SHIRE of DANDARAGAN

SHIRE of COOROW

in conjunction with

MAIN ROADS
Western Australia

# COASTAL ROAD
# JURIEN to GREEN HEAD

# CONSULTATIVE ENVIRONMENTAL REVIEW

FEBRUARY 1995

*ecologia*
ENVIRONMENTAL CONSULTANTS

in association with

Paul Holmes & Associates
BSD Consultants Pty Ltd
Quartermaine Consultants

**SHIRE of DANDARAGAN**

**SHIRE of COOROW**

in conjunction with

**MAIN ROADS**
**Western Australia**



# COASTAL ROAD
# JURIEN to GREEN HEAD

# CONSULTATIVE ENVIRONMENTAL REVIEW

**February 1995**

Prepared by

*ecologia*
ENVIRONMENTAL CONSULTANTS

in association with
**Paul Holmes & Associates**
**BSD Consultants Pty Ltd**
**Quartermaine Consultants**

# COASTAL ROAD - JURIEN TO GREEN HEAD

## CONSULTATIVE ENVIRONMENTAL REVIEW



### Invitation to comment

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

The Consultative Environmental Review (CER) proposes the development of a new Coastal Road - Jurien to Green Head linking the Jurien and Green Head townships.

In accordance with the Environmental Protection Act, a CER has been prepared which describes this proposal and its likely effect on the environment.

The CER is available for public review for up to four (4) weeks from 20 February 1995 closing on 20 March 1995.

After receipt of comments from Government agencies and the public, the EPA will prepare an assessment report with recommendations to the Government, taking into account issues raised in public submissions.

### Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action including alternative approaches.

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 and may be quoted in full or in part in each report unless specifically marked confidential.

Submissions may be fully or partially utilised in compiling a summary of issues raised or where complex or technical issues are raised, a confidential copy of the submission (or part of it) may be sent to the proponent.

The summary of issues raised is normally included in the EPA's assessment report.

### Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining 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 while increasing the pool of ideas and information.

If you form a small group (up to 10 people) you may wish to 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 discussed in the CER or with 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 the issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the review document;
- if you discuss sections of the review document, keep them distinct and separate, so there is no confusion about which section you are considering;
- attach any factual information you want 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: 20 March 1995**

Submissions should be addressed to:

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

Attention: Mr Ron Van Delft

## CONTENTS


1.0 INTRODUCTION ..... 1
1.1 Identification of Proponent ..... 1
1.2 Background and Objective of the Proposal ..... 1
1.3 Timing of the Proposal ..... 3
1.4 Relevant Statutory Requirements and Approvals Process ..... 3
1.5 Scope, Purpose and Structure of the Consultative Environmental Review ..... 5

2.0 NEED FOR THE PROPOSED COASTAL ROAD - JURIEN TO GREEN HEAD ..... 6
2.1 Regional Context ..... 6
2.2 Benefits of the Proposal ..... 6

3.0 EVALUATION OF ALTERNATIVES ..... 7
3.1 Options Considered ..... 7
3.2 Summary of Environmental and Social Considerations ..... 9
3.2.1 Land Use ..... 9
3.2.2 Road and Traffic Considerations ..... 11
3.2.3 Biological Environment ..... 12
3.2.4 Dieback ..... 13
3.2.5 Social Environment ..... 13
3.2.5.1 Access into Green Head ..... 14
3.2.6 Landscape Amenity ..... 14
3.3 Comparative Evaluation of Alternative Route Options ..... 15

4.0 DESCRIPTION OF THE PROPOSAL ..... 17
4.1 Location ..... 17
4.2 Overall Concept of the Proposal ..... 17
4.3 Standards for Road ..... 17
4.4 Traffic Demands ..... 17
4.4.1 Regional Road Hierarchy ..... 17
4.4.2 Traffic Volumes and Access ..... 20
4.5 Wetland Crossings ..... 22
4.6 Sources of Materials ..... 22
4.6.1 Sand ..... 22
4.6.1.1 Private Land ..... 22
4.6.1.2 Crown Land ..... 22
4.6.2 Gravel ..... 22
4.6.3 Water Sources ..... 23

5.0 EXISTING ENVIRONMENT ..... 24
5.1 PHYSICAL ENVIRONMENT ..... 24
5.1.1 Climate ..... 24
5.1.2 Geology and Hydrology ..... 26
5.1.3 Landforms ..... 26
5.1.4 Soils ..... 26
5.2 BIOLOGICAL ENVIRONMENT ..... 26
5.2.1 Vegetation ..... 27
5.2.2 Flora ..... 30
5.2.2.1 Flora of significance ..... 30
5.2.3 Dieback Occurrence ..... 31
5.2.4 Fauna ..... 31
5.2.4.1 Faunal Habitats ..... 33
5.2.4.2 Rare Fauna ..... 33
5.2.5 Wetlands ..... 34
5.2.6 Summary ..... 34

5.3 HUMAN ENVIRONMENT ..... 34

5.3.1 Aboriginal Habitation ..... 34
5.3.1.1 Archaeology ..... 35
5.3.1.2 Ethnographic Sites ..... 36
5.3.2 European Settlement ..... 36
5.3.3 Existing Landuse ..... 37
5.3.3.1 Human Development ..... 37
5.3.3.2 Conservation Estate ..... 37
5.3.4 Population Density ..... 38
5.3.5 Local Access Patterns ..... 38
5.3.6 Recreation and Tourism ..... 39
5.3.7 Landscape Character ..... 39

6.0 PUBLIC CONSULTATION PROGRAMME ..... 41
6.1 Aims and Objectives ..... 41
6.2 Method ..... 41
6.3 Results ..... 42

7.0 ENVIRONMENTAL IMPACT ASSESSMENT ..... 44
7.1 Introduction and Objectives ..... 44
7.1.1 Biophysical Environment ..... 44
7.1.2 Human Environment ..... 45
7.2 PRE-CONSTRUCTION PHASE ..... 46
7.2.1 Biophysical Environment ..... 46
7.2.1 Human Environment ..... 46
7.3 DURING-CONSTRUCTION PHASE ..... 47
7.3.1 Biophysical environment ..... 47
7.3.1.1 Clearing ..... 47
7.3.1.2 Dieback ..... 47
7.3.1.3 Exotic Weeds ..... 48
7.3.1.4 People Pressures ..... 48
7.3.1.5 Noise and Dust ..... 48
7.3.1.6 Potential contamination ..... 48
7.3.1.7 Borrow Pit Locations ..... 49
7.3.2 Human Environment ..... 50
7.3.2.1 Severance ..... 50
7.3.2.2 Sites of particular value ..... 51
7.3.2.3 Landscape quality ..... 51
7.3.2.4 Landscape Amenity ..... 51
7.3.2.5 Noise, dust and light ..... 52
7.4 POST-CONSTRUCTION PHASE ..... 52
7.4.1 Biophysical Environment ..... 52
7.4.1.1 Dieback ..... 52
7.4.1.2 People pressures ..... 52
7.4.1.3 Potential contamination ..... 53
7.4.1.4 Noise and dust ..... 53
7.4.2 Human Environment ..... 53
7.4.2.1 Traffic impacts on existing dwellings ..... 53
7.5 SYNTHESIS ..... 54

8.0 ENVIRONMENTAL MANAGEMENT ..... 55
8.1 PRE-CONSTRUCTION PHASE ..... 55
8.1.1 Biophysical Environment ..... 55
8.1.1.1 Borrow Pits ..... 55
8.1.2 Human Environment ..... 56
8.1.2.1 Land Resumption ..... 56
8.2 DURING-CONSTRUCTION PHASE ..... 56
8.2.1 Biophysical Environment ..... 56
8.2.1.1 Vegetation ..... 56
8.2.1.2 Significant Flora species ..... 57

8.2.1.2 Dieback ..... 57
8.2.1.3 Noxious Weeds ..... 57
8.2.1.4 People Pressures ..... 58
8.2.1.5 Dust ..... 58
8.2.1.6 Potential Contamination ..... 58
8.2.2 Human Environment ..... 58
8.2.2.1 Severance ..... 58
8.2.2.2 Visual Impact ..... 59
8.2.2.3 Noise ..... 59
8.3 POST-CONSTRUCTION PHASE ..... 59
8.3.1 Biophysical Environment ..... 59
8.3.1.1 Landform and Soils ..... 59
8.3.1.2 Vegetation ..... 60
8.3.1.3 Dieback ..... 60
8.3.1.4 Noxious Weeds ..... 60
8.3.1.5 People Pressures ..... 60
8.3.1.6 Potential Contamination ..... 61
8.3.2 Human Environment ..... 61
8.3.2.1 Traffic Impacts on Existing Dwellings ..... 61
8.3.2.2 Sites of Particular Significance ..... 61
8.3.2.4 Landscape Amenity ..... 61

9.0 SUMMARY OF COMMITMENTS ..... 62
9.1 Pre-construction Commitments ..... 62
9.2 During Construction Commitments ..... 62
9.3 Post Construction Management ..... 64

10.0 CONCLUSIONS ..... 65

REFERENCES ..... 66

STUDY TEAM ..... 69

**TABLES**

Table 1: Comparative assessment of alternative route options for the proposed Coastal Road - Jurien to Green Head. ..... 16
Table 2: Summary climatic data for the Jurien region. ..... 25
Table 3: Archaeological sites within 5 kilometres of the proposed Jurien - Green Head Road ..... 35
Table 4: Summary of responses received as a result of the community consultation programme. ..... 43

**FIGURES**

Figure 1: Options for proposed route of the Coastal Road - Jurien to Green Head. ..... 8
Figure 2: General land use of the Jurien - Green Head area. ..... 10
Figure 3: Route of the preferred Western Alignment (Option 1) ..... 18
Figure 4: Typical road cross section. ..... 19
Figure 5: The proposed access into Green Head from the Coastal Road - Jurien to Green Head ..... 21
Figure 6: Proposed Southern Access Road into Green Head ..... 21
Figure 7: Potential Borrow Pit Sites ..... 23A
Figure 8: Mean monthly maximum and minimum temperatures and rainfall for Jurien. ..... 24

**APPENDICES**

Appendix A EPA CER Guidelines
Appendix B Biological Survey
Appendix C Ethnographic Survey
Appendix D Archaeological Survey
Appendix E Community Consultation Mailouts

# 1.0 INTRODUCTION

Options for improving road access between the coastal communities of Jurien (in the Shire of Dandaragan) and Green Head (in the Shire of Coorow) have been under consideration for a number of years. Community pressures stemming from social needs and economic requirements have played a significant part in reactivating the project. As a result of these pressures and the earlier investigations undertaken, the Shires of Dandaragan and Coorow in conjunction with Main Roads Western Australia are proposing to construct a new coastal road linking Jurien and Green Head.

The proposal to construct this road has been referred to the Environmental Protection Authority. Due to the high conservation values of the area that would be traversed by the proposed road, the Environmental Protection Authority will undertake formal environmental impact assessment of the proposal at Consultative Environmental Review level.

This document constitutes the Consultative Environmental Review for the proposed Coastal Road - Jurien to Green Head and has been prepared in accordance with the guidelines issued by the Environmental Protection Authority for the project (refer to Appendix A).

