was found at several of the survey sites. Although feral cats and foxes were not sighted during the survey, it is highly probable that the area would support these species. House Mice were common in the project area, and were trapped at five of the six sites.

3.7.2 Birds

Bird surveys of the project area recorded 44 species including 28 passerine and 16 non-passerine species (Appendix D2). Burbidge and Boscacci (1989) recorded a total of 56 bird species in the Southern Beekeeper's Nature Reserve, including several raptors, waterbirds and nocturnal species not recorded during this survey. In combination these two surveys indicate that at least 65 species have been recorded in the area. Based on known habitat preferences and species distributions the area may support up to 148 species including 87 non-passerine and 61 passerine species. This total is higher than the 124 species recorded from Lesueur National Park by Burbidge *et al.* (1990) since it includes a greater number of waders and waterbirds. However in reality it is unlikely that the area would support the full complement of species at any one time since a proportion of the species are migratory or transitory visitors.

Of the species recorded within the project area, the passerines predominate in abundance (62 %), particularly the honeyeaters, with large numbers of Brown Honeyeaters *Lichmera indistincta* present as well as other species including Singing Honeyeater *Lichenostomus virescens*, White-cheeked Honeyeater *Phylidonyris niger* and Tawny-crowned Honeyeater *P. melanops*. The most common species recorded during the survey was the Silvereye *Zosterops lateralis,* with other common species including Black-faced Cuckoo-shrike *Coracina novaehollandiae* and Western Warbler *Gerygone fusca.* Among the non-passerines the Australian Kestrel *Falco cenchroides* and Ringneck Parrot *Barnardius zonarius* were amongst the most numerous species. Waterbirds were represented in the Dingo Swamp area, of which the most common species were Australian Shelduck *Tadorna tadornoides* and Black-winged Stilt *Himantopus himantopus*.

More than half of the bird species (56.7 %) expected to occur in the project area are species with widespread distributions. Widespread species include common birds such as Pacific Black Duck *Anas superciliosa,* Australian Kestrel *Falco cenchroides*, and Brown Honeyeater *Lichmera indistincta.*

Only two introduced species are expected to occur in the area, and one of these, Laughing Turtledove *Streptopelia senegalensis*, was recorded during the survey.

3.7.3 Reptiles and Amphibians

Pit trapping and opportunistic collecting yielded seven reptile and four frog species from the project area. With examination of known species distributions and habitat preferences it is expected that up to 52 reptile species (Appendix D3) and 10 amphibian (Appendix D3)species may occur in the area. The majority of lizards expected in the area are skinks (18 species) followed by Geckos and Pygopods (seven species each). Representatives of two families of amphibians are likely to occur in the study area; the Hylidae (tree-frogs) and Myobatrachidae (ground-frogs). A single turtle species, the Western Long-Necked Turtle *Chelodina oblonga,* presumably occurs in the Hill River.

Nine species, including *Gehyra variegata* and *Lialis burtonis*, have Australia-wide distributions occurring mainly arid and semi-arid habitats; while a further 13 species (24 %) such as *Morelia stimsoni* and *Varanus tristis* have a predominately arid distribution with a range that extends into the south-west of the State. Some 17 species (32 %) characteristically inhabit coastal areas and sandplains and are restricted to areas along the west coast, inhabiting the Swan Coastal Plain and Geraldton Sandplains Biogeographic regions identified by the Australian Nature Conservation Agency (Thackway & Cresswell, 1995).

Amphibians expected to occur in the study area include hylid frogs of the genus *Litoria* which inhabit lakes and swamps and their immediate surrounds, and Myobatrachid frogs including a variety of burrowing

species (*e.g. Heleioporus* spp. and *Myobatrachus gouldii*) which inhabit areas that are often widely separated from any surface or standing water bodies. Two Hylid and two Myobatrachid frog species were recorded during the survey, with three species *Litoria moorei, L. adelaidensis,* and *Limnodynastes dorsalis* recorded at Dingo Swamp.

3.7.4 Rare And Specially Protected Fauna

Fauna species which have been formally recognised as rare, threatened with extinction or as having high conservation value are protected by law under the Western Australian Wildlife Conservation Act 1950. Classification of rare and endangered fauna under the Wildlife Conservation (Specially Protected Fauna) Notice 1996 recognises four distinct schedules;

(i) Schedule 1 "are fauna which is rare or are likely to become extinct, are declared to be fauna in need of special protection";

(ii) Schedule 2 "are fauna which is presumed to be extinct, are declared to be fauna that is in need of special protection";

(iii) Schedule 3 "are birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of special protection"; and

(iv) "Schedule 4 are declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned in paragraphs (a), (b) and (c)."

Schedule 1
A number of Schedule 1 mammal species are now locally extinct but still occur in other parts of southwest Australia (Burbidge, Hopper & van Leeuwen, 1990). Species include the Woylie *Bettongia penicillata,* Chuditch *Dasyurus geoffroii,* Dibbler *Parantechinus apicalis,* Southern Brown Bandicoot *Isoodon obesulus,* Western Mouse *Pseudomys occidentalis* and Heath Rat *Pseudomys shortridgei.* Three bird species listed as Schedule 1 are considered possible inhabitants of, or visitors to, the project area:

The Western Long-billed Corella *Cacatua pastinator* The Long-billed Corella is uncommon to rare in its western distribution. It has disappeared from parts of its former range and appears to be declining.

Baudin's Black Cockatoo *Calyptorhynchus baudinii* Diminished in range since European settlement but is unlikely to become rare. *Banksia tricuspis* is a food plant for Baudin's Black Cockatoo which forages in heaths and nests in woodlands.

Carnaby's Black Cockatoo *Calyptorhynchus latirostris* Is closely related to Baudin's Black Cockatoo but occupies different habitats. The status and distribution of Carnaby's and Baudin's Cockatoo are currently under review.

No scheduled bird species were recorded during the current field survey, however, Burbidge and Boscacci (1989) recorded Carnaby's Black Cockatoo in the Southern Beekeeper's Nature Reserve.

Schedule 2

No Schedule 2 species are expected to occur within the project area.

Schedule 3

No Schedule 3 species are expected to occur within the project area.

Schedule 4

Peregrine Falcon *Falco peregrinus* Is uncommon but widespread throughout Australia.

Two reptile species of Schedule 4 status, the Woma and the Carpet Python, potentially occur in the project area (CALM, 1996). There was no evidence of either species during the field survey:

Woma *Aspidites ramsayii* This species is rare and locally declining and is unlikely to be found in the project area since it is at the extreme southern end of its distribution.

Carpet Python *Morelia spilota imbricata* Widespread but uncommon in southwest WA.

3.7.5 International Agreements

The CAMBA and JAMBA agreements between the Federal Government of Australia and the respective governments of China and Japan bind the signatory governments to the protection of migratory birds. These international agreements are designed for the "protection of migratory birds and birds in danger of extinction and also for the management and protection of their environments".

The ANZECC convention lists fauna as "Endangered - Species in danger of extinction and whose survival is unlikely if the causal factors continue to operate" and "Vulnerable - species believed likely to move into the 'Endangered' category in the near future if the causal factors continue to operate."

A range of migratory species are protected under these international agreements (JAMBA, CAMBA, ANZECC). Within the project area, these include Fork-tailed Swift *Apus pacificus,* a relatively common transequatorial migrant which visits mainland Australia from October through April (Slater *et al.,* 1989), and Rainbow Bee-eater *Merops ornatus,* an aerial forager which utilises the upper strata of the tree canopy for flying insects, moving to southern Australia to breed during summer. These and other possible (unlisted) species are visitors which should not be adversely affected by the proposed development.

3.7.6 Species of Interest

The White-breasted Robin *Eopsaltria georgiana,* is not listed as a priority species but is considered to be of local significance due to its restricted distribution in coastal *Acacia* thickets where it is isolated from the majority of the population of this species which is distributed through south-west forests.

3.8 CONSERVATION RESERVES

There are three main conservation areas in the Cervantes to Jurien area, all of which are vested in the National Parks and Nature Conservation Authority:

- Drovers Cave National Park (Reserve ↑31302) to the north of the study area was vested as a National Park on the 3rd February 1978 and encompasses a relatively small area of 2,681 ha. It is located in the diverse limestone associations of the Jurien Vegetation System.

- The "C" Class Southern Beekeeper's Nature Reserve (↑36053) was vested for the purpose of apiculture and protection of flora and has a total area of 10 841 ha. The Nambung National Park Draft Management Plan (CALM, 1995a) has recommended that the reserve be changed to an 'A' Class miscellaneous reserve for the purpose of 'Apiculture and Conservation of Flora and Fauna'. The proposed road passes through the Southern Beekeeper's Nature Reserve which incorporates an area of 10 841 ha extending from the northern boundary of Nambung National Park north to the Hill River.

- Nambung National Park (Reserve ↑24522) is south of the study area and is a major tourist attraction because of the unusual limestone formations "pinnacles" in the park. It encompasses an area of 18 319 ha extending from Cervantes approximately 20 km southward to the vicinity of the coastal townsite of Grey.

In addition there are a number of National Parks and Nature Reserves in the immediate area including Lesueur National Park and Coomallo Nature Reserve to the north and north-east respectively (see CALM, 1995b), and Badgingarra National Park and Hill River Reserve to the east. Conservation areas in the Cervantes - Jurien region are shown in Figure 9.

The road alignment does not cross any areas listed under the System 5 (Northern Sandheaths) Conservation Reserves as recommended by the EPA (EPA, 1993).

3.9 LAND USE

The Shire of Dandaragan is located 160 km north of Perth and incorporates the two townsites of Cervantes and Jurien, as well as Badgingarra and Dandaragan to the east and south-east respectively. The Shire is undergoing a phase of rapid development with the expansion of the rock lobster industry and more recently, tourism.

Jurien developed as a legal townsite in the 1950s and 1960s with growth of the rock lobster industry, and is also growing in popularity as a tourism, recreational and retirement destination. The Central Coast Planning Strategy developed by the Department of Planning and Urban Development (1994) proposes to promote Jurien as the single major service centre for the Central Coast region.

Cervantes was established in 1962 and is a fairly typical west coast holiday / retirement centre. The town is supported by the rock lobster industry supplemented by recreational activities and tourism, with over 120 000 tourists visiting the Pinnacles at Nambung National Park annually DPUD (1994).

Beyond the gazetted townsites, Crown Land of varying status predominates, most of which is allocated for conservation purposes (Refer to Figures 6 & 9). A number of mineral and petroleum exploration and development tenements exist throughout Crown Land, although at present only the Tiwest Joint Venture Mineral Sands Project is a major employer in the area. Within the study area privately owned land is limited to the "Fatfields" farm, which contains some areas of cleared land including areas for grazing and mixed farming.

South of Jurien, a parcel of approximately 2000 ha (Victoria Locations 1556, 7377, pt 7950, pt 9302, pt 8837) is the subject of a Town Planning Scheme amendment for rezoning to be a Special Development Zone.