## 1.1 Identification of Proponent

The proponents for the proposed Coastal Road - Jurien to Green Head are:

| | | |
|---|---|---|
| Name | Shire of Dandaragan | Shire of Coorow |
| Address | Dandaragan Road<br>DANDARAGAN WA 6507 | Main Street<br>COOROW WA 6515 |
| Postal Address | As above | PO Box 42<br>COOROW WA 6515 |
| Telephone Number | (096) 51 4010 | (099) 52 1103, 52 1009 |
| Facsimile Number | (096) 51 4057 | (099) 52 1173 |

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

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

## 1.2 Background and Objective of the Proposal

Jurien and Green Head are important centres within the Central Coast Region, which extends from the Perth metropolitan area to Geraldton. Jurien and Green Head are a distance of approximately 25 kilometres (km) apart, although the present road link between the two centres is an indirect route of about 57 km.

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 recently released Central Coast Regional Strategy (prepared by the Department of Planning and Urban Development) provides for a continuous coastal road between Lancelin and Dongara (Department of Planning and Urban Development, 1994a). The proposed Coastal Road - Jurien to Green Head will form part of this ultimate coastal road.

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 (Department of Planning and Urban Development, 1994a) 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 (Department of Planning and Urban Development, 1994a).

Current access between Jurien and Green Head is via Jurien East Road, Cockleshell Gully Road, Coorow - Green Head and Green Head - Leeman Roads, a travel distance of 57 km of which 33 km is sealed (Main Roads Western Australia, 1990). A more direct road link between Jurien and Green Head 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 Jurien and Green Head communities; and
- increased recreational and tourism opportunities.

The proposed Coastal Road - Jurien to Green Head is therefore consistent with the Central Coast Regional Strategy.

Investigations that have been undertaken as part of the proposed Coastal Road - Jurien to Green Head 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 between Jurien and Green Head (refer to Chapter 3 and Figure 1);
- comparative analysis of route options and recommendations of a preferred route between Jurien and Green Head (the proposed direct link of Option 1 - the Western Alignment) (Chapter 3);
- 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 (Chapter 5); and
- assessment of potential environmental impacts arising from construction and operation of the proposed road and development of strategies for managing these impacts (Chapters 7 and 8 respectively).

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 (refer to Chapter 6).

### 1.3 Timing of the Proposal

Construction of the proposed Coastal Road - Jurien to Green Head is regarded as a priority by the Shires of Dandaragan and Coorow and the State Government and, subject to environmental and other relevant clearances being obtained, is programmed to commence in mid-1995 and anticipated to be completed over two financial years.

### 1.4 Relevant Statutory Requirements and Approvals Process

The Environmental Protection Authority is required to assess all development proposals which may have a significant environmental effect. In this instance, because of the high conservation value of the area traversed by the proposed Coastal Road - Jurien to Green Head, the Environmental Protection Authority has decided to formally assess the proposal pursuant to the provisions of Part IV of the Environmental Protection Act, 1986.

The Environmental Protection Authority'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 Environmental Protection Authority. In assessing the proposal, the Environmental Protection Authority specifically considers all comments received.

In setting the level of formal environmental impact assessment for the proposed Coastal Road - Jurien to Green Head at Consultative Environmental Review, the Environmental Protection Authority 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, Government agency or instrumentality can peruse the document and lodge a submission on the proposal with the Environmental Protection Authority. This Consultative Environmental Review is a public document and is part of the Environmental Protection Authority's public environmental impact assessment process. Interested individuals or parties are encouraged to interact with the proponent agencies during the public review period for the project.

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

The Minister will release the Environmental Protection Authority's Assessment Report for a two (2) week period during which the public can scrutinise the Authority's conclusions and, if considered warranted, appeal to the Minister against the Environmental Protection Authority's recommendations about the proposal. The Minister 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 Coastal Road - Jurien to Green Head project to proceed, the following statutory requirements need to be completed:

- a Consultative Environmental Review to be prepared and submitted to the Environmental Protection Authority (which must be satisfied with the quality of the document before it can be released for public review);
- release of the Consultative Environmental Review for a four (4) week public review period;
- proponents provide the Environmental Protection Authority with written responses to all issues raised in submissions received during the public review period;

- the Environmental Protection Authority provides its advice to Government on the proposal through its Assessment Report to the Minister for the Environment;
- the Minister determines any appeals against the Environmental Protection Authority's Report and if the proposal is regarded as environmentally acceptable, sets legally binding conditions on the proponents;
- land acquisition occurs as necessary through direct negotiation with landowners pursuant to the provisions of the Public Works Act, 1902 - 1974;
- appropriate construction materials are sourced and secured. If new pits or quarries are required on land under the Department of Conservation and Land Management's control, appropriate mining tenements must be obtained pursuant to the provisions of the Mining Act, 1978 - 1987; quarries/pits on privately owned land must comply with relevant Council Extractive Industry By-laws (pursuant to the provisions of the Local Government Act, 1960);
- preparation of detailed road design/construction documentation by Main Roads Western Australia;
- relocation of public services/facilities affected by the proposed road; affected private facilities to be resolved through negotiation with landowners;
- construction of the proposed road, including connection to the existing road network; and
- operational monitoring and management (as outlined in this document).

Requirements under the following legislation are relevant to the proposal and have been considered in preparing this Consultative Environmental Review:

- Aboriginal Heritage Act, 1972 - 1980
- Bushfires Act, 1854 - 1981
- Conservation and Land Management Act, 1984 - 1990
- Environmental Protection Act, 1986
- Land Act, 1933
- Local Government Act, 1960
- Mining Act, 1978 - 1987
- Public Works Act, 1902 - 1974
- Soil and Land Conservation Act, 1945 - 1982
- State Planning Commission Act, 1985
- Wildlife Conservation Act, 1950 - 1980

### 1.5 Scope, Purpose and Structure of the Consultative Environmental Review

The objective of the Consultative Environmental Review is to provide the Environmental Protection Authority with information about the proposed Coastal Road - Jurien and Green Head 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 Protection Authority's environmental impact assessment process if they so wish.

This Consultative Environmental Review is the second document produced as part of the process of evaluating the environmental acceptability of the proposed road. The first of these documents (the Preferred Alignment Statement - PAS) provided an overview of the biological and human environments within the overall project area based essentially on a desk review of existing information. The PAS evaluated three options for improving the level of road access between Jurien and Green Head and, based on a consideration of 19 criteria covering biophysical and social factors, identified route Option 1 (the Western Alignment) as the preferred alternative.

This Consultative Environmental Review focuses on construction of a new route between Jurien and Green Head based on the Western Alignment and draws on material presented in the PAS and information derived from specific investigations undertaken, including an extensive community consultation programme.

Chapters 2 and 3 of the Consultative Environmental Review provide information about the alternatives considered for improving road access between Jurien and Green Head and the comparative assessment process used to identify the preferred option, while Chapter 4 specifically describes the proposed new route.

Chapter 5 describes the existing biological and human environments within the area affected by the route options.

Chapter 6 addresses the community consultation/public participation programme undertaken and the issues and concerns raised in submissions received.

Chapter 7 canvasses potential environmental impacts associated with the proposed route, while Chapter 8 details the management programmes proposed to mitigate these impacts.

Chapter 9 draws the various components of the Consultative Environmental Review into a cogent synthesis of existing environmental conditions, likely impacts, management measures and consequent commitments which form the conclusion to the Consultative Environmental Review.

# 2.0 NEED FOR THE PROPOSED COASTAL ROAD - JURIEN TO GREEN HEAD

This chapter briefly outlines the rationale underlying the proposal to construct a new road link between the towns of Jurien and Green Head.

## 2.1 Regional Context

Development within the Central Coast Region is characterised by small coastal townships. The Central Coast Region has exhibited increased growth and development during the past decade, and a continuation of this trend is likely due to the region's proximity to Perth combined with the attractions for tourism and recreational development that it offers.

As the established coastal centres and informal squatter settlements within the region have grown, the demand for better road access has also increased. The Central Coast Regional Strategy recently released for public comment by the Department of Planning and Urban Development identifies the need for a regional framework to coordinate planning and development decision-making (Department of Planning and Urban Development, 1994a). This strategy seeks to maintain the region's natural environmental values, whilst 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 Planning Strategy provides for a continuous coastal route between Lancelin and Dongara and parts of this route already exist. The Green Head to Cliff Head section of the overall route has already been constructed while the Brand Highway provides an effective link between Cliff Head and Dongara. In addition that section of the overall route between Cervantes and Jurien was assessed by the Environmental Protection Authority in 1985 to be environmentally acceptable but has yet to be constructed.

Construction of an improved road link between Jurien and Green Head is an integral part of the overall coastal route. In addition, the Central Coast Planning Strategy establishes Jurien as the regional centre and thus effective road connections to neighbouring townships are a priority.

## 2.2 Benefits of the Proposal

Benefits from the development of a more direct route between Jurien and Green Head would include:

- enhanced connectivity between Jurien and Green Head, stimulating greater economic development of centres that provide commercial and administrative functions;
- improved social and community development given better access to and therefore utilisation of existing facilities, services and infrastructure;
- enhancement of access to Jurien as a regional centre in keeping with the Central Coast Planning Strategy;
- reduced travelling time for students attending local schools;
- demarcation of the western boundary of the Lesueur National Park and consequently an opportunity to rationalise access to and management of the Park;
- formalisation of access in the North Head - Sandy Point area which will facilitate coastal management initiatives therein, including recreational and tourism development;
- increased tourism and recreational activity;
- improved access for transport of minerals resources from coastal mining tenements; and
- increased safety through the provision of a better class of road.

A more direct road link between Jurien and Green Head would bring these and other benefits. However because the road route is situated in an area of biological and landscape diversity and has high conservation values it is imperative that the route selected is carefully assessed in terms of potential environmental impacts. The evaluation of these impacts is described in the next chapter.

# 3.0 EVALUATION OF ALTERNATIVES

Several alternatives have been considered in determining the preferred option for enhancing road access between Jurien and Green Head. This chapter provides background information about the process by which the preferred route option was determined. The options considered are outlined and the comparative evaluation that led to selection of the preferred option is explained.

## 3.1 Options Considered

Considerable attention at both the regional and local scale has been given to the identification of options for a more direct road link between Jurien and Green Head. However, it is necessary to acknowledge that some progress toward enhancing road access between the townships could be achieved by upgrading the existing circuitous route linking the centres. Current access between Jurien and Green Head is via Jurien East Road, Cockleshell Gully Road, Coorow - Green Head and Green Head - Leeman Road, a travel distance of 57 km.

While upgrading the present road link would minimise environmental impacts by confining construction-related impacts to an existing corridor of disturbance, benefits from a more direct route (as previously outlined) would not arise. In addition, having the road running directly through the Lesueur National Park as opposed to forming the boundary of this area of high conservation value would not be a preferred option. Nevertheless, in any review of alternatives undertaken as part of an environmental impact assessment process, the "base case" option (based on maintaining the status quo) must be addressed.

Options for achieving a more direct road link between Jurien and Green Head focus on an alignment consistent with the continuous coastal route indicated in the Central Coast Planning Strategy (Department of Planning and Urban Development, 1994a).

Interactions between the then Main Roads Department and Department of Conservation and Environment in the early 1980's led to identification of an alignment for the northern portion of a direct road link between Jurien and Green Head. An important determinant in identifying this alignment was establishment of an appropriate western boundary to the Lesueur National Park. The recent report "Nature Conservation, Landscape and Recreational Values of the Lesueur Area" (Burbidge, Hopper and van Leeuwen, 1989) confirms the boundary of the National Park is to be determined through the above process.

Two options exist for the southern portion of the direct link between Jurien and Green Head. The essential difference between the options is that one (referred to as the Western Alignment) passes west of the Cockleshell Gully salt lake complex, while the other (the Eastern Alignment) passes east of the salt lake complex to a point about three kilometres south of Cockleshell Gully, where it veers west and traverses the wetland system to merge with the Western Alignment.

Thus the alternatives evaluated in determining the preferred option for the Coastal Road - Jurien to Green Head were:

**Option 1: Western Alignment**

This option entails a direct route comprising the northern Green Head Section adjacent to the Lesueur National Park plus the Western Alignment (refer to Figure 1). This option is approximately 27 km in length and entails a 14.5 km section referred to as the "Western Alignment" which starts 1.5 km north of the Jurien East Road junction (approximately 1 km east of Jurien). From this point the Western Alignment heads north-west, passing between the large gypsum lake inland from Sandy Point and the remainder of the Cockleshell Gully salt lake complex to the east, to a point approximately 10 km north of the Jurien East Road junction.

The Western Alignment is approximately 1.5 to 3.5 km from the coastline and is clearly the nearest alignment to the coastal localities of Sandy Point and North Head. The proposed extensions from the Western Alignment to Sandy Point pass directly north and west of the gypsum lake which lies south-east of Sandy Point.

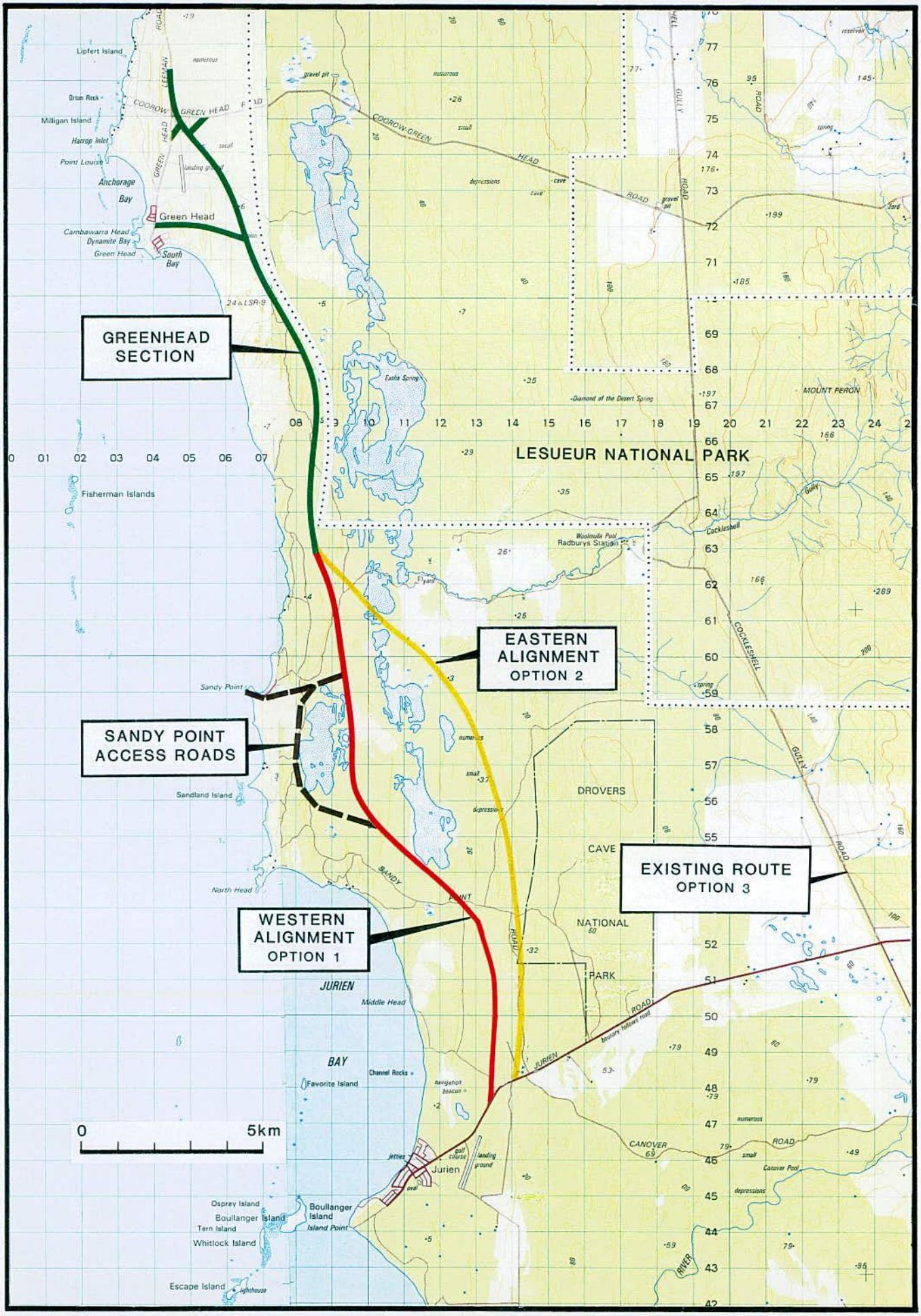
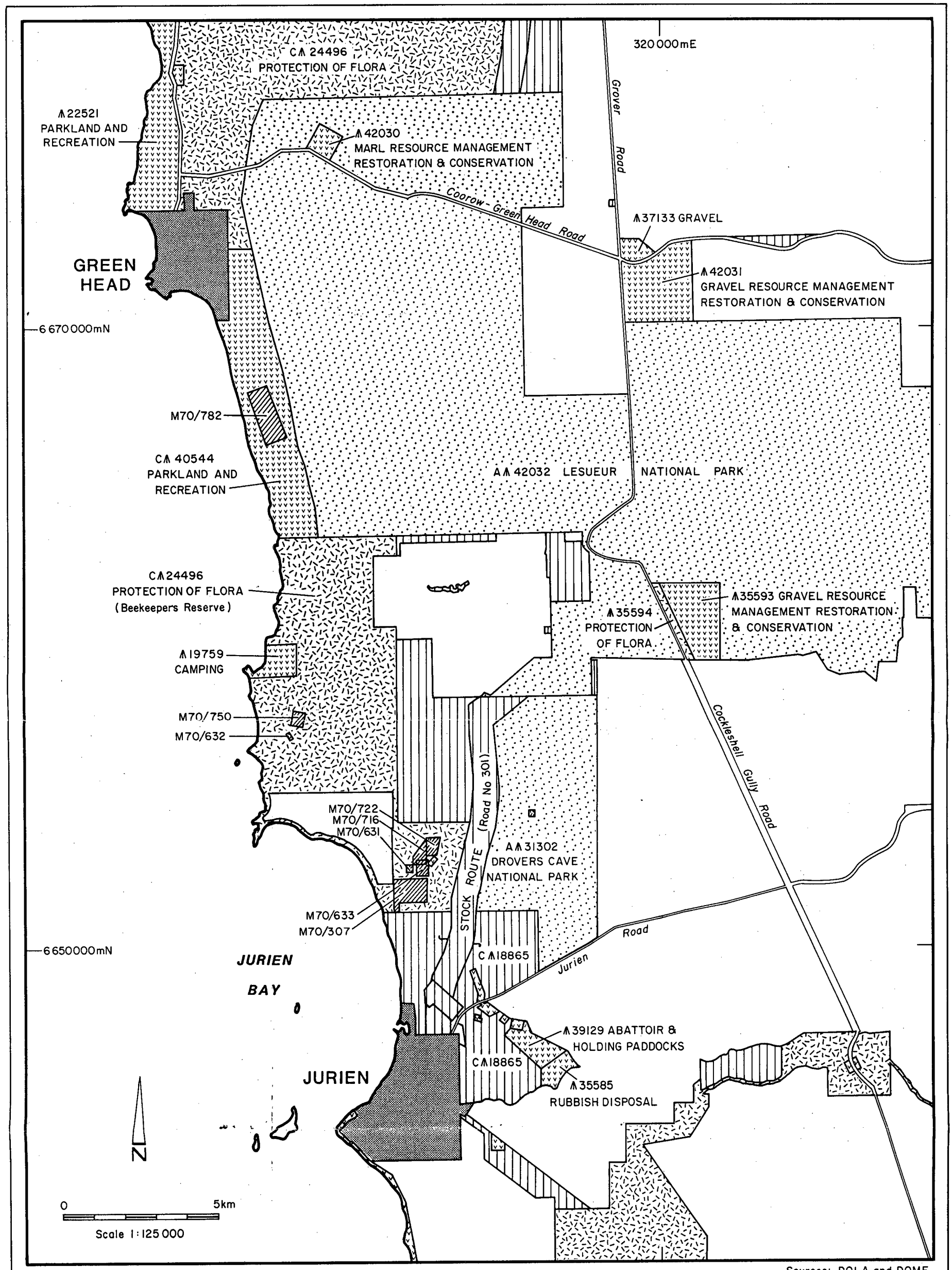



Figure 1: **Options for proposed Coastal Road Jurien to Green Head**




Sources: DOLA and DOME

Figure 2: JURIEN - GREEN HEAD AREA
GENERAL LAND USE

**Option 2: Eastern Alignment**

This option entails a direct route comprising the northern Green Head Section adjacent to the Lesueur National Park plus the Eastern Alignment (refer to Figure 1). This option is also approximately 27 km in length but with a 14.5 km section of its length known as the "Eastern Alignment", which is generally situated west of the Drovers Cave National Park.

The Eastern Alignment enters the Drovers Cave National Park approximately 9.5 km north of the Jurien East Road and emerges one kilometre further north. A proposed alternative for this section involves skirting the National Park boundary. Approximately 13.5 km north of the Jurien East Road, the Eastern Alignment enters the Cockleshell Gully salt lake complex, traversing the wetlands for a distance of about 1 km. In addition, any direct access roads from the Eastern Alignment to Sandy Point would have to traverse the wetland complex unless realigned to avoid the wetlands.

**Option 3: Cockleshell Gully Road**

This option entails upgrading of the existing link between Jurien and Green Head via Cockleshell Gully Road, a total travel distance of 57 km (refer to Figure 1). Although an established route, this option traverses the Lesueur National Park which has high conservation significance.

### 3.2 Summary of Environmental and Social Considerations

The three route options have been compared on the basis of their predicted impacts on social and biological conditions within the project area.

The project area comprises about 500 square kilometres of the near coastal environs encompassing Jurien and Green Head, approximately 200 km north of Perth. Social and biological considerations arising from the project are summarised hereunder.