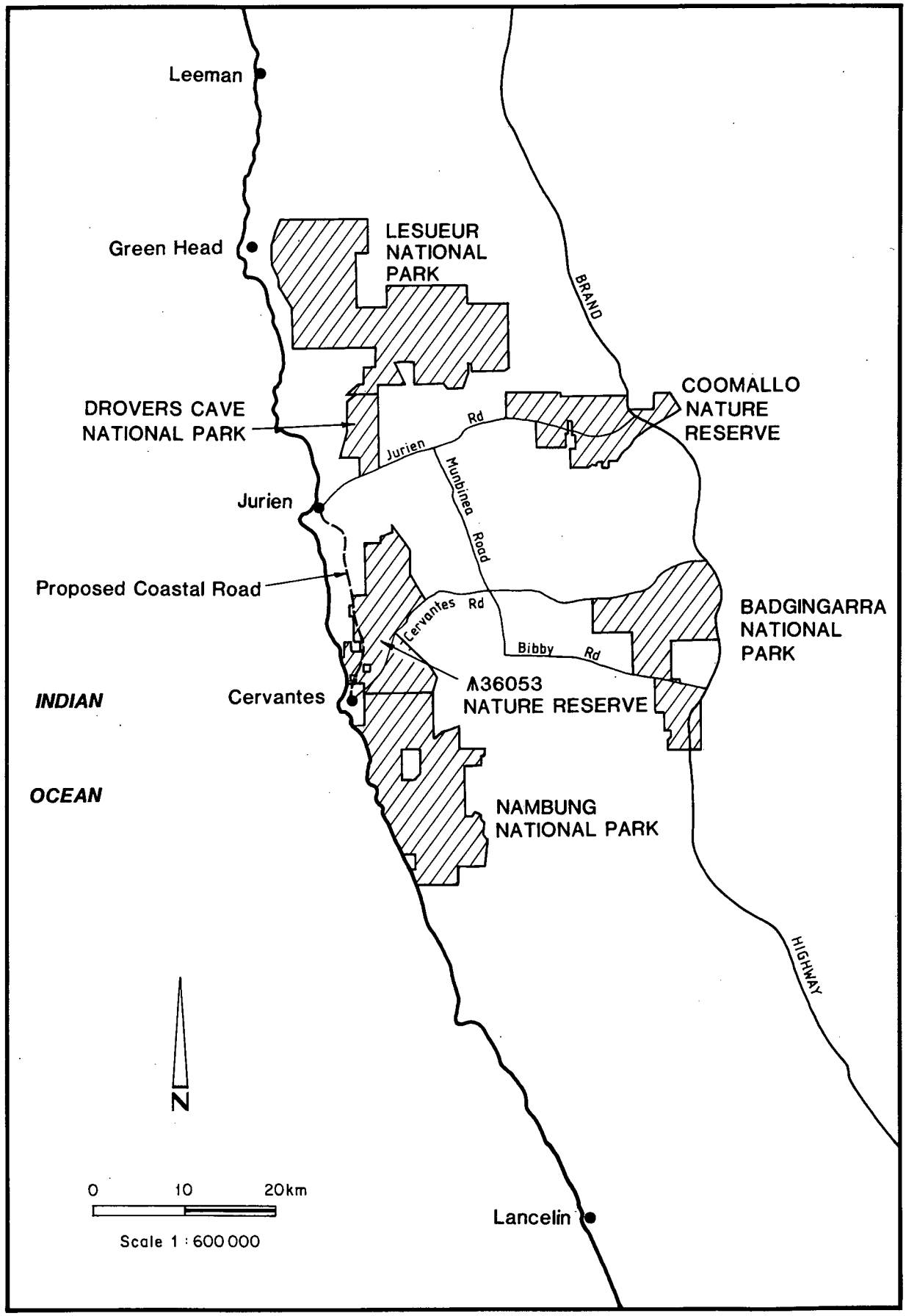


Figure 9: Conservation Reserves in the Cervantes to Jurien Area

3.10 POLICY AND PLANNING STRATEGIES

The project area lies within the Central Coast Region; which comprises the coast between Guilderton and Dongara and inland to the Brand Highway. The Central Coast Regional Strategy (WAPC, 1996) provides the outcome of a three year study to provide regional land use, planning and management guidelines. The major issues prompting the study were:

(i) Access, protection and use of the coastline;

(ii) The need for new road connections between Greenhead and Lancelin;

(iii) The future use and management of the large amount of public land; and

(iv) The impact of metropolitan development on the future of the region.

Development of the road network is a major component of the Central Coast Regional Strategy, which incorporates an indicative alignment for a Proposed Secondary Road between Lancelin and Dongara, of which the Cervantes - Jurien Coastal Road forms a part.

The advantages of such a road are considered to outweigh the disadvantages, with location and design characteristics recommended so the coastal road should:

- minimise impact on the natural environment and provide planned access to the coastal environment for conservation, recreation and other uses.
- prevent unmanaged intensive use of the coast and discourage pressure for ad hoc settlement and development.
- encourage inter-regional traffic, with an interest in the scenic characteristics of the region or the facilities of the coastal towns rather than heavy haulage traffic.
- encourage intra-regional and local traffic including tourists travelling between towns.
- maximise opportunity for management of the conservation estate.

(WAPC, 1996).

3.11 CULTURAL ENVIRONMENT

3.11.1 Aboriginal Heritage

The Cervantes - Jurien area is within the broader south-western portion of Western Australia traditionally occupied by the Aboriginal tribal groups collectively known as the Noongars. The Noongars ranged throughout the south-west in response to seasonal availability of food and through this nomadic lifestyle, were able to adapt to long-term environmental change.

No archaeological sites have been registered with the Aboriginal Affairs Department for the project area. No archaeological sites were recorded during the systematic survey conducted for this project (Quartermaine Consultants, 1996).

Only four studies detail information relevant to Aboriginal ethnographic sites in the area (O'Connor, Quartermaine & Bodney, 1989; Quartermaine, 1989; O'Connor, 1992; Quartermaine, 1992). Information obtained from previous ethnographic surveys in this region indicates that this area is unlikely to contain sites of significance to Aboriginal people. No known sites of ethnographic importance were recorded during the ethnographic survey undertaken for this project (O'Connor, 1996).

There are four separate Native Title Claims pending which incorporate the project area.

3.11.2 European Heritage

Since European settlement, coastal localities within the region have been popular holiday and recreational destinations and a number of ad hoc squatter settlements evolved. These settlements developed progressively, particularly with growth of the fishing industry, to the point that several, were upgraded to legal townsite status. However squatter settlements remain a significant feature of the overall development pattern within the Central Coast Region.

Development within the immediate area affected by the Cervantes - Jurien Road project is dominated by the two townships. Jurien, within the Shire of Dandaragan, developed as a legal townsite in the 1950s and 1960s with growth of the rock lobster industry but it is also growing in popularity as a tourism / recreational and retirement destination.

A portion of the Old North Road Stock Route occurs to the south-east of the Jurien townsite (Victoria Location 3116/3968, Road Number 301), and recommences to the north-east of the townsite. The route was used in the 1800s for travelling between districts and was used during World War II as a movement corridor for the army (WAPC, 1996). Investigations into the Stock Route by the National Trust of Australia may result in section of the route becoming listed on the Register of the National Estate. The stock route is also listed as the Coastal Stock Route in the heritage inventory of the Shire of Dandaragan (Mid West Heritage Incorporated, 1996).

3.11.3 Recreation Activities

The Cervantes to Jurien area is a popular destination for coastal holidays involving typical beach and ocean activities such as swimming and fishing. The nature of the coastal terrain, in a relatively isolated region also provides an attractive area for use of Off Road Vehicles (ORVs), and natural features such as the Pinnacles also encourages transient tourist visitation to the region.

The principal recreational and tourism activities occurring within the Central Coast Region, including the project area, are:

- visiting natural attractions;
- holidaying;
- sightseeing;
- beach recreation; and
- fishing (Department of Planning and Urban Development, 1994b).

The diversity of terrestrial natural environments (particularly wildflowers and other native vegetation) can perhaps be seen as the major attraction and in this regard. Crown land within the project area is of considerable importance in this regard.

The Nambung National Park Draft Management Plan (CALM, 1995) classifies the Nambung National Park and the Southern Beekeeper's Nature Reserve into management zones of Natural Environment and Recreation Zones. Molah Hill is designated as a recreation zone, and this is in keeping with the lookout facility proposed in conjunction with the coastal road project.

3.11.4 Visual Amenity

Assessment of visual amenity is based upon the premise that the visual quality of a landscape is a resource that can be managed. Landscape or visual quality is determined by geology, soils, landforms, vegetation, water features and land use history (Schmidt, 1990). The extent of human development within the project area is relatively limited, a direct function of the extensive tracts of Crown land that remains. Combined with the open landscape, the absence of development tends to create a sense of broad scale wilderness.

The study area lies within the Wheatbelt Plateau Landscape Character Type, and the Geraldton Plains Landscape Character Sub-Type (CALM, 1994). The Geraldton Plains occurs between the Indian Ocean, east to the Meekatharra Plateau, south to the Swan Coastal Plain and north to the Kalbarri Sandplain. Based upon the Visual Quality Classification Frame of Reference provided for the Geraldton Plains Landscape Character Sub-Type, it would be classified as having moderate scenic quality for landform, vegetation and waterform characteristics. The Hill River however is classified as a waterform with high scenic quality.

The Hill River has been recommended for protection through zoning or policy controls as an area of Rural Landscape Amenity (WAPC, 1996). This classification indicates that the area is considered to be a regionally important landscape and important environmental system that should be managed accordingly.

4.0 PUBLIC CONSULTATION

4.1 OBJECTIVE

The Public Consultation programme for the Cervantes - Jurien Coastal Road occurred both to disseminate information on the project, as well as to assist in the definition of a preferred alignment from the range of options considered.

4.2. METHOD

The consultation process comprised:

- regular meetings of the working group comprising State and Local Government agencies, and representatives of community groups, to facilitate the transfer of information;
- distribution of an information brochure to affected landowners, including a reply-paid proforma for receipt of public comment on the project;
- utilisation of the local press to disseminate information about the study; and
- presentation of a staffed public information display in both Jurien and Cervantes, showing the options available and gauging community preference.

An additional public meeting was convened for the residents of Cervantes following closure of the public comment period associated with the public displays and distribution of the information brochure. The meeting was held to canvass additional options for entry of the Coastal Road into the northern end of the townsite.

4.3 RESULTS

4.3.1 Newsletter and Public Display

A total of 103 written submissions were received from the newsletter mailout and public information displays. Of these 38 expressed general approval for the proposal, with many indicating that the project should be implemented as soon as possible. One submission indicated disagreement with the road construction on the grounds of preserving the isolated nature of the region.

The Cervantes options were presented as separate options, although they are not necessarily mutually exclusive. Seventeen submissions supported the S1 option, with an additional 10 submissions supporting construction of S1 on the grounds that the alignment along Brown Street be altered. A total of 28 submissions supported the S2 or Bypass option. One response specifically stated that both options be constructed simultaneously.

Fewer responses were received concerning the Jurien entry options, with equal numbers (seven) in support of the N1 and bypass options. Four responses were in preference for the N2 option and there was no support for the N3 alignment. One response favoured the construction of both the bypass and N1 option simultaneously.

4.3.2 Additional Cervantes Meeting

An additional public meeting was held in Cervantes to go over options for the location of the entry of S1 into the townsite. The original newsletter and display illustrated one entry option to Cervantes, however, additional options were developed due to the lack of resolution from the preceding alignment selection process.

Of the additional options considered (refer to Figure 5), the favoured option was for connection of the proposed road to Catalonia Street, which is the main street with a suitable width road reserve. This option can be developed to prevent impact on Wealacutta Pool, the Cervantes Golf Course and alleviate concern about the use of the residential Brown Street for the proposal. A total of 77 % of attendants at the meeting were in favour of the S1 option entering Catalonia Street.

4.4 DISCUSSION

Although a higher level of support was received from written submissions for the bypass of Cervantes, a number of them were qualified as to the location of the S1 option, making local support evenly split between the S1 entry to Cervantes and the S2 bypass of Cervantes. The public submissions indicated that a number of people were not opposed to the S1 option but were opposed to the use of Brown Street as the point of entry to the Cervantes township. The development of additional S1 entry options following the original consultation period resulted in a proposal for the use of Catalonia Street. This option avoided the social problems possible from the original proposal, and as indicated by the public meeting has a high level of support within the local community.

In comparison to the residents and landowners in Cervantes, a low level of response was received regarding the Jurien section of the proposed road. However, the Northern 1 option had the same level of support as the "bypass" option, with minimal support of the additional two options. The public consultation phase provided no result significant enough to justify selection of the N1 option over the Bypass option, or vice versa.