#### 3.2.1 Land Use

Land uses within the project area are an important influence on the location of the proposed route. Irrespective of the route ultimately chosen there will be a direct physical impact on landuses through the displacement of activities occurring within the designated road reserve. An impact on the current landuses can potentially occur even if existing road reserves are used. For example, an increased physical 'barrier' could be created between established activities and the possible attraction of new activities may impinge on established uses. In this regard, particular consideration to the servicing of existing and future mineral sands and gypsum mining operations in the project area is necessary.

The northern portion of the project area including Green Head is within the Shire of Coorow while the southern portion including Jurien is part of the Shire of Dandaragan. The majority of the project area beyond these townsites comprises Crown land of varying status (refer to Figure 2).

As can be seen from Figure 2, the majority of Crown land within the project area is reserved for conservation purposes, the principal areas in this context being:

- Lesueur National Park: A↑42032 - area of about 26,500 hectares (ha);
- Drovers Cave National Park: A↑31302 - area of about 2,700 ha; and
- Beekeepers Reserves: C↑24496 and C↑31302 - total area of about 70,000 ha of which approximately 4,500 ha only is within the project area.

All of these reserves were the subject of Environmental Protection Authority Red Book recommendations (System 5), the intentions of which are being effectively met in all instances (Environmental Protection Authority, 1993).

Other major areas of Crown land within the project area comprise the unvested C↑18865 and the Stock Route (Road No. 301) immediately south and west of the Drovers Cave National Park and about 1,000 ha of Vacant Crown land immediately north-west of the Stock Route.

Privately owned property (essentially farmland) occurs predominantly in the south-eastern and north-eastern sectors of the project area, although some 2,600 ha of private land occurs around Cockleshell Gully in the central portion of the project area. The only other privately owned land within the project area is an undeveloped site of about 660 ha extending east and south from North Head. Option 1 (the Western Alignment) impinges on the north-eastern extremity of this property.

The existing road link between Jurien and Green Head principally affects privately owned land and the Lesueur National Park, while the two options for construction of a more direct link between the centres principally affect the unvested ↑40544 (recreation reserve), C↑18865 and Stock Route, Beekeepers Reserve and Vacant Crown land.

In terms of human habitation, no archaeological or ethnographic sites of Aboriginal importance have been previously recorded or identified within the project area as a whole (refer to Appendices 2 and 3). Two sites within the project area have been included on the Register of the National Estate (the Mount Lesueur Reserve and the Drovers Cave National Park) although with the objective of protecting their conservation values rather than their human-related heritage value.

The Old North Road Stock Route (only part of which remains, extending from Jurien East Road to the privately owned land along Cockleshell Gully) undoubtedly played a role in terms of historical agricultural development within the broader Central Coast Region and beyond. The Stock Route is identified in the Central Coast Regional Strategy as providing an opportunity for development of a regional heritage trail (Department of Planning and Urban Development, 1994a).

A number of tenements under the Mining Act, 1978 occur within the project area (refer to Figure 2). Tenements in the western portions of the project area would be traversed by a new more direct link between Jurien and Green Head and are more likely to be affected than those along the alignment of the existing road link between the two centres. While the new route options may impinge on some of the tenements, the net result (i.e. in terms of enhancing access to the tenement area) is likely to be beneficial.

Thus in a land use sense, the areas of Crown land that have been reserved for conservation purposes represent the most important consideration in terms of the project.

### 3.2.2 Road and Traffic Considerations

The three options were initially assessed in order to determine the most desirable route in traffic terms. Traffic analysis involved the review of available material, which included 1: 100,000 scale GIS mapping; 1:25,000 scale aerial photography; Main Roads and Department of Planning and Urban Development reports; and traffic volume data supplied by the Shires of Coorow and Dandaragan.

Access

In regional traffic terms Option 1 (the Western Alignment) is clearly a preferable alternative to Options 2 and 3, given that it is the most accessible route to coastal localities between Jurien and Green Head, notably those of Sandy Point and North Head which are popular fishing locations with the potential for future tourist developments.

It is considered that the Eastern Alignment associated with Option 2 is not as attractive for regional access as Option 1. The alignment is further away from the coast, approximately five to six kilometres east of Sandy Point and North Head. Any direct access roads to these localities from Option 2 would therefore entail greater construction length and also traverse sensitive wetlands. It should be noted however that Option 2 is located closer to farming properties in the Cockleshell Gully area, thereby improving local accessibility between these properties and the communities at Jurien and Green Head.

Option 3, which represents the existing connection from Jurien to Green Head, is not recommended as the preferred regional traffic route. The route is 30 km longer than Options 1 and 2, which does not provide for the benefits in travel time savings that the "coastal" alignments present for regional transport. In regional transport terms, Option 3 also does not provide accessibility to and from the coastal localities of Sandy Point and North Head, which are potential points of future tourist-oriented development.

In addition, upgrading of that part of Option 3 utilising the existing Cockleshell Gully Road would traverse the Lesueur National Park.

Property Severance

The characteristics of Option 1 and Option 2 are similar in terms of potential severance, except for the 14.5 km sections of their respective lengths known as the "Western Alignment" (Option 1) and the "Eastern Alignment" (Option 2). For the greater part of its length the Western Alignment traverses a Nature Reserve. The route of Option 1 does not impact upon any private property except for the extreme north-eastern corner of the North Head property owned by Leonard and Silvia Milgram. It should be noted that a Gypsum mine access road has already been constructed along several kilometres of the alignment in this area.

The Eastern Alignment traverses a sizeable tract of vacant Crown Land and a section of an unvested Crown Reserve immediately west of the Drovers Cave National Park. In terms of the Drovers Cave National Park itself, Main Roads Western Australia's Initial Planning Study (1990) indicated that a corner of its south-western boundary may need to be truncated for construction of the Eastern Alignment in this area. Main Roads Western Australia noted that if this situation was unsatisfactory to the Department of Conservation and Land Management, then the alignment would be shifted west, involving greater earthworks costs.

Noise

Traffic noise associated with the three route options is not regarded as a significant potential impact. Of the respective route options, the Eastern Alignment (Option 2) would come closest to any existing dwellings. Where this alignment skirts the south-western extremity of the farming properties along Cockleshell Gully, it would be within several hundred metres of existing dwellings. This separation combined with the low volume of traffic likely to use the road indicates the unlikelihood of significant noise impact. The separation between the other route options and existing dwellings is substantially greater in all instances.

The potential for traffic noise impact can perhaps be perceived as greater within the Green Head Townsite where the proposed southern access road into the town would skirt an existing residential area. However even here significant noise impact would be unlikely. The access road would essentially function as a distributor route servicing the north-eastern section of the Townsite and it has been aligned so as to maximise its separation from the residential area (within limits imposed by existing facilities). The alignment and function of this access road is a local land use planning issue to be resolved by the Shire of Coorow.

### 3.2.3 Biological Environment

In the context of identifying constraints and opportunities for route selection, the major areas of biological conservation significance within the project area are:

i) Cockleshell Gully salt lake complex. Salt lakes are important feeding and breeding habitats for migratory birds and feature unique vegetation associations. The preferred Western Alignment (Option 1) skirts the Cockleshell Gully salt lake complex and thus does not directly impact any wetlands. Option 2 (the Eastern Alignment) crosses the salt lake complex for a distance of approximately 1 km. In addition, access roads to the North Head - Sandy Point area would cross the salt lake complex unless redirected around. While Option 3 does not itself impact on any wetlands, coastal access roads would traverse the wetlands as for Option 2.

ii) DRF and priority flora. The area within a 50 km radius of Jurien contains 114 species of flora listed as priority taxa including one presumed extinct species, *Platysace dissecta*; 15 species of Declared Rare Flora (including seven species of *Eucalyptus*); and 98 Priority species (Atkins, 1993). However the majority of these species are restricted to the shallow sand over limestone of the Jurien System vegetation complex. Of the three options, Option 1 traverses the least amount of land within the Jurien System, followed by Option 2 and finally Option 3 which lies almost entirely within this System. Thus Option 1 (the Western Alignment) is expected to have the least effect on rare and priority flora of the three alternatives considered.

iii) Conservation Estate
There are three main reserved areas in the Jurien to Green Head area, all of which are vested in the National Parks and Nature Conservation Authority:

- Lesueur National Park This "A" Class Reserve (A↑42032) was vested on the 24th January 1992 for the purpose of conservation of flora and fauna. Its area is currently listed as 26,987 ha however this is expected to increase by the extension of the western boundary to the proposed Coastal Road. The reserve will thus contain areas of both the Jurien and Guilderton Vegetation Systems. Options 1 and 2 would form the western boundary of the Lesueur National Park, with Option 1 including more of the Cockleshell Gully salt lake complex within the enlarged reserve. Option 3 would cut directly through this National Park, which is an unfavourable option in terms of the potential for dieback to spread through the reserve.
- Drovers Cave National Park This "A" Class Reserve (A↑31302) was vested as a National Park on the 3rd February 1978 and has a much smaller area at 2,681 ha. It is located in the diverse limestone associations of the Jurien Vegetation System. This National Park is only directly impacted by Option 2 which would cut through the southwestern corner of the reserve unless diverted around.
- Beekeepers Reserves These "C" Class Reserves (C↑24496 & C↑31302) are located in three sections;
  a) south of Jurien towards Cervantes, "Southern Beekeepers Reserve";
  b) north of Green Head, "Northern Beekeepers Reserve"; and
  c) a central portion located in the North Head - Sandy Point area.
  The entire reserves comprise an overall area of 69,158 ha and were vested on the 23rd August 1991 for the purpose of protection of flora. Of the three options considered, only Option 1 impacts on the Beekeepers Reserves. This Option traverses the central portion of Reserve 24496. This portion of the reserve lies within the Guilderton Vegetation System and is thus expected to contain more uniform vegetation associations and fewer rare and priority species of flora than the more eastern areas which lie within the Jurien System.

### 3.2.4 Dieback

The *Phytophthora* species which cause dieback have only been known to occur in the Northern Sandplains region (i.e. north of Moore River) since 1986: prior to this it was believed that these fungi could not survive in such an harsh environment (Petersen, 1992). The only known outbreak of *Phytophthora cinnamomi* north of Moore River was at Eneabba in 1989 and six other species are now known to occur in the northern kwongan (Petersen, 1992).

Despite the sparse current distribution of *Phytophthora* species in the northern kwongan, their potential presence cannot be ignored due to the devastating effects that could occur if the fungi became successfully established in large areas.

Impacts of the proposed options on the spread of dieback are expected to be minimal given the limited occurrences of the infection in the region. In this regard, Option 3 is again the least preferable route alternative as it will cut through the Lesueur National Park which has a high conservation value and features species particularly susceptible to this disease.

### 3.2.5 Social Environment

The main objective of the proposal is to enhance the level of road access between Jurien and Green Head and therefore in essence the project is intended to produce social benefits such as increased interaction between the communities deriving from more direct access. The potential for adverse impacts upon the human environment does however exist, for example if the route option adopted disrupted established activities or developments.