5.0 ANTICIPATED IMPACTS AND THEIR MANAGEMENT

5.1 GENERAL

5.1.1 Key Environmental Factors

During the early feasibility stages of the project, and utilising the CER guidelines issued by the EPA, the key factors identified are:

(1) Biophysical
- Regionally significant wetlands
- Locally significant wetlands
- Watercourses
- Conservation Areas
- Flora and Fauna
- Vegetation
- Vegetation Diseases
- Movement of Fauna
- Dune Protection
- Erosion
- Drainage Management

(2) Other
- Visual Impacts
- Aboriginal Heritage
- Source of road construction materials
- Noise
- Risk and Hazard

This section describes the anticipated or potential impacts from the proposal on each of the key factors, followed by a description of the management strategy to be implemented to mitigate identified impacts.

5.1.2 Environmental Management Strategy

The aim of the documented environmental management strategies to be applied to the proposal, is to demonstrate that the environmental impacts of the proposal are of an acceptable level and nature according to the assessment process under the Environmental Protection Act 1986.

There is considerable precedent to demonstrate that the environmental impacts of road projects can be managed. This section provides the general principles for management of potential impacts in the context of prevailing policy and practice and is consistent with the Main Roads Environmental Management Manual (MRWA, 1992).

Commitments made by Main Roads for this project are made under discussion of each environmental factor, and the agency to whose satisfaction each commitment will be implemented. The impacts and related commitments are summarised at the end of this Section.

In order to ensure that the management commitments made within the CER, and that any additional conditions resulting from the assessment process are implemented, Main Roads will undertake auditing of the Conditions of the Minister for the Environment resulting from the CER assessment. Reporting will occur at the completion of each major phase of the project, or an annual basis where any one phase extends over more than 12 months. The report will be in the format of a typical Progress and Compliance Report and will be submitted to the Audit Branch of the DEP for assessment.

Commitment

(1) Implementation and auditing of the environmental management strategies documented within this CER, as approved by DEP and CALM, throughout the life of the project.

5.2 BIOPHYSICAL FACTORS

5.2.1 Regionally Significant Wetlands

Wealacutta Pool is classified as a regionally significant wetland due to its inclusion within the Draft Environmental Protection (South-west Agricultural Zone Wetlands) Policy, although it was assessed as being locally significant by the evaluation of System 5 Region wetlands (V & C Semeniuk Research Group, 1994). The entry to the Cervantes township crosses in close proximity to the eastern side of the wetland, however the proposal does not directly impact on Wealacutta Pool as it is beyond the 50 m buffer zone recommended for management purposes.

Little specific information is available relating to local groundwater conditions in the study area, however it is likely that Wealacutta Pool has some input from groundwater moving westwards prior to discharging at the coast. It is therefore possible that some contamination may reach Wealacutta Pool via road runoff entering the groundwater and then migrating into the wetland. This issue is discussed further in relation to drainage management for the project.

Wealacutta Pool is essentially located within a dune swale, and hence the proposal will have little or no impact on surface runoff entering the wetland. That is, there is no anticipated alteration in surface water quantity or quality entering the wetland.

Management Strategy
No specific management measures are required in relation to Wealacutta Pool.

5.2.2 Locally Significant Wetlands

Dingo Swamp may be considered as a locally significant wetland in spite of its freehold tenure. The 1989 survey of the Southern Beekeeper's Nature Reserve recommended that the wetland be incorporated into the Nature Reserve (Burbidge & Boscacci, 1989). The road alignment occurs approximately 250 m west of the western edge of the swamp and so will cause no direct impact on the wetland.

Groundwater movement is predominantly from east to west and therefore the project will not impact on Dingo Swamp in this respect. No alteration in surface water runoff is anticipated due to the distance of the swamp from the proposal, and the sandy soils in the region encouraging rapid infiltration of surface water.

Management Strategy
There are no locally significant wetlands directly impacted by the proposal, and no management initiatives are required.

5.2.3 Watercourses

The proposed Cervantes - Jurien Coastal Road must cross the Hill River, and therefore the requirement for bridge construction may create short-term construction impacts, primarily that of sediment disturbance. Bridge design has not been finalised, however it is likely that pylons will be required at the edge of the river channel.

The initial concept design for the project has been based upon waterways analysis specifically performed for this project (Main Roads WA, 1986). The bridge design will incorporate spill-through abutments which account for river flow characteristics.

The proposal will also impact on fringing riverine vegetation. The impact essentially will be localised and related to site disturbance during construction.

Management Strategy
Management and control of road runoff in the vicinity of Hill River is discussed in Section 5.2.11 concerning drainage management.

The bridge will not cause any significant alteration of hydrological conditions, and no management initiatives are required.

5.2.4 Conservation Areas

The proposed road alignment passes through the western edge of the Southern Beekeeper's Nature Reserve. It has been proposed that the eastern boundary of the road reserve form the western boundary of the Nature Reserve, in order to prevent the creation of small isolated pockets of CALM estate to the west of the Cervantes - Jurien Coastal Road. The road reserve would also serve as a delineation between freehold land and the Nature Reserve.

Land exchanges will be required to achieve this aspect of the proposal, and discussions have been held between the Shire of Dandaragan, the Department of Land Administration and the private landholder in this respect. The proposed areas for land exchange associated with the coastal road proposal have been documented within the Nambung National Park Draft Management Plan (CALM, 1995).

The potential for introduction of weed species and dieback to the Southern Beekeeper's Nature Reserve is a potential significant impact of the road proposal.

Management Strategy
Management measures are required in relation to the proximity of the road alignment to the Southern Beekeeper's Nature Reserve. In addition to weed and dieback management measures (Sections 5.2.6 and 5.2.7 respectively) access and fire management strategies are also relevant to the proposal. Strategies identified in liaison with CALM will then be incorporated into the design and construction phases of the project.

Commitment

(2) Main Roads WA will liaise with CALM to determine requirements for fire management access tracks and firebreaks for the section of the Southern Beekeeper's Nature Reserve where the Coastal Road forms the western boundary of the reserve.

5.2.5 Flora and Fauna

No Declared Rare or Priority flora species listed in the Wildlife Conservation (Declared Rare Flora) Notice 1996, were located within the project area. Clearing is therefore the most significant impact to vegetation and flora and is discussed in Section 5.2.6.

There were no Rare or Schedule Fauna listed in the Wildlife Conservation (Specially Protected Fauna) Notice 1996 recorded from the biological survey carried out for the project. Although some listed bird species may occur within the region, no direct impact to Scheduled rare fauna is expected from the proposal.

The impact to fauna is therefore generally secondary. There will be local impacts initially with loss of habitat and relocation of mobile species into adjacent habitats.

Management Strategy
No Declared Rare Flora or Scheduled Fauna species are likely to be impacted by the project and no management strategies are required. Management of vegetation clearing is discussed in Section 5.2.6.

5.2.6 Vegetation

The loss of vegetation through clearing activities constitutes the principal direct impact from the construction of the proposal. The majority of the project area comprises native vegetation which is in good condition. The main source of historical disturbance has been Off Road Vehicle use.

Areas that would be impacted by the construction of the preferred alignment for the Cervantes to Jurien Coastal Road are summarised in Table 3. This table presents a worst case scenario of clearing 30 m of the 100 m reserve for construction purposes.

The area of vegetation affected has been worked out for the preferred alignment and the Cervantes Bypass. In addition to the areas for clearing summarised in Table 3, the alignment traverses 4.8 km of pasture. The loss of native vegetation will be very minimal given the wide representation of associations both within the region and in established Nature Reserves and National Parks.

Table 3: Area of clearing required for construction of the Cervantes to Jurien Coastal Road

Vegetation Type	Distance Traversed (km)	Area Impacted (ha)
Coastal *Melaleuca acerosa* heath	16.02	48.06
Coastal Scrub *Acacia cyclops* over *Melaleuca* spp	5.40	16.2
Dryandra sessilis scrub heath	5.32	15.96
Riverine thicket *Eucalyptus rudis* over *Acacia cyclops*	0.30	0.9
Low *Melaleuca scabra* heath	0.375	1.125
Scrub dominated by *Allocasuarina lehmaniana*	0.375	1.125

There is some potential to aide the dispersal of weeds which are known to be present on pastoral land in the region, during construction and use of the proposed road.

Management Strategy
Impacts shall be minimised by undertaking clearing as each stage of roadworks is to commence, limiting clearing to that which is absolutely essential (demarcation of a limit-of works), and limiting road and track development. Areas with intact vegetation beyond the limit of works shall not be disturbed. Large trees close to the limit of works shall be identified and clearly marked to avoid accidental damage.

Suitable vegetative material and topsoil required to be removed as a result of construction will be used in the land rehabilitation process. Vegetation is only to be cleared in areas directly required for roadworks, and is to be re-applied to approximately the same area as it was collected from. Where an excess of material occurs in a given area it is to only be used in areas of the same vegetation association, as defined by vegetation mapping undertaken for the project.

Any vegetation not required for rehabilitation, or which has a high proportion of weeds, is to be taken off-site to a pit area designated by the local authority.

Commitment

(3) Clearing and stockpiling of vegetation shall occur in accordance with the procedures designated within the MRWA Environment Management Manual and Roadside Flora Care Manual. These factors will be addressed to the satisfaction of the DEP.

(4) During construction, road verges shall not be cleared by Main Roads beyond the corridor required for the construction of the road formation and earthworks. This commitment will be implemented to the satisfaction of the DEP.

During and following the construction phase, weed control will need to be incorporated into the rehabilitation strategy to maximise success of the revegetation programme. Weed control will be required for the road alignment and material source sites. Weed eradication and control procedures will be implemented according to established Main Roads WA practice. Control measures may be by manual, mechanical or chemical means to remove noxious weed stocks, including seed, plant and root material.

Commitment

(5) Weed control shall be included as a component of the rehabilitation strategy and form an ongoing component of road reserve management. Implementation will be to the satisfaction of the DEP and CALM.

5.2.7 Vegetation Diseases

Phytophthora cinnamomi and other *Phytophthora* species have only been found north of Moore River since 1986, with a known outbreak at Eneabba in 1989. Vegetation particularly susceptible to the disease include species of Proteaceae, Epacridaceae, Myrtaceae, Dilleniaceae, Papilionaceae and Xanthorrhoeaceae (Hill, 1990). Twelve infections have been noted in the Beekeepers Nature Reserve up to 1993 (Kinhill Engineers, 1995).

As the southern project area occurs through alkaline coastal soils, with associated coastal vegetation species, the likelihood of dieback infestation occurring is low. However, the northern section of the alignment crosses Proteaceous vegetation of the Jurien system which is susceptible to *Phytophthora* infection.

It has been shown that introduction and intensification of *Phytophthora cinnamomi* disease in four National Parks in Western Australia is directly attributable to disturbance of the area caused by road and firebreak construction and their subsequent use. Construction activity within the project area could therefore lead to the spread of dieback, either directly through the movement of infected construction material or due to the passage of vehicles and machines through the infected areas.

The impact which would be most significant should it occur, is therefore the potential for the spread of dieback infection, particularly both from and to material source sites and surrounding areas. The proximity of the project area to the Drovers Cave and Nambung National Parks makes the introduction of dieback into the area of particular significance at a regional level.

Management Strategy
Due to the risk of the introduction of dieback to the project area, dieback management will form a crucial component of environmental management for the project. The management strategy will be based upon ensuring that no soil movement will occur between infected and non-infected areas of vegetation within the project area.

The Dieback Management Programme will be prepared in accordance with dieback hygiene procedures developed by CALM and MRWA. Strategies to be included in the dieback procedures may include:

- selection of appropriate road construction materials;
- cleaning down of machinery prior to delivery to the site, to ensure all soil and root material is removed, using a brush and/or compressed air in dry soil conditions, or washdown with dieback-free water in wet soil conditions;
- where practicable, construction activities to occur during summer to minimise risk of spreading of dieback; and
- education of construction and operations staff in procedures of dieback hygiene.