In this context, the existing road link between Jurien and Green Head can be regarded as part of the established development pattern, thereby lessening the potential for adverse effects as a result of development of this route. While the other options would entail construction of a new route, the extent and nature of human habitation and development within the areas such routes would traverse (refer to Section 3.2.1 above) suggests that significant effects are unlikely with the possible exception of the southern access road into Green Head. However, as discussed in Sub-section 3.2.5.1 the southern access road into Green Head has been realigned so as to limit potential impacts within nearby residential areas.

#### 3.2.5.1 Access into Green Head

As a result of the concerns expressed during the consultation process (refer Chapter 6) the need for a Southern Access Road into Green Head and alternative alignments for such a link were investigated.

Several residents also had concerns with the existing road layout of Mitchell / Battersby and Greenhead Road. Council acknowledges these concerns as this intersection is currently inadequate to safely accommodate both pedestrian and vehicular traffic.

Further pressures would come onto this road system as a result of proposed Stage 6 Residential Subdivision coming on stream possibly within the next 12 months.

In response to the concerns expressed during the initial consultation process, an alternative alignment for the proposed southern access road has been identified.

The Coorow Shires Town Planning consultant and Main Roads Western Australia have supported the alternative alignment (as shown on Figures 5 and 6). The alternative alignment increases the separation between the proposed road and the existing residential areas, thereby enhancing the opportunity to manage any spillover effects from the road.

The alternative alignment shown in Figures 5 and 6 also fits well into the Green Head Townsite Structure Plan and will help to relieve some of the pressures the existing road network is under.

A northerly link into Green Head through the Light Industrial Area was also considered however aesthetically this alignment is considered undesirable. Also because of the close proximity of the existing junction of the Coorow - Green Head and Leeman - Green Head Roads, an extra northerly link into Green Head could not be justified economically.

### 3.2.6 Landscape Amenity

Impact on landscape amenity is a function of the visual prominence of a feature and the opportunity for the feature to be viewed by people.

Parts of the existing road link traverse relatively elevated land within the Lesueur National Park and are therefore visually prominent within an area frequented by people using the National Park. The existing route can therefore be regarded as detracting from landscape amenity. Both new route options traverse ground that is exposed to view from the public lookout that has been established adjacent to the Jurien townsite water supply tank and can thus be regarded as detracting from landscape amenity within the local area. Elsewhere both of the new route options have an alignment that is relatively low in the landscape and therefore effectively screened form external viewpoints.

As a result of the community consultation process, an alternative alignment much closer to the coast than initially envisaged for the new route alignment was suggested. However this route would have necessitated the crossing of several substantial dune systems. As a consequence, the potential for adverse visual impact would have increased, a consideration that contributed to rejection of the alternative near-coastal alignment suggested. Another important factor against this alignment was the sensitivity of foredune habitats to disturbance.

The alternative alignment was suggested in order to provide ocean views. However an elevated site suitable for establishment of a scenic lookout has been identified adjacent to the Western Alignment. This will enable panoramic views (including the coast and ocean) without significant consequent visual impact (as would result from the suggested alternative alignment).

### 3.3 Comparative Evaluation of Alternative Route Options

The effects of the three alternatives in terms of the following criteria were ranked and aggregated to provide an overall comparative evaluation as a basis for identification of the preferred option:

Biological and Physical Environmental Factors

- Vegetation Clearing
  - habitat disturbance
    - extent of direct loss of habitat
    - diversity and conservation value of habitat likely to be lost
  - Declared Rare Flora
    - likely occurrence (and therefore disturbance) of such species
- Dieback Occurrence
  - likely occurrence
  - susceptibility of endemic vegetation to infection
- Erosion Potential
  - inherent stability of the soil/landform units traversed by the route
  - extent of earthworks required for route construction
- People Pressures
  - workforce
    - consequences of introducing people to the area traversed by the route
    - conservation value and status of the area traversed
  - road users
    - as for workforce
- Pollution/Contamination Potential
  - proximity of the route to feature/area of water resource significance
  - proximity of route to other areas sensitive to pollution/contamination

Human Environmental Factors

- Aboriginal Sites
  - direct/indirect intrusion upon known/identified sites
- Heritage Sites
  - as for Aboriginal Sites
- Visual Impact
  - visibility of route from external viewpoints
- Severance
  - potential for severance/disruption of
    - private land
    - Crown land (Reserves, National Parks etc.)
    - existing access links
    - services
- Noise and Dust
  - proximity of the route to areas/features of particular sensitivity

The comparative evaluation was undertaken prior to completion of the detailed site surveys but was based on detailed literature review, evaluation and preliminary survey results. The anticipated effects of the route options on a range of biophysical and human environmental factors were considered. The impacts are ranked either as Low (L), Medium (M) or High (H). The ranking adopted was based upon an evaluation of the magnitude and significance of impact imposed by each route option upon the factor being considered.

The results from the comparative evaluation are summarised in Table 1. As can be seen, there was little difference in the relative preferability of the three options in terms of their overall impact. However, Option 1 (the Western Alignment) appears to result in the least overall impact and will also produce the greatest demonstrable level of community/social benefit. Option 1 was therefore selected as the preferred alignment, a decision endorsed by the proponents, Main Roads Western Australia, the Department of Conservation and Land Management, the Department of Planning and Urban Development and the Geraldton Mid-West Development Authority.

The Western Alignment therefore formed the basis of the detailed field investigations undertaken and as discussed in the following chapters, these investigations did not identify any reason/s considered to warrant adoption of either of the other options as the preferred alternative.

**TABLE 1: Comparative assessment of alternative route options for the proposed Coastal Road - Jurien to Green Head.**

| Environmental Factor | Option 1 Western Alignment | Option 2 Eastern Alignment | Option 3 Existing Route |
|---|---|---|---|
| Biophysical | | | |
| - clearing: | | | |
| habitat disturbance | M | H | L |
| DRF | M | H | M |
| - dieback | M | M | H |
| - erosion | H | M | L |
| - people pressures | M | M | H |
| - water pollution | L | H | M |
| Human | | | |
| - Aboriginal sites | L | L | L |
| - heritage sites | M | M | L |
| - visual impact | M | L | H |
| - severance: | | | |
| private land | L | L | M |
| Crown land | H | H | M |
| access | M | L | L |
| services | L | L | L |
| - diminution of amenity | M | M | H |
| - intrusion on dwellings | M | M | M |
| Construction | | | |
| - clearing for materials | H | H | M |
| - contamination | M | H | M |
| - noise/dust | H | H | M |
| - people pressures | M | M | H |

# 4.0 DESCRIPTION OF THE PROPOSAL

The proposed Coastal Road - Jurien to Green Head encompasses the direct road link between Jurien and Green Head as shown in Figure 3, and the associated access roads to Sandy Point. The road is planned to be constructed under the control of the Main Roads Western Australia Northam Division in conjunction with the Shires of Dandaragan and Coorow.

## 4.1 Location

The proposed Coastal Road - Jurien to Green Head is located approximately 200 km north of Perth and follows a coastal route between the two towns. The proposed road intersects with the Jurien East Road approximately one kilometre east from Jurien and runs north, before turning west to avoid the Cockleshell Gully salt lake complex. The road then continues north, skirting the salt lakes, to Green Head (Figures 1 and 3).

## 4.2 Overall Concept of the Proposal

The overall concept of the proposed Coastal Road - Jurien to Green Head is to enhance the level of road access between the two towns by developing a new road link on an environmentally and socially acceptable alignment.

## 4.3 Standards for Road

Standards to be adopted for construction of the Coastal Road - Jurien to Green Head 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 |

A typical cross section of the proposed road is illustrated in Figure 4. All proposed intersections with the Coastal Road will be designed in accordance with AUSTROADS "Guide to Traffic Engineering Practice - Intersections at Grade".

The Sandy Point access roads will be to a lower standard comprising a 6 m wide unsealed road similar to other unsealed roads in the region.

## 4.4 Traffic Demands

The Coastal Road - Jurien to Green Head entails numerous transport benefits for the immediate region. These relate specifically to a number of issues, including:

- establishing a regional road hierarchy;
- the likelihood of reducing traffic volumes on existing roads; and
- improving local and regional access conditions.

### 4.4.1 Regional Road Hierarchy

At present, the Jurien - Green Head region is served by several local roads which together do not constitute any functional hierarchical pattern. Access from Jurien to Green Head is only achievable via use of the Jurien East Road, Cockleshell Gully Road and the Coorow - Green Head Road, a circuitous route which does not conveniently serve existing and potential coastal localities. On a wider regional scale, localities such as Jurien, Green Head and Leeman are only currently accessible via local access roads to/from the Brand Highway.