Commitment

(6) Prior to construction, a Dieback Hygiene Management Programme shall be developed and implemented, to the requirements of CALM.

5.2.8 Movement of Fauna

Impact to fauna is generally secondary, resulting initially from a loss of habitat and relocation of mobile species into adjacent habitats.

The road alignment will create a physical barrier to small fossorial and sedentary fauna species. Due to the narrow width of the road and the low volume of traffic, the majority of the fauna within the study area will not be affected. Localised death of larger mobile species, predominantly kangaroos and snakes through road deaths is likely to be the main impact on fauna presently within the study area.

Management Strategy
The proposed road is considered to cause only minor impact as a barrier to fauna movement. Further, road deaths are an unavoidable impact of a rural road of this nature. The bridge at the Hill River shall be designed to provide for fauna movement along the stream banks by the provision of adequate freeboard.

5.2.9 Dune Protection

The proposed road is not located within the active coastal zone, but is situated entirely within dune terrain. Some impact on dune topography is therefore unavoidable from the road construction.

The alignment passes to the east of a mobile sand sheet with a general south-west to north-east trend. The proposal does not directly impact on the sand sheet, and any further movement would be likely to be north-east and therefore away from the Cervantes - Jurien road.

The entry of the proposed road into Jurien occurs across the beach ridge plain. The Northern 1 option is a more direct mode of entry so will minimise direct impact to the dune system in comparison to the other entry options. It should be noted that this section of the alignment passes through freehold land which is likely to be subject to future development.

Management Strategy
Dune protection is not considered to be a significant management requirement for the Cervantes - Jurien road proposal and will be achieved through restriction of vegetation clearing and progressive rehabilitation of disturbed areas not forming a component of the road or adjacent shoulders.

5.2.10 Erosion

Due to the alignment being located on the Spearwood Dune system, the potential for erosion can result from the clearing of vegetation allowing wind and water transport of destabilised sand. Construction of the proposed route will inevitably entail the clearing of dune vegetation, thereby enhancing erosion hazard on a localised scale. Management of clearing, road construction and post-construction rehabilitation will prevent the project from resulting in the formation of dune blowouts.

Management Strategy
Erosion is not expected to form an impact from the proposal, and surface stabilisation of disturbed dune sands will be achieved through rehabilitation measures.

5.2.11 Drainage Management

Potential exists for any road project to create a pollution impact on the adjacent environment, through transport of contaminants (*e.g.* nutrients, heavy metals, hydrocarbons) deposited on the road surface being washed into the surrounding area following rainfall events. Heavy metals and hydrocarbons are the main pollutants resulting from traffic movement. These tend to be in particulate form, or if in solution will tend to adsorb to suspended sediments prior to settling (Maestri *et al.*, 1995). Encouragement of settling is therefore a mechanism to minimise pollutants entering groundwater and waterbodies adjacent to a roadway.

The majority of the drainage from the Cervantes - Jurien road will occur by road runoff draining from the pavement to natural surface levels at regular intervals. Runoff will percolate through the sandy soil, which will effectively act as a natural filter mechanism. Studies into the impact of storm water runoff from highways have found that runoff from rural highways with traffic volumes less than an average of 30,000 vehicles per day is considered to have a low potential to cause adverse effects (Maestri *et al.*, 1995). This conclusion is based upon the direct discharge of runoff into receiving water bodies.

It is Main Roads WA practice however, that uncontrolled or untreated storm water not be discharged into wetlands and the road drainage system will therefore incorporate features to ensure that Hill River is not subject to direct inflow of road runoff. The local topography creates a situation where there is 200 m to the south of the bridge and 80 m to the north which will drain towards the Hill River. This section of the proposed road will require drainage management measures to prevent runoff directly entering the waterway.

Management Strategy
Due to the dune feature separating Wealacutta Pool from the proposed alignment, there is no likely impact on the wetland from direct road runoff. There is the potential for movement of contaminants through the westwards movement of groundwater, however in reference to traffic volumes and the low potential for adverse environmental effects from this source, no management measures are proposed for this aspect of the proposal.

Specific design measures will however be implemented to prevent direct discharge of road runoff into Hill River. A number of options will be investigated during the design phase to address stormwater management, including:

- the use of water compensation / retention basins with nutrient / pollutant retaining characteristics;
- road and bridge runoff be directed into vegetated swale drains, reducing flow velocity and encouraging infiltration and settling of sediment; and
- incorporation of sediment traps at the bridge site to reduce flow velocity and to collect sediment, before stormwater enters the river channel.

Commitment

(7) Prior to construction, an appropriate design be developed to prevent direct discharge of stormwater runoff to the Hill River, to the satisfaction of the DEP and the Water & Rivers Commission.

5.3 OTHER FACTORS

5.3.1 Visual Impacts

The visual amenity of the area will be altered by the road project, due to the requirement for vegetation clearing. Sections of the road will be located upon dune ridges which will provide road users with views of the ocean and will therefore be more prominent in the landscape. The majority of the alignment is however located within dune swales and will therefore not be generally visible.

The impact of clearing will however be a short-term one, as clearing for road construction requires approximately 30 m out of the 100 m reserve, the road will remain within a corridor of remnant vegetation. The height of the vegetation varies from 1.5 m in coastal heath, to 4 m through *Acacia* scrub and up to 8 m in riverine vegetation. The retention of the vegetation within the 100 m reserve, with a pavement and shoulders of 10 m, and the rehabilitation of the additional 10 m on either side of the alignment will create a predominantly enclosed driving environment.

Management Strategy
Following construction, land rehabilitation and revegetation will be instigated to mitigate the evident alteration caused by clearing. All areas disturbed as a result of construction of the proposed road shall be rehabilitated.

Potential for adverse visual impact will be mitigated through selection of the road alignment within the 100 m reserve being made to minimise the extent of earthworks and vegetation clearing required, consistent with maintenance of vertical and horizontal design standards and sight distances.

Topsoil management will form an important component of the rehabilitation process, and is to include stripping, stockpiling and respreading. In-situ topsoil is a rich seed source and will assist in the regeneration of the roadside vegetation. If revegetation does not occur naturally, direct seeding will be carried out utilising local native flora species sourced from the project area.

Commitment

(8) Rehabilitation shall be incorporated into the project and is to be based upon procedures designated within the MRWA Environment Management Manual and the Roadside Flora Care Manual.

5.3.2 Heritage

No Aboriginal archaeological or ethnographic sites have been found within the alignment corridor and therefore no impact is anticipated.

The coastal road crosses sections of the historic Old North Road Stock Route or Coastal Stock Route between Cervantes and Jurien, but does not affect the proposed heritage trail associated with the route.

Management Strategy
Should any Aboriginal archaeological material be uncovered during road construction activities work in the immediate area shall be stopped and the Aboriginal Affairs Department notified. No management initiatives are required for European heritage in the project area.

5.3.3 Material Sourcing

There are two aspects of environmental impact from use of borrow pits. The first is the direct impact of clearing for materials extraction, and the second is the potential for the transport of weeds and / or dieback disease from source sites.

Of the sixteen pits examined for the project, four were unproven or unsuitable as a source of materials (Pits 5, 10,13 & 14). One of the source sites is within an existing reserve designated for quarrying (Pit 4) and would require clearing of additional remnant vegetation. Pits 1, 2 and 6 are adjacent to existing pits and their use would require clearing of additional remnant vegetation. Pits 7, 8 and 9 are newly identified sources in uncleared areas of remnant vegetation. The remaining pits (3, 11, 12, 15 & 16) are located within cleared pasture areas.

Due to the large areas of land within conservation reserves, clearing of vegetation for material sourcing will be a localised impact. The transport of weeds from borrow pits in paddocks is likely to be the most significant impact from material sourcing for the project.

Management Strategy
An appropriate location for construction materials will need to be determined, to ensure that materials do not form a source of dieback or weed contamination. Acquisition of construction materials from sites away from the alignment will be subject to appropriate environmental assessment and management procedures commonly implemented for such sites.

Sites selected for provision of construction materials will be subject to assessment for the presence of dieback. Road materials will not be utilised from sites which have been confirmed to contain soil borne fungal pathogens, especially *Phytophthora* species.

Commitment

(9) Sites utilised for acquisition of construction materials will be subject to assessment for the presence of dieback. No materials will be sourced from areas infected with the dieback fungus. This commitment will be implemented to the satisfaction of the DEP.

(10) On completion of construction, all borrow pits on private or public lands shall be reinstated or rehabilitated in accordance with Main Roads policy, and in consultation with the owners on private and / or CALM and other authorities on public lands. This commitment will be implemented to the satisfaction of the DEP.

5.3.4 Noise

The noise levels will be altered at the points where the Coastal Road enters Cervantes and Jurien, due to the increased traffic volumes that the proposal will generate. Noise will also be an impact during the construction phase of the project.

Management Strategy
Construction noise is likely to cause nuisance to the residents of Cervantes and Jurien in close proximity to the entry of the Coastal Road to the townsites. This can be managed by restricting construction times to minimise the amount of time local residents are affected. As both entry points make use of existing residential roads, no measures are proposed for lessening noise generated from higher traffic volumes.

Commitment

(11) Construction activities adjacent to residential areas will be limited to reasonable daylight hours to mitigate noise impacts in adjacent localities.

5.3.5 Risk and Hazard

The Cervantes to Jurien Coastal Road may be utilised by freight traffic which may include the transport of hazardous materials. The risk therefore exists for accidents to occur causing the release of such materials to the road and adjacent areas. The main impact of this in environmental terms would be the pollution risk to the surface and ground water systems along the alignment.

Risk and hazard are issues related to the properties of the materials being transported. Regulations for transport and emergency response procedures for hazardous goods are the responsibility of the transporter under the Dangerous Goods Regulations 1992 (set under the Explosives and Dangerous Goods Act 1961) in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail. The Regulations specify labelling and packaging of materials, licensing and inspection of transport vehicles and the emergency procedures for response to accidents.

Management Strategy
The road design will be in accordance with the alignment standards specified by Austroads, which will minimise the risk of accidents occurring. Landscape planting will also account for sight requirements to maximise safety.