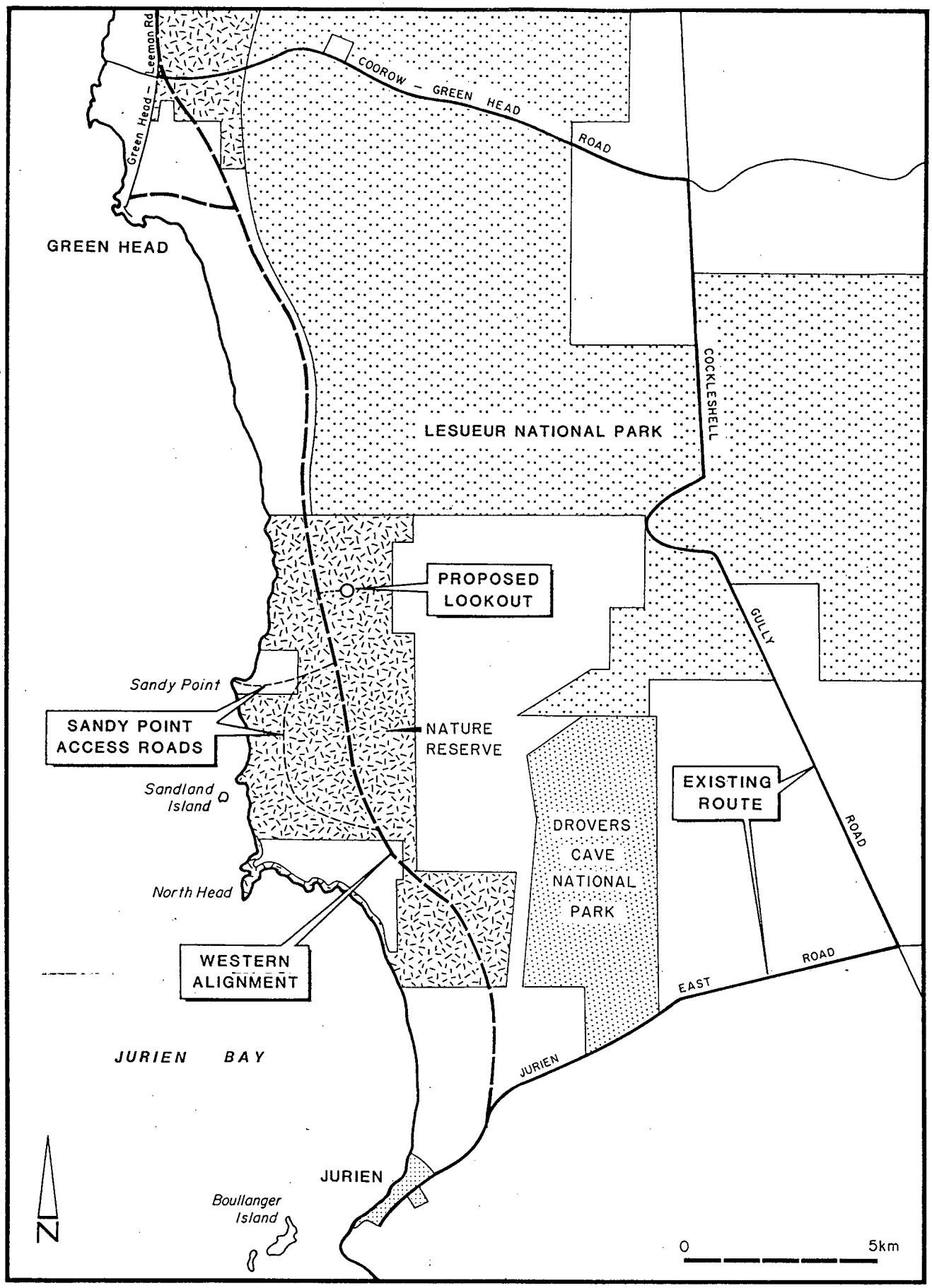



**Figure 3:** Route of the preferred Western Alignment (Option 1).

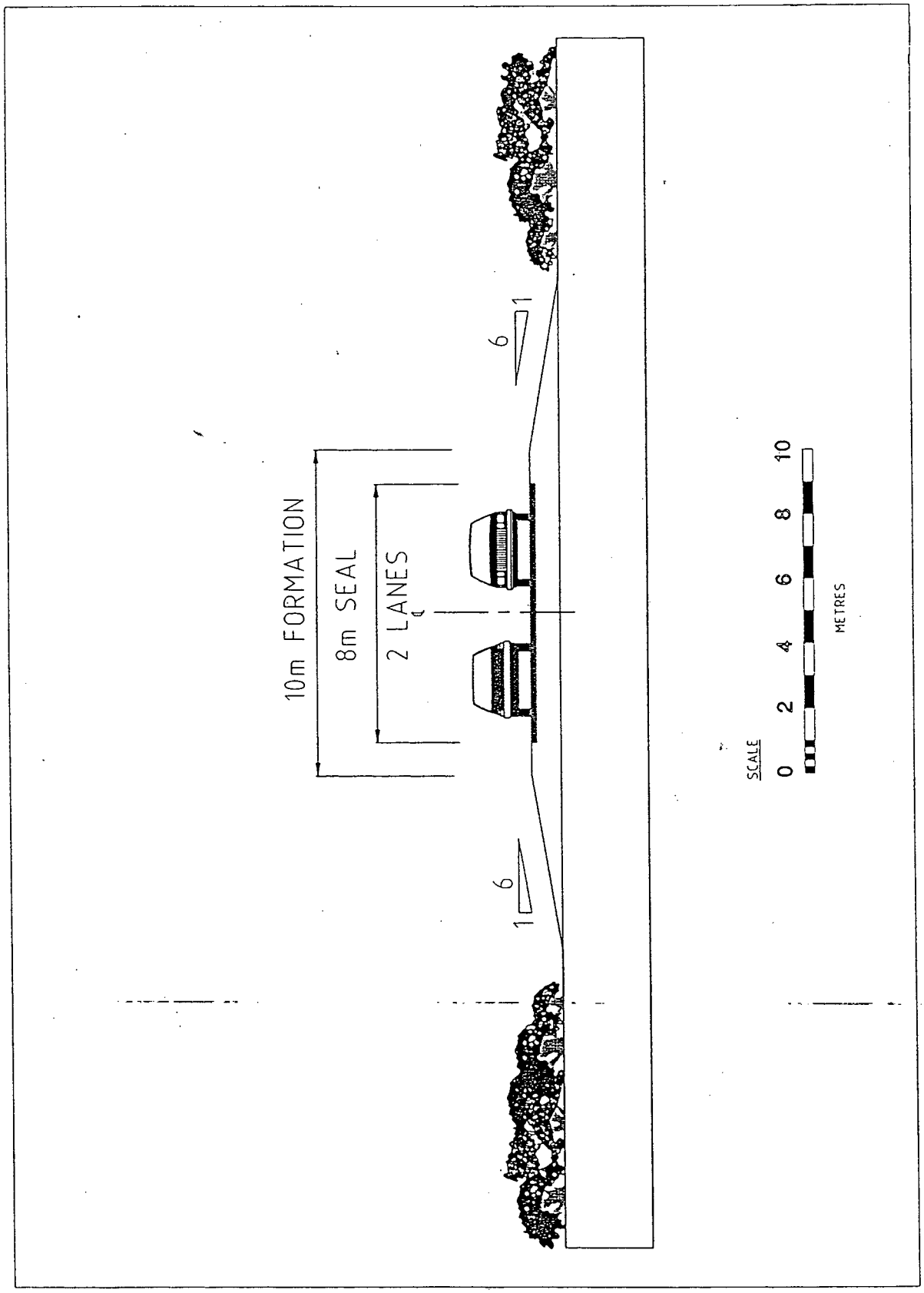



**Figure 4:** Typical Road Cross-section.

### 4.4.2 Traffic Volumes and Access

Traffic volumes obtained through the local Shires for the majority of roads in the immediate study area indicated maximum average vehicles per day volumes of approximately 500 during the busy January holiday period. With construction of the new coastal road, it is expected that the aforementioned minor traffic volumes, which are associated with roads such as the Jurien East Road and Coorow - Green Head Road to and from the Brand Highway, would be largely transferred onto the new route. To this end, construction of the new road will adhere to design standards which will guarantee adequate safety conditions for traffic expected to utilise the new route.

In terms of local and regional access, Section 4.4.1 has already discussed the improvement to local/regional accessibility provided by the new road. The travel times and distance associated with intra-regional travel from Jurien, Green Head, Leeman etc. will be substantially reduced with utilisation of the new coastal route - as opposed to having to utilise Brand Highway and relevant link roads from this highway to coastal communities in the study area.

Furthermore it is recommended that as part of the detailed design the new coastal route should incorporate suitable rest areas to be provided where appropriate, with information bays also to be included at selected locations (i.e. near the proposed minor access road to the Scenic Lookout located approximately 400 m east of the new coastal road).

Complementing provision of the new coastal route, several new access roads and intersections to/from the new route are also proposed. These affect access to/from the localities of Green Head and Sandy Point, with the relevant details given below:

Access into Green Head

The new coastal road will necessitate a revision of the existing Green Head - Leeman Road / Coorow - Green Head Road junction, in order to establish the primacy of the new coastal route as a through traffic carrier. Accordingly, a staggered T-junction is proposed where the Coorow - Green Head Road will connect with the new coastal route approximately 300 m south of the Green Head - Leeman Road T-junction with the new road (see Figure 5). The staggered T-junction separation allows for safe access of all vehicles to/from the Coorow - Green Head and Green Head - Leeman Roads.

A proposed new access road known as the Southern Access Road will run from the coastal route directly into the Green Head locality and the Green Head - Leeman Road, with an alignment to the north of Battersby Road and Mitchell Street. Of this proposal, two options have been considered:

- 1) the initial option was situated parallel to and approximately 30 m north of the Battersby Rd and Mitchell St alignments, intersecting the Green Head - Leeman Road approximately 30 m north of Mitchell St and included three potential direct access links to / from Battersby Rd and Mitchell St;
- 2) following adverse public reaction to the initial proposal a second option was developed. This option provides for a single access point to Battersby Road (to intersect at McGilp Street) and connects with the Green Head - Leeman Road approximately 100 m north of the existing Mitchell Street junction, thereby greatly increasing the buffer area to the adjoining residential areas (see Figure 6).

In traffic terms, the second option is considered a more desirable alternative to the first. The first alignment is in close proximity (i.e. 120 - 160 m) to approximately 15 residences on Battersby Road and Mitchell Street, which will suffer an increase in noise both during and post construction of the southern access. Dust during construction may also be of concern to these residences. Furthermore, in access terms the provision of additional entry points onto Battersby Road from the new link road would increase the likelihood of traffic utilising roads such as Battersby Road and McGilp Street to access the beachfront area. This is undesirable not only in access terms (regional traffic utilising local streets) but also in safety terms with the increase of traffic on residential streets.

Sandy Point Access Roads

An unsealed road is also proposed to access the Sandy Point area through the Beekeepers Nature Reserve. The loop road would be constructed to a 6 m width (refer to Section 4.3) and would be constructed by the Shire of Dandaragan to provide for local recreational access.