Summary of Proponent Commitments

FACTOR	OBJECTIVE	IMPACTS OF THE PROPOSAL	NO.	COMMITMENT	PHASE	TO SATISFY
Environmental Management Programme (EMP)	Address the CER commitments	The key environmental factors requiring management strategies have been identified, and commitments made to ensure that project impacts are minimised.	1	Implementation and auditing of the environmental management strategies documented within the CER.	All Phases	DEP & CALM
BIOPHYSICAL ENVIRONMENT						
Conservation Areas	Ensure the project does not have a detrimental impact on the Southern Beekeeper's Nature Reserve	The proposal will result in a road forming the western boundary of the Southern Beekeeper's Nature Reserve, causing potential for introduction of weeds and dieback, and increased ease of access.	2	Liasion with CALM to determine requirements for fire management access tracks and firebreaks for the section of the southern Beekeepers Reserve where the coastal road forms the western boundary of the reserve.	Pre-construction	CALM
Vegetation and Management of clearing	Minimise clearing of remnant vegetation within the road reserve during construction	The proposal will require vegetation clearance which will destabilise the ground surface. Rehabilitation of disturbed ground will be required following road construction.	3	Clearing and stockpiling of vegetation shall occur in accordance with the procedures designated within the MRWA Environmental Management Manual and Roadside Flora Care Manual, and incorporated into the project EMP.	Construction	DEP
	Minimise clearing of remnant vegetation within the road reserve during construction	Clearing of native vegetation is a major impact of the proposal. Clearing can be minimised by management techniques implemented during the construction phase.	4	During construction, road verges shall not be cleared by beyond the corridor required for the road formation and earthworks.	Construction	DEP
	Prevent the introduction and spread of weeds.	Weeds can be introduced or spread due to increased vehicle movement through the project area. The extent to which this occurs requires management to minimise impact to conservation value vegetation in the region.	5	Weed control shall be included as a component of the rehabilitation strategy developed for the project and form an ongoing component of road reserve management.	Pre-construction and Construction	CALM
Vegetation Diseases	Prevent the introduction and/or spread of dieback.	The spread of dieback is a potential impact of the proposal due to construction activities and increased traffic on the road itself. The significance of this aspect results from the proximity to dieback susceptible vegetation types.	6	A Dieback Management Programme shall be developed and implemented to the requirements of CALM .	Pre-construction and Construction	CALM
Drainage Management	To prevent contamination of wetlands and watercourses	As the proposal crosses the Hill River, a potential impact is that of contaminated road runoff entering the watercourse.	7	An appropriate design be developed to prevent direct discharge of stormwater runoff to the Hill River.	Pre-construction	DEP & Water & Rivers Commission
OTHER FACTORS						
Visual Impacts	To minimise the impact of the proposal on visual amenity within the project area.	The proposal will alter the visual amenity of the area as there is currently no formal access and little development in the region.	8	Rehabilitation shall be incorporated into the project and is to be based upon procedures designated within the MRWA Environmental Management Manual and the Roadside Flora Care Manual.	Pre-construction	DEP & CALM
Material sourcing	To ensure that material source sites are subject to appropriate levels of environmental management.	The main impact from use of material source sites is that of potential for dieback contamination.	9	Sites utilised for acquisiton of construction materials will be subject to appropriate environmental assessment and management procedures commonly implemented for such sites	Post-construction	DEP
	To rehabilitate source material sites	Ground disturbance will result from obtaining construction materials.	10	On completion of construction, all borrow pits on private or public lands shall be reinstated or rehabilitated, in accordance with Main Roads policy and in consultation with owners or management agencies.	Post-construction	DEP
Noise	To avoid creating noise nuisance for local residents	Construction noise may disturb residents where the proposal enters the Cervantes and Jurien townsites.	11	Construction activities adjacent to residential areas will be limited to reasonable daylight hours to mitiate noise impact in adjacent localities	Construction	Shire of Dandaragan

STUDY TEAM

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APPENDIX A

EPA Guidelines for the Preparation of the Consultative Environmental Review

COASTAL ROAD BETWEEN JURIEN AND CERVANTES (1019)

GUIDELINES FOR THE ENVIRONMENTAL IMPACT ASSESSMENT DOCUMENT

CONSULTATIVE ENVIRONMENTAL REVIEW

Overview

All environmental reviews have the objective of protecting the environment, and 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 environmental impacts and the management of the issues arising from the environmental impacts, so that the environment is protected to an acceptable level.

Throughout the assessment, the Department of Environmental Protection (DEP) aims to assist the proponent to improve the proposal so that environmental impacts are minimised. The DEP also co-ordinates advice from relevant government agencies and the public about environmental matters during the assessment of the Consultative Environmental Review (CER).

Objectives of the CER

- To communicate clearly with the public and government agencies, so that the EPA can obtain informed comment to assist in providing advice to government.
- To describe all aspects of the proposal adequately, so that the Minister for the Environment can consider approval of a well-defined project.
- To provide the basis for the environmental management programme, which should demonstrate that the environmental issues resulting from the proposal can be acceptably managed.

The contents of the CER should reflect these objectives.

Contents of the CER

The text of the CER should be simple, concise, and referenced. This document would form the legal basis of the Minister for the Environment's approval of the proposal and should include a description of all the components of the proposal.

The environmental management programme for the proposal should be developed in conjunction with the engineering and economic programs of the proposal. That is, the CER should be designed to be immediately useful at the start of the proposal, and the DEP recommends that an environmental management and audit programme be incorporated as a concluding part of the CER.

The textual content of the CER should include:

- introduction to the proponent, the project and location;
- the legal framework, decision making authorities and involved agencies;
- description of the components of the proposal and identification of the potential environmental impacts;
- description of the receiving environment which may be affected;
- discussion of the environmental factors (shown in the next section), including an assessment of their significance in comparison to relevant objectives, policies or standards;
- discussion of the objectives for management of the environmental factors, including commitments to appropriate action; and

- a summary of the environmental management programme, including the key commitments, monitoring work and the auditing of the programme.

The EPA considers that the proponent should approach environmental management in terms of best practice, which includes:

- development of an environmental policy;
- agreed environmental objectives;
- management practices to achieve the objectives;
- involve the public as appropriate;
- audit environmental performance against agreed indicators;
- regular reporting to the EPA (or nominated agency);
- commitment to a quality assured management system and continuous improvement; and
- periodic review in conjunction with the EPA (or nominated agency).

Additional content requirements for the CER are included in the next section.

Environmental factors

The environmental factors relevant to this proposal can be determined from a consideration, called scoping, of the potential impacts of the proposal on the environment. The receiving environment includes social surroundings.

The CER should focus on the environmental factors for the proposal as agreed in consultation with the DEP and relevant government agencies. A description of the project component and the receiving environment should be directly included with, or referenced to, the discussion of the environmental factor. The technical basis for measuring the impact and any specifications or standards for assessing and managing the environmental factor should be provided.

The environmental factors identified at this stage, and the assessment objectives include:

Biophysical

Environmental factor	Environmental Protection Authority objective
Regionally significant wetlands	Wetlands along the route should be protected and key ecological functions should be maintained.
Locally significant wetlands	Where possible, key wetland functions should be retained or enhanced. Where not possible, key wetland functions should be retained through replacement.
Watercourses	Watercourses along the route should be protected and key ecological functions should be maintained.
Conservation Areas	The vegetation in the conservation reserves (Conservation Through Reserves Committee recommended areas 5.15 (Beekeepers Reserve) and 5.24 (West Coast)) should not be adversely affected.
Flora and Fauna	Protect Declared Rare and Priority flora and Reserve Listed fauna.
Vegetation	Minimise the loss of locally and regionally significant vegetation associations and plant and animal habitats.
Vegetation diseases	Ensure the protection of areas free of vegetation diseases and minimise the spread of diseases where they are identified.
Movement of fauna	The constructed road should not form a barrier to natural fauna movement or corridors.

Dune protection	The integrity, function and environmental values of the dune system(s) should be maintained.
Erosion	The road should be constructed so that it does not cause erosion in the adjacent Reserves.
Drainage management	Ensure no adverse changes to existing drainage systems, vegetation/land systems, and dependent flora and fauna.
Visual impacts	The visual amenity of the area adjacent to the project should not be unduly affected by the proposal.

Other

Environmental factor	Environmental Protection Authority objective
Aboriginal heritage	Construction of the road should comply with the Aboriginal Heritage Act.
Source of road construction materials	Only by prior agreement with CALM/NPNCA may road construction materials come from the Reserves. Imported materials are to be weed and dieback free.

Commonwealth requirements (if applicable)

Environmental factor	Environmental Protection Authority objective
Endangered species	Protect species listed in Schedule 1 of the Endangered Species Protection Act.

In discussing the environmental factors identified in the table above, the CER should contain:

- the reasons for selection of the preferred alignment, and the alternatives considered (with particular regard for the southern end of the alignment. ie. potential to link with Cervantes township, Nambung National Park, Cervantes by-pass, etc.);
- monitoring and management of off-site impacts on the Reserves adjacent to the proposal. Particular attention should be given to the interface between this area and the proposed road, management of weeds, erosion, dieback, fauna corridors and hydrological impacts;
- the location of wetlands, including areas of seasonal inundation, and watercourses and proposals to manage and minimise disturbance of these areas (eg. buffers);
- if buffers are proposed, the basis for proposed buffer widths. The proposal should map proposed buffer areas;
- the results of recent, comprehensive, fauna, flora and vegetation surveys, taking into account vegetation communities as well as the status of particular species of flora and fauna. On-going management of vegetation, flora and fauna should be described;
- procedures with regard to any Declared Rare and/or Priority flora and Reserve Listed fauna;
- an assessment of the regional significance of the vegetation associations likely to be affected by this proposal, including discussion of the representation of these associations in secure conservation areas; and
- a table summarising the environmental impacts of the proposal and describing:
  - the present state of the environment;
  - potential impacts of the proposal on the environment;
  - environmental management objectives for those aspects which require management;
  - environmental management proposed to manage impacts to meet those objectives; &
  - envisaged resultant state of the environment.

These factors should be presented under the major headings used in the table above and as appropriate, ie. biophysical, pollution, social surroundings and other.

Further environmental factors may be raised during the preparation of the CER, and on-going consultation with the DEP and relevant agencies is recommended. Minor issues which can be readily managed as part of normal operations may be briefly described. Information used to reach conclusions should be properly referenced, including personal communications. Assessments of the significance of an impact should be soundly based rather than unsubstantiated opinions, and the assessment should lead to a discussion of the management of the environmental factor.

Public consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent in preparing the CER. 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 environmental 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.

Environmental management commitments

The method of implementation of the proposal and all commitments made by the proponent in the CER become legally enforceable under the conditions of environmental approval issued by the Minister for the Environment. Commitments which address environmental factors form a schedule to the Minister's environmental conditions and will be audited by the DEP.

The commitments have the form of: the proponent (who) will prepare a plan or take action (what) to meet an objective, to the timing for its achievement (when), and to which agencies will be consulted or to whose requirements, if not the DEP, the action/plan will be prepared.

Other commitments show that the proponent is dedicated to good environmental management of the project, and the DEP expects that the proponent will audit these commitments by internal processes under an Environmental Management System. Though not subject to routine audit, the DEP may request that compliance with, or the in-house audit of, these commitments be demonstrated, so as to verify satisfactory environmental performance. The commitments define the goals/objectives for the environmental management programme and procedures (the details of how the commitment will be met), which should be described in as much detail as possible. The DEP acknowledges that, with the implementation of best practice and continuous improvement for the project, the procedures may need to be modified, or added to, in regular updates to the environmental management programme. An example of a typical commitment is:

Env. factor	Objective	Commitment	Timing (Phase)	Whose requirements	Specification (Performance Indicator)
EMP	Implement effective EMP	Develop and implement an effective EMP	Pre-construction and on-going	DEP	EMP developed and implemented to requirements of DEP.

For QA purposes, these draft guidelines reflect the outcome of the Strategy meeting held on 7 May 1996 and endorsed at the managers meeting on 8 May 1996. They have also been checked against the Decision to Assess or Not Assess Form 2.

APPENDIX B

Description of Vegetation Associations in the Cervantes to Jurien Project Area

Appendix B: Vegetation Association Descriptions

JURIEN SYSTEM

ASSOCIATION 1. Scrub heath.

This association was characterised by a dense to mid dense shrub stratum with *Dryandra sessilis* usually dominant. This vegetation association occurred on the low undulating plains of sand that overlay Tamala Limestone. If present, an upper stratum of shrubs 1 - 2 m tall, comprised of dense to sparse *Dryandra sessilis* or *Jacksonia furcellata* with *Acacia cyclops* sometimes present. The lower shrub stratum comprised of dense to spares mixed species with *Hibbertia hypericoides* usually present, often dominant. The ground cover of grasses, herbs and sedge like plants was very sparse, if present, often with *Loxocarya flexuosa*.

ASSOCIATION 2. *Allocasuarina lehmanniana* Scrub

This association was characterised by sparse *Allocasuarina lehmanniana* in the upper stratum to 4 m in height. Only one occurrence of this association was recorded, with an adjacent site also recording very sparse *Allocasuarina lehmanniana*. The taller shrub layer also included *Acacia cyclops*. A sparse lower shrub stratum of mixed species was dominated by *Melaleuca cardiophylla* and *M. acerosa*. A ground cover of very sparse grasses and sedge like plants was dominated by *Stipa ?elegantissima* and *Lepidosperma angustatum* (complex). Also present in the ground cover were mixed sparse herbs, no dominants.

ASSOCIATION 3. Hill top heath on Molah Hill

This association was characterised by sparse low shrubs growing in shallow soil pockets on the exposed limestone outcrop of the hill top. Only one such hill occurred in the study, Molah Hill. The low shrub stratum of mixed species to 0.5 m tall was dominated by very sparse *Acacia sphacelata* and *Dodonaea bursariifolia*. A ground cover of herbs, grasses and sedge like plants were less than 2% cover.

The hill top has experienced extensive trampling due to its prominence on a landscape of otherwise low profile.

GUILDERTON SYSTEM

ASSOCIATION 4. Low heath on coastal flats dominated by *Melaleuca scabra*

This association was characterised by dense to sparse to very sparse *Melaleuca scabra*. This vegetation association occurred on grey loamy sand over limestone. Where present, there was an upper stratum of shrubs, 0.5 - 1 m tall, comprised of occasional emergent *Acacia cyclops*. The lower shrub stratum consisted of mid-dense to sparse mixed species dominated by either mid-dense to sparse *Melaleuca scabra* or *Acacia lasiocarpa*. The ground cover of mixed herbs, grasses and sedge like plants were very sparse, if present, and no species dominated.

ASSOCIATION 5. Coastal scrub on dunes

This association was characterised by a tall shrub stratum of dense to sparse to very sparse *Acacia cyclops*. This vegetation association occurred mostly on dunes. The upper stratum of shrubs, 1 - 4 m tall, comprised almost or entirely of *Acacia cyclops*. If present, other species included mid-dense to sparse to very sparse *Melaleuca cardiophylla*. The lower shrub stratum to 1 m tall comprised of mid-dense to sparse to very sparse mixed species, dominated variously by mid-dense *Acacia ?leptospermoides*, very sparse *Melaleuca scabra* or *M. hamulosa*, mid-dense *Acacia lasiocarpa* or *Melaleuca acerosa*. The ground cover of mixed herbs, grasses and sedge like plants, if present, was mostly very sparse, no species dominated, except in disturbed areas where mid-dense to sparse *Ehrharta longiflora* and *Bromus diandrus* were common.

This association graded into the next association (Coastal scrub disturbed), depending on the degree of disturbance.

ASSOCIATION 6 - Coastal scrub disturbed

This association was the same as the previous association (Coastal scrub) but the lower stratum was replaced by mid-dense weeds to 1 m high, dominated by *Avena satava* and *Hypochaeris glabra*. The areas appear to have been heavily grazed.

ASSOCIATION 7. Coastal heath on flats

This association was characterised by a mid dense to sparse to very sparse *Melaleuca acerosa* and frequently *Acacia lasiocarpa*. This vegetation association occurred on the swales and plains between the dunes. If present, an upper stratum of very sparse shrubs, 1 - 2 m tall, comprised *Acacia cyclops* and near coastal sites, *Spyridium globulosum*. The lower shrub stratum consisted of mid-dense to sparse mixed species dominated by either mid-dense to sparse *Melaleuca scabra* or *Acacia lasiocarpa*, less common were mid dense *Scaevola lanceolata*, *Lysinema ciliatum*, and sparse *Leucopogon australis*. The ground cover of mixed herbs, grasses and sedge like plants was mid dense to sparse to very sparse, included the following more common species: mid dense to sparse *Lomandra maritima*, sparse *Stipa flavescens* and very sparse *Conostylis candicans*. The climbing parasite *Cassytha micrantha* when present was mid dense.

ASSOCIATION 8. Samphire communities

This association was characterised by sparse *Halosarcia indica* var. *bidens* and-or very sparse *Frankenia pauciflora*. This vegetation association occurred on the fringing edges of the playa lake and adjacent low laying areas. A shrub stratum, 0.5 - 1 m tall of very sparse *Sarcocornia quinqueflora* was only present away from the lakes edge. The low shrub stratum was mid dense to sparse, to 0.3 m tall, dominated by very sparse *Frankenia pauciflora* with *Sarcocornia quinqueflora* and *Halosarcia indica* var. *bidens* common. The ground cover of mid dense to sparse mixed herbs to 0.2 m tall were dominated at the lakes edge by very sparse *Wilsonia humilis*, no other species were common. Mixed grasses and sedge like plants were present but with a cover less than 2%.

ASSOCIATION 9. *Melaleuca hamulosa* low scrub

This association was characterised by a shrub stratum of sparse *Melaleuca hamulosa*. This vegetation association occurred on ridges fringing the playa lake. The upper stratum of shrubs, 1 - 2 m tall, comprised entirely of very sparse *Melaleuca huegelii*. The sparse lower shrub stratum to 1 m tall, was dominated by sparse *M. hamulosa*. Shrubs less than 0.5 m were uncommon (< 2%). The ground cover of sedge like plants were sparse, dominated by sparse *Lomandra maritima* and very sparse *Schoenus* sp.1. Grasses and herbs were uncommon with a cover less than 2%, no dominants.

ASSOCIATION 10. *Melaleuca cardiophylla* thicket

This association was characterised by a tall shrub stratum of mid dense *M. cardiophylla*. This vegetation association occurred on high ground surrounding the playa lake where salt concentration was lower. The upper stratum of mid dense shrubs, 1 - 3 m tall, was dominated mid dense *M. cardiophylla* with sparse *Acacia ? rostellifera*. The lower sparse shrub stratum to 1 m tall was dominated by very sparse *M. acerosa*, *Acanthocarpus preissii* and *Conostylis candicans*. The ground cover was sparse mixed herbs, no species dominated.

ASSOCIATION 11. Riverine

This association was characterised by a dense thicket of *Acacia cyclops* and very sparse *Eucalyptus rudis* trees. This vegetation association occurred on higher ground of the Hill River banks. The upper stratum was very sparse *E. rudis* to 8 - 12 m. The dominant stratum was a dense thicket of *A. cyclops* to 3 - 5 m.

Sparse mid level shrubs were 1 - 2 m tall, dominated by sparse *Melaleuca cardiophylla* and less commonly very sparse *Guichenotia micrantha*. The ground cover was dense low grass dominated by dense *Ehrharta longiflora*. The only climber, *Clematicissus angustissima*, was very sparse to 2 m in height.

ASSOCIATION 12. Mobile sand dunes

This association was characterised by a total absence of plants, with the exception of those being engulfed and the pioneers on the trailing edge. These plants were typical of those found in adjacent associations, usually coastal scrub.

ASSOCIATION 13. Pasture

This association was characterised by an almost or total absence of native species. In some areas a few scattered *Acacia cyclops* survived over the pasture species.

APPENDIX C

Flora Species List for the Cervantes to Jurien Project Area

APPENDIX C: VASCULAR PLANT SPECIES LIST: COASTAL ROAD - CERVANTES TO JURIEN.

Classification and nomenclature according to Census of Australian Vascular Plants 1990., R.J. Hnatiuk Australian Government Publishing Service.

Key: * = introduced species
† = flora of interest

FAMILY	SPECIES
JUNCAGINACEAE	*Triglochin calcitrapa*
	Triglochin mucronatum
	Triglochin striata
POACEAE	**Avena sativa*
	**Briza maxima*
	**Briza minor*
	**Bromus diandrus*
	Bromus arenarius
	?Danthonia setacea
	**Ehrharta longiflora*
	**Hordeum leporinum*
	**Lolium rigidum*
	**Trisetaria cristata*
	*?*Holcus* sp. 1
	*?*Lolium* sp.1
	Microlaena stipoides
	Poa drummondiana
	Poaceae 1
	Poaceae 2
	Poaceae 3
	Poaceae 4
	Stipa ?elegantissima
	Stipa ?flavescens
	Stipa campylachne
	Stipa elegantissima
	Stipa flavescens
	Stipa sp. 1
CYPERACEAE	*Gahnia trifida*
	Isolepis marginata
	Lepidosperma ?leptostachyum
	Lepidosperma angustatum
	Lepidosperma angustatum complex
	?Lepidosperma angustatum complex
	Lepidosperma sp.1
	Lepidosperma squamatum
	Mesomelaena stygia
	Schoenus asperocarpus
	Schoenus caespitosa
	Schoenus grandiflorus
	Schoenus sp.1
RESTIONACEAE	*Loxocarya flexuosa*

FAMILY	SPECIES
CENTROLEPIDACEAE	*Centrolepis aristata*
JUNCACEAE	*Luzula meridionalis*
DASYPOGONACEAE	*Acanthocarpus preissii* *?Lomandra integra* *Lomandra maritima* *Lomandra* sp.1
XANTHORRHOEACEAE	*Xanthorrhoea ?preissii* *Xanthorrhoea preissii*
PHORMIACEAE	*Dianella revoluta*
ANTHERICACEAE	*Thysanotus manglesianus* *Thysanotus* sp.1 *Tricoryne elatior*
LILIACEAE	*Wurmbea* sp.1
HAEMODORACEAE	*Anigozanthos humilis* *Conostylis candicans* *Conostylis prolifera*
IRIDACEAE	**Gladiolus* sp. 1 *Patersonia occidentalis*
ORCHIDACEAE	*Caladenia* sp. 1 *Cyrtostylis robusta* *?Prasophyllum* sp.1 *Prasophyllum parviflora*
CASUARINACEAE	*Allocasuarina humilis* *Allocasuarina lehmanniana*
URTICACEAE	*Parietaria debilis*
PROTEACEAE	*Banksia prionotes* *Banksia sphaerocarpa* *Conospermum stoechadis* *Dryandra lindleyana* var. *lindleyana* *Dryandra sessilis* *Grevillea preissiana* *Hakea costata* *Hakea erinacea* *Hakea prostrata* *Hakea trifurcata* *Hakea undulata* *Petrophile media* *Petrophile serruriae*

FAMILY	SPECIES
SANTALACEAE	*Exocarpus aphyllus*
	Leptomeria preissiana
	Leptomeria sp. 1
	Leptomeria spinosa
	Santalum acuminatum
OLACACEAE	*Olax benthamii*
LORANTHACEAE	*Nuytsia floribunda*
POLYGONACEAE	*Muehlenbeckia adpressa*
CHENOPODIACEAE	**Chenopodium pumilio*
	Halosarcia indica var. *bidens*
	Rhagodia preissii
	Sarcocornia quinqueflora
	Suaeda australis
	Threlkeldia diffusa
AMARANTHACEAE	*Ptilotus ?drummondii*
	Ptilotus ?stirlingii
	Ptilotus drummondii
	Ptilotus sp.1
GYROSTEMONACEAE	*Gyrostemon* sp. 1
	Gyrostemon racemiger
	Gyrostemon ramulosus
	Gyrostemon subnudus
AIZOACEAE	**Tetragonia decumbens*
PORTULACACEAE	*Calandrinia calyptrata*
CARYOPHYLLACEAE	**Cerastium glomeratum*
	**Silene gallica*
RANUNCULACEAE	*Clematis microphylla*
	Clematis pubescens
LAURACEAE	*Cassytha flava*
	Cassytha micrantha
	Cassytha racemosa
BRASSICACEAE	**Brassica tournefortii*
	**Diplotaxis muralis*
	**Heliophila pusilla*
	Stenopetalum robustum
CRASSULACEAE	*Crassula colorata*
CAESALPINIACEAE	*Labichea cassioides*