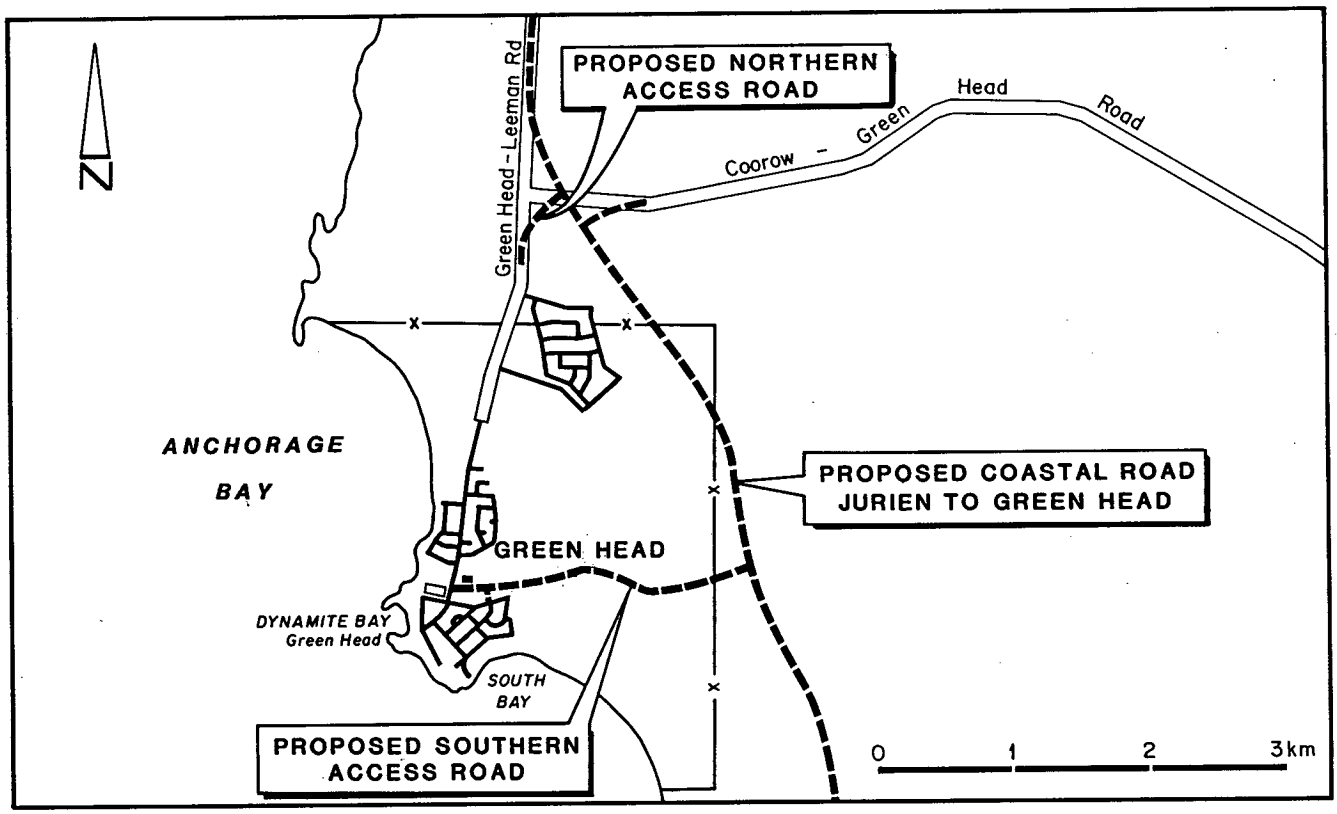



**Figure 5:** The proposed access into Green Head from the Coastal Road - Jurien to Green Head.

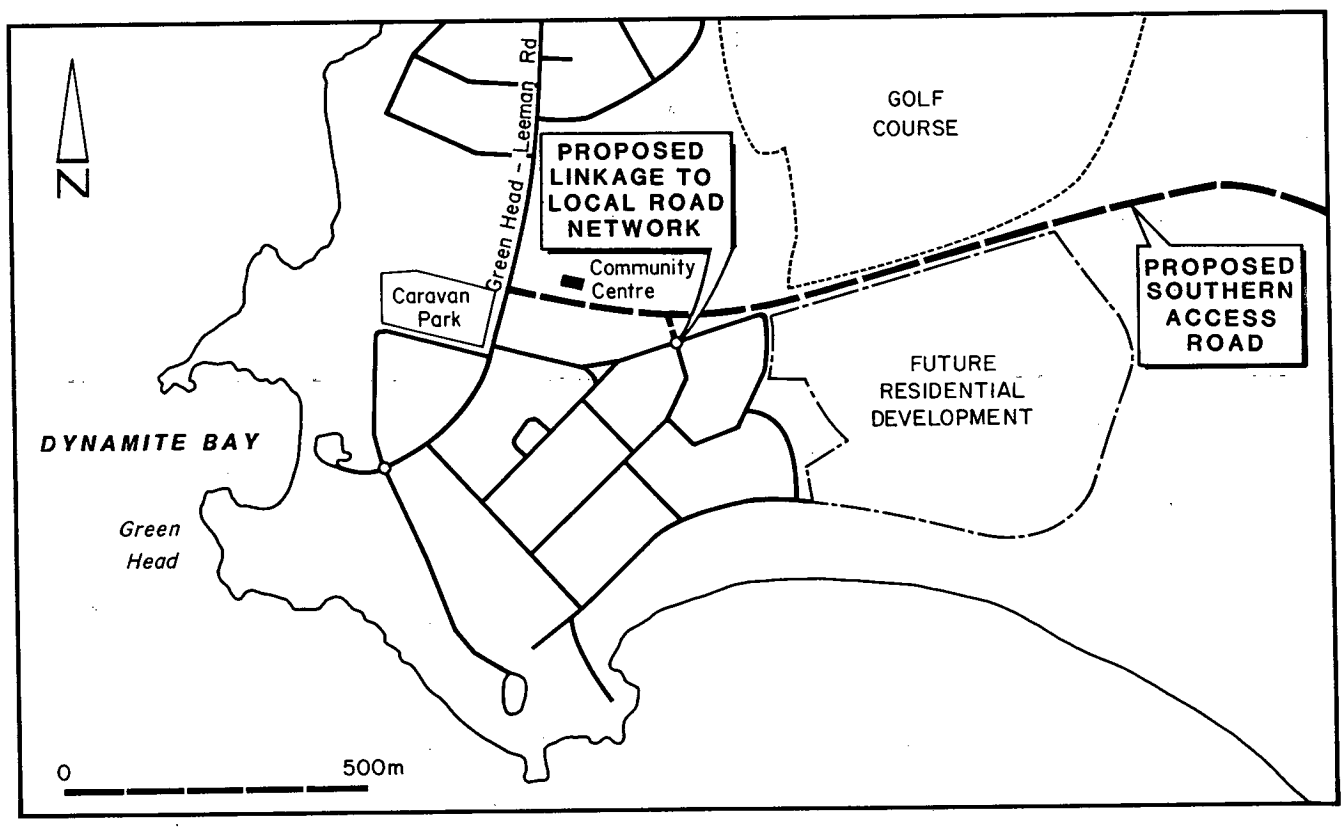



**Figure 6:** Proposed southern access road into Green Head.

### 4.5 Wetland Crossings

No wetlands will be crossed directly by the preferred alignment (Option 1) for the proposed road. This alignment runs adjacent, 300 m to 500 m to the east of, the gypsum lake south-east of Sandy Point for approximately two kilometres. The remaining two options both involve some part of the Coastal Road itself or the access roads to the North Head - Sandy Point area crossing the salt lake complex.

In such areas, and generally on the flat areas of the route, an embankment of minimum 0.5 m height will be required. Regular culvert placement on all natural and artificial channels will maintain current hydrological regimes with minimum disruption. These culverts will also maintain fauna pathways for aquatic and amphibian species.

### 4.6 Sources of Materials

The following section details the sites which potentially contain suitable materials that are to be used during the road construction phase of the project. While the materials sites form an integral component of the proposed Coastal Road Jurien - Green Head project, the ultimate selection of the sites to be utilised can not be undertaken until initial bulk testing is carried out and final road design determines the amount of material required. Approval is sought within the current Consultative Environmental Review for access to utilise those borrow pit sites on private and Crown Land not within conservation areas. Separate approval will be sought under Section 46 of the Environmental Protection Act 1986 for those sites occurring within conservation areas, such as Beekeepers Reserve, which are to be utilised. An appropriate Environmental Management Plan will be formulated at the time approval is sought.

#### 4.6.1 Sand

Sand fill will be required during the construction of the road. Where possible "cut to fill" operations will be employed whereby sand is removed from higher ground along the alignment and used to build the road base in lower areas. However a shortfall of sand fill material is expected thus necessitating the requirement to obtain further material from other sources. It is expected that only one or two such sites will need to be utilised.

##### 4.6.1.1 Private Land

Main Roads Western Australia conducted a preliminary materials investigation of the study area in June 1994 and indicated that sand for fill purposes may be obtained from private property. Two areas have been identified;

Area 1: A & N. Grigson's property, situated west of the Cockleshell Gully Road and five to seven kilometres east of the proposed coastal route;

Area 2: An additional 350 m x 350 m area has been identified on CG 10599 adjacent to the Jurien East Rd approximately 10 km east of Jurien. Precise details of said locations are tabled in the Main Roads Western Australia report "Jurien - Green Head Road Project - Preliminary Materials Investigation" (June 1994).

##### 4.6.1.1 Crown Land

Subsequent investigations have identified a further seven potential sites for sourcing sand fill material from within Crown Land (See Figure 7).

Several mobile dunes and two stabilised dunes along the route of the proposed alignment contain suitable sand fill deposits. Suitable dunes are located at GIS Co-ordinates Dune 1 305590/6673316; Dune 2 308576/6671700; Dune 3 307866/667051; Dune 4 311659/6653655; Dune 5 311866/6652184; Dune 6 311088/6654384 and at Sandy Point.

Additionally, Suitable yellow sand deposits are located in;

Area 3: Just to the north western extremity of Drovers Cave National Park within Vacant Crown Land (GIS Co-ordinates 31381 66574 Hill River)

### 4.6.2 Gravel

Gravel is required for the road base formation. Gravel deposits are located approximately 12 km east of the new coastal road both on and to the immediate east of the Cockleshell Gully Road. Numerous old pits are situated in this area with the majority being vested with the Department of Conservation and Land Management or the Shires of Coorow and Dandaragan. Main Roads Western Australia have also identified possible basecourse pit locations along Cockleshell Gully Road, with precise details tabled within the above report (Main Roads Western Australia, 1994).

One area, Gravel 2 (Figure 7), is located on R & P Ward's property (CG 10413 & CG 10414) and Heytesbury Pastoral (CG 10415), running in a strip parallel to the Cockleshell Gully Road and abutting the Lesueur National Park on the northern boundary and the Jurien East Rd on the southern boundary. The proposed pit would occur somewhere within this strip, approximately 500 x 200 m in area to a depth of 1 m. The strip is a totally cleared agricultural area consisting of non-native pasture grasses.

A second proposed pit is located on M Keenan's & J & K Stove's property (CG 10687) (Gravel 1, Figure 7) and is of approximately 300 X 150 m in area to a depth of 1 m. This area is extensively cleared. Isolated patches of remnant vegetation exist but the area is dominated by non-native pasture grasses.

### 4.6.3 Water Sources

Reliable sources of water are required for construction purposes and dust suppression during the construction phase. The prospects for finding suitable water are good since the project area overlays quaternary sand and coastal limestone with solution cavities occurring in the limestone. In line with the recommedations contained within the Biological Asssement Survey for the project (Appendix B: *ecologia* 1994) saline water supplies will not be utilised.

Jurien Township obtains its water supply from an unconfined Quaternary aquifer within Tamala Limestone. Previous bores sunk in the limestone belt south of Jurien have yielded fresh water in excess of 20 KLH and total soluble salts between 600 mg/L and 1,000 mg/L. The intake for this aquifer is both local and from the Gin Gin Scarp to the east. Salinities are likely to increase not only towards the coast but also with depth. Static water level should generally be close to sea level.

Within the project area MRWA have identified three locations which may potentially fulfil the required needs. All three locations lie within the proposed road reserve. The sites were selected as they were close to the proposed alignment, located over Tamala Limestone and minimal site preparation was required for any future drilling operations. The prospective sites are located 5.5 km (AMG 6653103, 312922) and 18 km (AMG 664332, 307771) north of the Jurien East Road and approximately 2.5 km north east (AMG 6672094, 307152) of Green Head township. The three sites occur over cemented caprock associated with the Tamala Limestone geological unit. The aquifer is generally situated below the cap rock with only shallow bores (30 m to 40 m) being required.