FAMILY	SPECIES
DROSERACEAE	*Drosera ?neesii*
	Drosera bulbigena
	Drosera bulbosa
	Drosera glanduligera
	Drosera huegelii
	Drosera sp.1
	Drosera sp.2
	Drosera stolonifera
MIMOSACEAE	*Acacia ?leptospermoides*
	Acacia ?rostellifera
	Acacia cyclops
	Acacia lasiocarpa
	Acacia spathulifolia
	Acacia sphacelata
	Acacia xanthonema
PAPILIONACEAE	*Bossiaea eriocarpa*
	Daviesia preissii
	Dillwynia sp.1
	Gompholobium scabrum
	Gompholobium tomentosa
	Hardenbergia comptoniana
	Isotropis cuneifolia
	Jacksonia furcellata
	Kennedia coccinea
	Kennedia prostrata
	**Medicago* sp. 1
	**Melilotus indica*
	Nemcia reticulata
	Sphaerolobium macranthum
	Templetonia retusa
	**Trifolium arvensis*
GERANIACEAE	**Erodium botrys*
	**Erodium cicutarium*
	**Pelargonium capitatum*
	Pelargonium littorale
OXALIDACEAE	*Oxalis corniculata*
RUTACEAE	*Diplolaena angustifolia*
	Diplolaena dampieri
	Eriostemon spicatum
POLYGALACEAE	*Comesperma volubile*
STACKHOUSIACEAE	*Stackhousia huegelii*
	Stackhousia monogyna
SAPINDACEAE	*Dodonaea bursariifolia*

FAMILY	SPECIES
EUPHORBIACEAE	*Adriana quadripartita* *Beyeria cinerea* **Euphorbia peplus* **Euphorbia terracina* *Phyllanthus calycinus* *Poranthera microphylla* *Stachystemon vermicularis*
RHAMNACEAE	*Cryptandra* sp. 1 *Spyridium globulosum* *Stenanthemum* sp. 1 *Trymalium ledifolium*
VITACEAE	*Clematicissus angustissima*
MALVACEAE	**Alyogyne huegelii* *Malva parviflora*
STERCULIACEAE	*Commersonia crispa* *Guichenotia micrantha* *Thomasia cognata*
DILLENIACEAE	*Hibbertia hypericoides* *Hibbertia racemosa* *Hibbertia subvaginata*
FRANKENIACEAE	*Frankenia pauciflora*
VIOLACEAE	*Hybanthus calycinus*
THYMELAEACEAE	*Pimelea ?calcicola* *Pimelea ferruginea*
LYTHRACEAE	**Lythrum hyssopifolia*
MYRTACEAE	*Calothamnus quadrifidus* *Eucalyptus rudis* *Kunzea/Melaleuca* sp. *Melaleuca ?cardiophylla* *Melaleuca acerosa* *Melaleuca cardiophylla* *Melaleuca hamulosa* *Melaleuca huegelii* *Melaleuca scabra* *Scholtzia* aff. *involucrata* *Scholtzia umbellifera*
ONAGRACEAE	**Epilobium billardierianum*
HALORAGACEAE	*Haloragis* sp.1

FAMILY	SPECIES
APIACEAE	*Daucus glochidiatus*
	Hydrocotyle callicarpa
	Hydrocotyle hispidula
	Hydrocotyle plebeja
	Hydrocotyle sp.1
	Trachymene pilosa
EPACRIDACEAE	*Acrotriche cordata*
	Brachyloma preissii
	Leucopogon australis
	Leucopogon propinquus
	Leucopogon revolutus
	Leucopogon sp. 1
	Lysinema ciliatum
PRIMULACEAE	**Anagallis arvensis*
	Samolus repens
CONVOLVULACEAE	*Wilsonia humilis*
BORAGINACEAE	**Echium plantagineum*
VERBENACEAE	*Pityrodia paniculata*
LAMIACEAE	**Stachys arvenses*
	Hemiandra pungens
SOLANACEAE	**Anthocercis ilicifolia*
	Anthocercis littorea
	Solanum nigram
SCROPHULARIACEAE	**Dischisma arenarius*
	**Parentucellia latifolia*
	**Verbascum virgatum*
OROBANCHACEAE	**Orobanche minor*
MYOPORACEAE	*Eremophila glabra*
	Myoporum insulare
	Myoporum tetrandrum
PLANTAGINACEAE	*Plantago debilis*
RUBIACEAE	*Opercularia spermacocea*
	Opercularia vaginata
LOBELIACEAE	*Isotoma hypocrateriformis*
GOODENIACEAE	*Dampiera ?altissima*
	Dampiera altissima
	Danthonia setacea

FAMILY	SPECIES
GOODENIACEAE cont.	*Goodenia pteridifolia*
	Goodenia pulchella
	Lechenaultia linarioides
	Scaevola ?lanceolata
	Scaevola ?porocarya
	Scaevola canescens
	Scaevola holosericea
	Scaevola lanceolata
	Scaevola thesioides
	?Scaevola sp.1
ASTERACEAE	**Arctotheca calendula*
	*Asteraceae sp. 1
	Asteraceae sp. 2
	Asteridea athrixoides
	Brachycome bellidioides
	Brachycome iberidifolia
	**Centaurea melitensis*
	**Conyza* sp. 1
	Gnaphalium sp.1
	**Hedypnois rhagadioloides*
	Hyalosperma cotula
	**Hypochaeris glabra*
	Leptorhynchos medium
	Olearia axillaris.
	Olearia rudis
	Podolepis ?nutans
	Podotheca angustifolia
	Quinetia urvillei
	Senecio ?lautus
	Senecio lautus
	Senecio lautus (ssp?)
	**Sonchus oleraceus*
	**Vellereophyton dealbatum*
	Waitzia citrina

APPENDIX D

Coastal Road - Cervantes to Jurien Project Area Fauna Species List

APPENDIX D: List of vertebrate fauna recorded or expected to occur within the habitats present in the Coastal Road - Cervantes to Jurien project area.

KEY

X = Species recorded during field survey
S = Signs of presence recorded: nests, scats, diggings and tracks.
+ = Species expected to occur
A = Predominately aerial species
(int.) = Introduced species

FAUNA HABITAT CODES

CH: Coastal Heath
AC: Acacia thicket
RI: Riverine habitat
LA: Lake system
MO: Modified habitat / farmland

APPENDIX D1: MAMMAL SPECIES WHICH OCCUR OR ARE EXPECTED TO OCCUR IN THE COASTAL ROAD - CERVANTES TO JURIEN PROJECT AREA.

FAMILY Common name	*Species name*	Fauna Habitats CH	AC	RI	LA	MO
Native Mammals						
Monotremes						
TACHYGLOSSIDAE						
Echidna	*Tachyglossus aculeatus*	+	+	+	+	+
Marsupials						
DASYURIDAE						
Fat-tailed Dunnart	*Sminthopsis crassicaudata*	+	+			+
White-bellied Dunnart	*Sminthopsis dolichura*	+	+			
Gilbert's Dunnart	*Sminthopsis gilberti*	+	+			
White-tailed Dunnart	*Sminthopsis granulipes*	+	+			
Grey-bellied Dunnart	*Sminthopsis griseoventer*	+	+	+		
PERAMELIDAE						
Southern Brown Bandicoot	*Isoodon obesulus*		+	+	+	
MACROPODIDAE						
Western Grey Kangaroo	*Macropus fuliginosus*	+	S	S	+	X
Western Brush Wallaby	*Macropus irma*		+		+	X
Euro	*Macropus robustus*	+	+	+		
PHALANGERIDAE						
Brushtail Possum	*Trichosurus vulpecula*			+		+
TARSIPEDIDAE						
Honey Possum	*Tarsipes rostratus*	X	+		X	
Placentals						
MURIDAE						
Southern Bush Rat	*Rattus fuscipes fuscipes*	X	X		X	
Ash Grey Mouse	*Pseudomys albocinereus*	X	X			
VESPERTILIONIDAE						
Gould's Wattled Bat	*Chalinobus gouldii*	A	A	A	A	A
Chocolate Bat	*Chalinobus morio*	A	A	A	A	A
King River Eptesicus	*Eptesicus regulus*	A	A	A	A	A
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	A	A	A	A	A
MOLOSSIDAE						
White-striped Mastiff Mat	*Tadarida australis*	A	A	A	A	A
Little Mastiff Bat	*Mormopterus planiceps*	A	A	A	A	A
Introduced Mammals						
House Mouse	*Mus musculus*	X	X	X	+	+
European Rabbit	*Oryctolagus cuniculus*	+	+	+	+	X
Domestic Cattle	*Bos taurus*					+
Horse	*Equus caballus*					+
Domestic Cat	*Felis catus*	+	+	+	+	+
Fox	*Vulpes vulpes*	+	+	+	+	+
Dog	*Canis familiaris*	+	+	+	+	+

APPENDIX D2: BIRD SPECIES WHICH OCCUR OR ARE EXPECTED TO OCCUR IN THE COASTAL ROAD - CERVANTES TO JURIEN PROJECT AREA.

FAMILY Common name	*Species name*	Fauna Habitats CH	AC	RI	LA	MO
Non-passerine						
CASUARIIDAE						
Emu	*Dromaius novaehollandiae*	+	+	+	+	X
PODICIPEDIDAE						
Hoary-headed Grebe	*Poliocephalus poliocephalus*				+	
Australasian Grebe	*Tachybaptus novaehollandiae*			+	+	
PELECANIDAE						
Australian Pelican	*Pelecanus conspicillatus*				+	
ANHINGIDAE						
Darter	*Anhinga melanogaster*			X	+	
PHALACROCORACIDAE						
Pied Cormorant	*Phalacrocorax varius*			+	+	
Little Pied Cormorant	*Phalacrocorax melanoleucos*			+	+	
Great Cormorant	*Phalacrocorax carbo*			+	+	
Little Black Cormorant	*Phalacrocorax sulcirostris*				+	
ARDEIDAE						
Pacific Heron	*Ardea pacifica*				+	
White-faced Heron	*Ardea novaehollandiae*			+	+	
Great Egret	*Egretta alba*				+	
Rufous Night Heron	*Nycticorax caledonicus*			+	+	
THRESKIORNITHIDAE						
Straw-necked Ibis	*Threskiornis spinicollis*				+	
Yellow-billed Spoonbill	*Platales flavipes*				+	
ANATIDAE						
Black Swan	*Cygnus atratus*			+	+	+
Australian Shelduck	*Tadorna tadornoides*				X	X
Pacific Black Duck	*Anas superciliosa*			X	+	X
Grey Teal	*Anas gibberifrons*				+	
Pink-eared Duck	*Malacorhynchus membranaceus*				+	
Maned Duck	*Chenonetta jubata*				+	
ACCIPITRIDAE						
Black-shouldered Kite	*Elanus notatus*	+				X
Black Kite	*Milvus migrans*		+	+		+
Whistling Kite	*Haliastur sphenurus*	+	+			
Brown Goshawk	*Accipiter fasciatus*	+	+	+		
Collared Sparrowhawk	*Accipiter cirrocephalus*	+	+	+		
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	+				X
Little Eagle	*Aquila morphnoides*	+	+	+		X
Wedge-tailed Eagle	*Aquila audax*	+	+		+	+
Spotted Harrier	*Circus assimilis*	+	+			
Marsh Harrier	*Circus aeruginosus*				+	
FALCONIDAE						
Little Falcon	*Falco longipennis*	+	+	+		+
Peregrine Falcon	*Falco peregrinus*		+		+	
Brown Falcon	*Falco berigora*	+	+	+		
Australian Kestrel	*Falco cenchroides*	X	+	X		X
PHASIANIDAE						
Stubble Quail	*Coturnix novaezelandiae*	+			+	

FAMILY Common name	*Species name*	Fauna Habitats CH	AC	RI	LA	MO
TURNICIDAE						
Painted Button-Quail	*Turnix varia*	+	+	+		
Little Button-Quail	*Turnix velox*	+	+			
RALLIDAE						
Banded Landrail	*Gallirallus philippensis*		+	+	+	
Spotted Crake	*Porzana fluminea*				+	
Baillon's Crake	*Porzana pusilla*				+	
Black-tailed Native Hen	*Gallinula ventralis*			+	+	
Eurasian Coot	*Fulica atra*			+	+	
OTIDIDAE						
Australian Bustard	*Ardeotis australis*	+	+			+
CHARADRIIDAE						
Banded Plover	*Vanellus tricolor*				+	
Grey Plover	*Pluvialis squatarola*				+	
Red-capped Plover	*Charadrius ruficapillus*				+	
Double-banded Dotterel	*Charadrius bicinctus*				+	
Black-fronted Dotterel	*Charadrius melanops*				+	
SCOLOPACIDAE						
Greenshank	*Tringa nebularia*				+	
Common Sandpiper	*Tringa hypoleucos*				+	
Red-necked Stint	*Calidris ruficollis*				+	
Sharp-tailed Sandpiper	*Calidris acuminata*				+	
Curlew Sandpiper	*Calidris ferruginea*				+	
RECURVIROSTRIDAE						
Black-winged Stilt	*Himantopus himantopus*				X	
Banded Stilt	*Cladorhynchus leucocephalus*				+	
Red-necked Avocet	*Recurvirostra novaehollandiae*				+	
LARIDAE						
Silver Gull	*Larus novaehollandiae*	+		+	+	X
Whiskered Tern	*Chlidonias hybrida*	+			+	
COLUMBIDAE						
Feral Pigeon (int.)	*Columbia livia*					+
Laughing Turtledove (int.)	*Streptopelia senegalensis*					X
Common Bronzewing	*Phaps chalcoptera*	+	+	+		+
Brush Bronzewing	*Phaps elegans*	+	+			
Crested Pigeon	*Ocyphaps lophotes*		+			
CACATUIDAE						
Red-tailed Black Cockatoo	*Calyptorhychus magnificus*		+	+		
Carnaby's Black Cockatoo	*Calyptorhynchus latirostris*	+	+	+		+
Western Corella	*Cacatua pastinator*	+	+			+
Galah	*Cacatua roseicapilla*	+	+			X
Cockatiel	*Nymphicus hollandicus*	+				
PSITTACIDAE						
Regent Parrot	*Polytelis anthopeplus*		+			+
Western Rosella	*Platycercus icterotis*		+	+		+
Port Lincoln Parrot	*Barnardius zonarius*	+	X	+	+	X
Mulga Parrot	*Psephotus varius*	+				
Rock Parrot	*Neophema petrophila*	+				

FAMILY Common name	*Species name*	Fauna Habitats CH	AC	RI	LA	MO
CUCULIDAE						
Pallid Cuckoo	*Cuculus pallidus*	+	+	+		
Horsfield's Bronze Cuckoo	*Chrysococcyx basalis*	X	+			+
Shining Bronze Cuckoo	*Chrysococcyx lucidus*		+	+		
Fan-tailed Cuckoo	*Cacomantis pyrrhophanus*	+	+			+
STRIGIDAE						
Southern Boobook	*Ninox novaeseelandiae*		+	+		+
TYTONIDAE						
Barn Owl	*Tyto alba*		+	+		+
AEGOTHELIDAE						
Australian Owlet-nightjar	*Aegotheles cristatus*		+	+		
CAPRIMULGIDAE						
Spotted Nightjar	*Caprimulgus guttatus*	+	+			
PODARGIDAE						
Tawny Frogmouth	*Podargus strigoides*		+	+		
APODIDAE						
Fork-tailed Swift	*Apus pacificus*	A	A	A	A	A
ALCEDINIDAE						
Laughing Kookaburra	*Dacelo gigas*			+		X
Sacred Kingfisher	*Todiramphus sanctus*			+	X	+
MEROPIDAE						
Rainbow Bee-eater	*Merops ornatus*		+	+		+
Passerine						
HIRUNDINIDAE						
White-backed Swallow	*Cheramoeca leucosternum*	+	+	+	+	
Welcome Swallow	*Hirundo neoxena*	+	+	+	X	X
Tree Martin	*Hirundo nigricans*			+	+	+
Fairy Martin	*Hirundo ariel*			+	+	
MOTACILLIDAE						
Richard's Pipit	*Anthus novaseelandiae*	X			+	X
CAMPEPHAGIDAE						
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	X	X	X	+	X
White-winged Triller	*Lalage sueurii*		+	+		
PETROICIDAE						
Red-capped Robin	*Petroica goodenovii*		+	+	+	
Scarlet Robin	*Petroica multicolor*	+	+	+		
Hooded Robin	*Melanodryas cucullatus*		+			
White-breasted Robin	*Eopsaltria georgiana*	+	X	+	X	
Western Yellow Robin	*Eopsaltria griseogularis*	+	+			
Jacky Winter	*Microeca leucophaea*		+	+		
PACHYCEPHALIDAE						
Golden Whistler	*Pachycephala pectoralis*		+	X		
Rufous Whistler	*Pachycephala rufiventris*		+	+		
Grey Shrike-thrush	*Colluricincla harmonica rufiventris*		X	+		
Crested Bellbird	*Oreoica gutturalis*		+	+		
DICRURIDAE						
Grey Fantail	*Rhipidura fuliginosa*		X	+	+	+
Willie Wagtail	*Rhipidura leucophrys*		+	+	X	X
Magpie-lark	*Grallina cyanoleuca*			+	+	X
POMATOSTOMIDAE						
White-browed Babbler	*Pomatostomus superciliosus*	+	+			

FAMILY Common name	*Species name*	Fauna Habitats CH	AC	RI	LA	MO
SYLVIIDAE						
Little Grassbird	*Megalurus gramineus*		+		+	
Clamorous Reed-warbler	*Acrocephalus stentoreus*				+	
Rufous Songlark	*Cinclorhamphus mathewsi*					+
Brown Songlark	*Cinclorhamphus cruralis*	X	+			+
MALURIDAE						
Splendid Fairy Wren	*Malurus splendens*	+	+	+		
White-winged Fairy Wren	*Malurus leucopterus*	X	+			
Variegated Fairy Wren	*Malurus lamberti*	X	X			
Blue-breasted Fairy Wren	*Malurus pulcherrimus*	+	+			
Southern Emu-wren	*Stipiturus malachurus*	+	+			
PARDALOTIDAE						
Western Warbler	*Gerygone fusca*	X	X	X		
Inland Thornbill	*Acanthiza apicalis*	X	X			
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		+			
Striated Pardalote	*Pardalotus striatus*			+		+
Spotted Pardalote	*Pardalotus punctata*			X		
Shy Hylacola	*Sericornis cautus*		+	+		
White-browed Scrub-wren	*Sericornis frontalis maculatus*	X	+	+		
Calamanthus	*Sericornis campestris*	+	+			
Weebill	*Smicrornis brevirostris*		+			
NEOSITTIDAE						
Varied Sitella	*Daphoenositta chrysoptera*		+	+		+
ZOSTEROPIDAE						
Silvereye	*Zosterops lateralis*	X	X	X	X	X
MELIPHAGIDAE						
Brown Honeyeater	*Lichmera indistincta*	X	X	X	X	X
Singing Honeyeater	*Lichenostomus virescens*	X	+	+	X	X
Brown-headed Honeyeater	*Melithreptus brevirostris*		+	+		
Western Spinebill	*Acanthorhynchus superciliosus*		+	+		
Tawny-crowned Honeyeater	*Phylidonyris melanops*	X	+		X	
White-cheeked Honeyeater	*Phylidonyris niger*	X	+		X	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	+	+			
Pied Honeyeater	*Certhionyx variegatus*		+			
Red Wattlebird	*Anthochaera carunculata*	X	+	+		+
Little Wattlebird	*Anthochaera chrysoptera*		+	+		
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	X	+		X	
EPHTHIANURIDAE						
White-fronted Chat	*Ephthianura albifrons*				X	
DICAEIDAE						
Mistletoebird	*Dicaeum hirundinaceum*			+		
ARTAMIDAE						
Dusky Woodswallow	*Artamus cyanopterus*		+	+		
Black-faced Woodswallow	*Artamus cinereus*	+	+			X
Grey Butcher-bird	*Cracticus torquatus*	X	+			+
Pied Butcher-bird	*Cracticus nigrogularis*					+
Australian Magpie	*Gymnorhina tibicen*			+		X
CORVIDAE						
Australian Raven	*Corvus coronoides*	X	X	X	X	X
Little Crow	*Corvus bennetti*					+

APPENDIX D3: REPTILE SPECIES WHICH OCCUR OR ARE EXPECTED TO OCCUR IN THE COASTAL ROAD - CERVANTES TO JURIEN PROJECT AREA.

FAMILY *Species name*	**Fauna Habitats** CH	AC	RI	LA	MO
Lizards					
GEKKONIDAE					
Crenadactylus ocellatus	X	X			
Diplodactylus alboguttatus	+	+		+	
Diplodactylus ornatus	+	+			
Diplodactylus spinigerus	X	X			
Gehyra variegata	+	X	+		
Christinus marmoratus	+	+	+	+	+
Underwoodisaurus millii	+	+	+	+	
PYGOPODIDAE					
Aclys concinna concinna	+	+			
Aprasia repens	+	+			
Delma fraseri	+	+			
Delma grayii	+	+		+	
Lialis burtonis	+	+	+	+	+
Pletholax gracilis	+	+			
Pygopus lepidopodus	+	+			
AGAMIDAE					
Tympanocryptis adelaidensis adelaidensis	+	+		+	
Ctenophorus maculatus maculatus	+	+			
Pogona minor minor	+	X			+
SCINCIDAE					
Cryptoblepharus plagiocephalus	+	+	+		+
Ctenotus fallens	+	+			
Ctenotus lesueurii	+	+			
Ctenotus impar		+			
Egernia multiscutata bos	+				
Egernia napoleonis	+	+	+	+	
Hemiergis peronii quadrilineata	+	+	+	+	
Lerista distinguenda	+	+			
Lerista elegans	+	+	+	+	
Lerista lineopunctulata	+	+			
Lerista planiventralis	+	+			
Lerista praepedita	+	+			
Menetia greyii	+	+			+
Morethia lineoocellata	+	+			
Morethia obscura	+	+		+	+
Omolepida branchialis	X	+			
Tiliqua occipitalis		X	+		
Tiliqua rugosa	+	+	X	+	X
VARANIDAE					
Varanus gouldii	+	+	+	+	+
Varanus tristis	+	+			

FAMILY *Species name*	Habitat CH	AC	RI	LA	MO
Snakes					
BOIDAE					
Morelia stimsoni stimsoni	+	+			
Morelia spilota imbricata	+	+			
ELAPIDAE					
Pseudechis australis	+	+	+		
Notechis curtus	+	+			
Notechis scutatus			+	+	+
Pseudonaja nuchalis	+	+			
Pseudonaja affinis	+	+	+	+	+
Demansia psammophis reticulata	+	+			
Rhinoplocephalus gouldii	+	+	+		
Rhinoplocephalus nigriceps	+	+	+		
Vermicella littoralis	+	+			
Vermicella bimaculata	+	+			
Vermicella fasciolata	+	+			
Vermicella semifasciata	+	+			
TYPHLOPIDAE					
Ramphotyphlops australis	+	+	+	+	
Ramphotyphlops waitii	+	+			
Turtles					
Chelodina oblonga			+		

APPENDIX D4: AMPHIBIAN SPECIES WHICH OCCUR OR ARE EXPECTED TO OCCUR IN THE COASTAL ROAD - CERVANTES TO JURIEN PROJECT AREA.

FAMILY	**Habitat**				
Species name	**CH**	**AC**	**RI**	**LA**	**MO**
HYLIDAE					
Litoria adelaidensis			+	X	
Litoria moorei			+	X	+
MYOBATRACHIDAE					
Myobatrachus gouldii	+	+			
Crinia insignifera			+	+	
Heleioporus albopunctatus			+		
Heleioporus eyrei		+	+	+	+
Heleioporus psammophilus	X	X	+		
Limnodynastes dorsalis	X	+	+	X	+
Neobatrachus pelobatoides				+	
Pseudophryne guentheri	+	+		+	

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