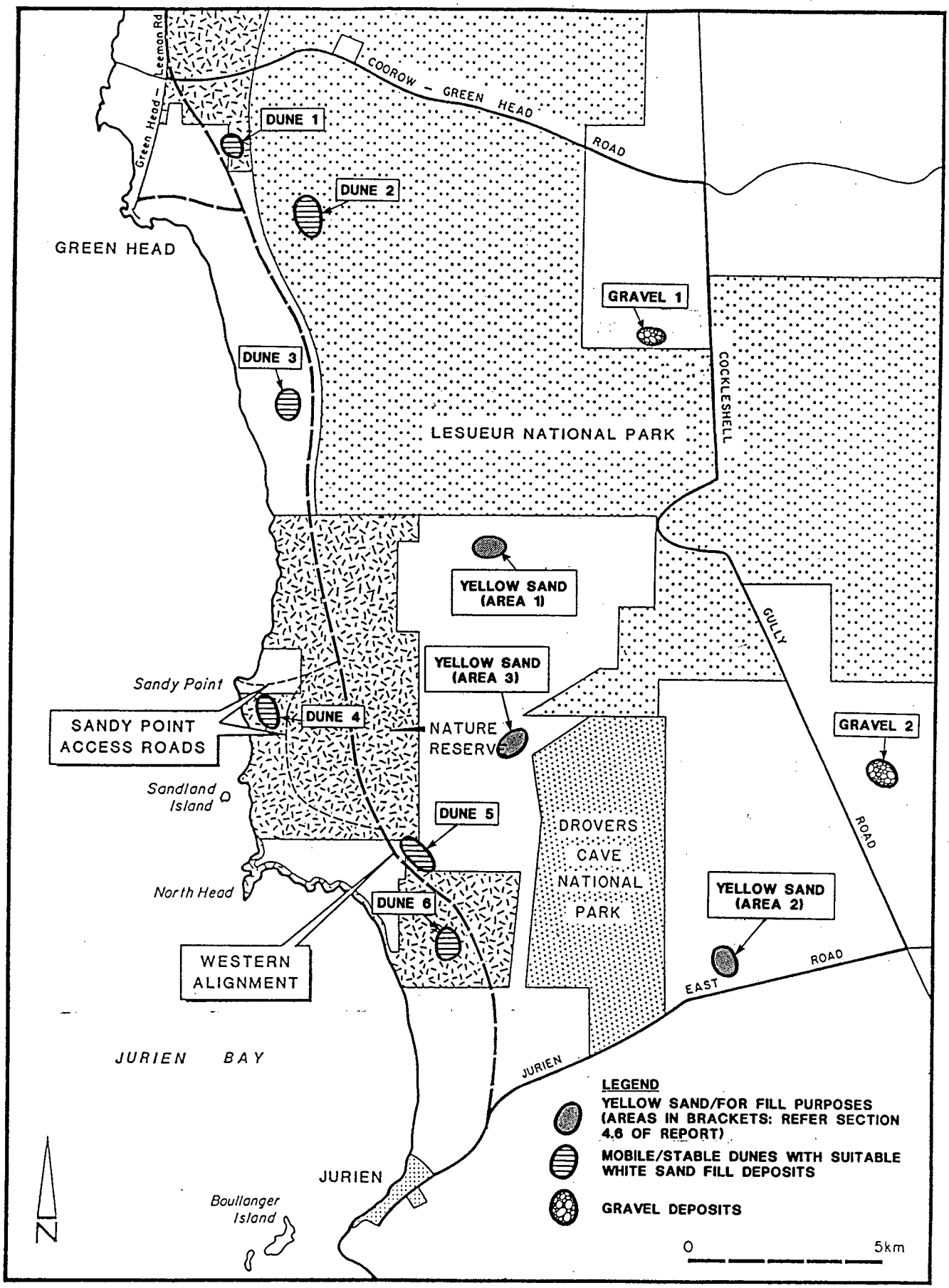



**Figure 7:** Potential Road Materials Borrow Pit Sites

*ecologia*

# 5.0 EXISTING ENVIRONMENT

The existing biological and human environments pertaining to the project area are described in Appendices B, C and D of this report respectively. Within this chapter the environment pertaining specifically to the recommended route is described in more detail.

## 5.1 PHYSICAL ENVIRONMENT

### 5.1.1 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 19.3°C in July to 30.8°C in February. August has the lowest mean daily minimum temperature of 9.2°C while February has the highest of 17.8°C. Average yearly maximum and minimum temperatures are 24.7°C and 12.9°C respectively. 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 883 mm at Perth, to 564 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 8).

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 which is considered inadequate for plant growth (Bagnouls & Gaussen, 1967) (Figure 8).

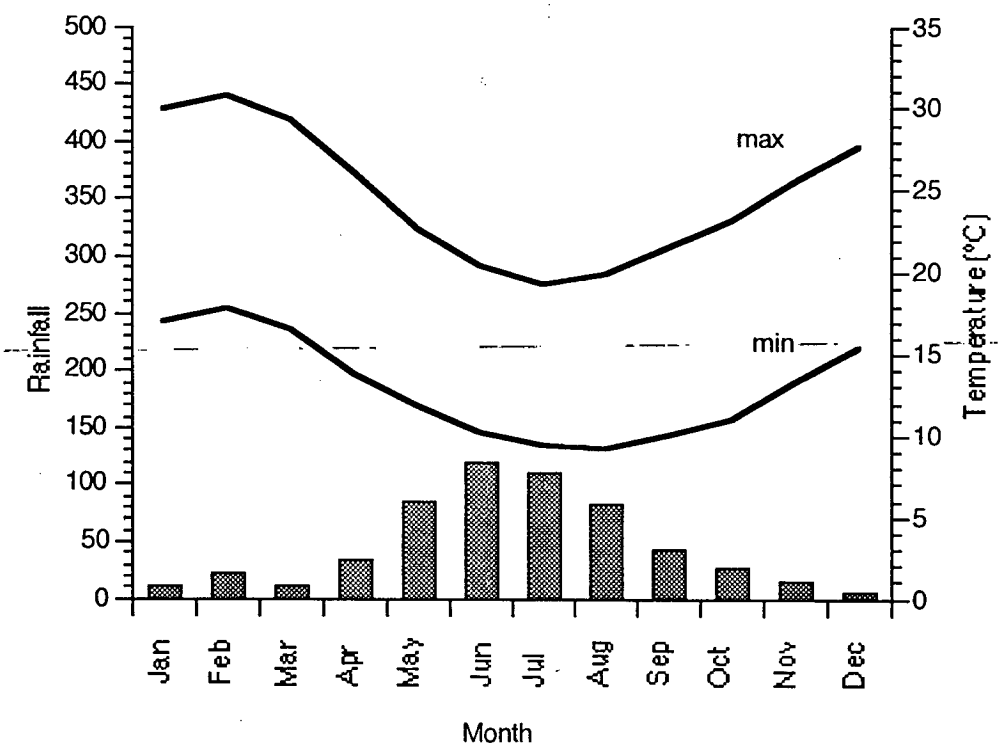



**Figure 8: Mean monthly maximum and minimum temperatures and rainfall for Jurien.**

**Table 2: Summary of Climatic Data for the Jurien - Green Head region.**

**JURIEN**

1968 - 1991 Elevation: 2 m Location: 30° 18' S, 115° 3' E

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct | Nov. | Dec. | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TEMPERATURE** (°C) | | | | | | | | | | | | | |
| Daily max. - mean | 29.9 | 30.8 | 29.2 | 26.0 | 22.7 | 20.3 | 19.3 | 19.8 | 21.5 | 23.1 | 25.5 | 27.7 | 24.7 |
| Daily min. - mean | 17.0 | 17.8 | 16.4 | 13.7 | 11.7 | 10.1 | 9.3 | 9.2 | 10.0 | 11.0 | 13.3 | 15.3 | 12.9 |
| **RAINFALL** mm | | | | | | | | | | | | | |
| Mean | 10 | 22 | 11 | 33 | 84 | 120 | 110 | 82 | 43 | 27 | 16 | 6 | 564 |
| Mean # raindays | 2 | 3 | 3 | 7 | 12 | 15 | 17 | 15 | 12 | 9 | 5 | 3 | 103 |

### 5.1.2 Geology and Hydrology

Within the Darling System the geological structure largely determines the physiognomy of the region. The study area is part of the northern Perth Basin, 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 the Explanatory Notes to the 1: 250, 000 Geological Series Dongara-Hill River map sheet (Lowry, 1974).

The basin has at least four major faults in an approximately north-south direction, one of which (the Beagle Fault System) lies to the east of the study area (Beard, 1979). This fault separates the Permian deposits which underlie the study area from the adjacent Triassic Lesueur Sandstone, evident in Mt. Lesueur and Mt. Peron (Beard, 1979). The majority of the surface outcrop is Cretaceous in origin.

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 (GIS Map 1). Only one drainage system is associated with the immediate study area: Cockleshell Gully originates in the Gairdner Range to the east and runs towards Sandy Point before discharging into salt lakes. 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 and Burbidge, 1989).

### 5.1.3 Landforms

The study area lies within the Coastal Belt geomorphological unit of the Swan Coastal Plain. This unit is made up of two dune systems, of which the younger Quindalup Dune System (McArthur and Bettenay, 1960) contains the majority of the study area. This system comprises Holocene shorelines and both fixed and mobile calcareous sand dunes which trend north-south (Lowry, 1974). The south-eastern part of the study area is contained in the older Spearwood Dune System (McArthur and Bettenay, 1960). This system is carbonate-rich and probably of marine origin, and contains dunes lithified to limestone (Lowry, 1974).

The boundary between the two 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 and Burbidge, 1989).

#### 5.1.3.1 Landform Stability

The foredunes of the Quindalup system comprise the youngest vegetated dunes with steep peaked relief and have little or no humus content. These dunes are highly susceptible to wind erosion where the crests are exposed by fire or damage from vehicles. The proposed route alignment remains well inland among the older Quindalup and Spearwood dunes. These dunes have a rounded gently undulating relief by comparison. The dunes are often thickly vegetated with a deep humus layer form 50 to over 100 cm thick. This layer compacts the sands making them much less prone to wind erosion (Department of Planning & Urban Development, 1994b).

### 5.1.4 Soils

As part of the Quindalup Dune System, the majority of the area features calcareous sands of minimal development (Beard, 1979). 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 extension appears to be Safety Bay Sand, which features aeolian and beach sands, mainly calcareous with minor quartoze sand (GIS Map 2). The eastern portion is Tamala limestone; primarily calcarenite, kankar and leached residual quartz sand.

The salt lake systems formed at the interface of the two dune systems may include lagoonal deposits of clay, silt, marl and shell beds, while others are mobile dunes or blowouts. An area of alluvium (clay, loam, silt and sand) bearing *Eucalyptus rudis* woodland is present to the north-east of the end of the Eastern Alignment (GIS Map 2).

## 5.2 BIOLOGICAL ENVIRONMENT

The region traversed by the proposed route is regarded as environmentally sensitive. It includes coastal dunes and sandplains, ephemeral wetland complexes, the "A" Class Drovers Cave and Lesueur National Parks and the "C" Class Beekeepers Nature Reserve (Reserve C↑24496) vested for the purposes of Apiculture and Protection of Flora. In view of this, a study of the flora and fauna of the area to be traversed by the proposed road was carried out in June 1994 (Appendix B). The following account is a synopsis of the study's findings.

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 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 (supporting a large number of genera) flora, and because many of the species occurring there are endemic or geographically restricted (Diels, 1906). In particular, the vegetation of the Mt. Lesueur - Jurien region has been noted for its richness and unique character and constitutes the extreme limit of distribution of a number of species (Speck, 1958; Conservation Through Reserves Committee, 1974; Griffin, Hopkins and Hnatiuk, 1983; Hopkins, Keighery and Marchant, 1983; Griffin and Hopkins, 1985; Froend, 1987).

A biological survey of the Cockleshell Gully Reserve (since incorporated into the Lesueur National Park) and its immediate surrounds appears to be the only fauna survey conducted in the immediate vicinity of the project area. The only rare species collected was the Long-billed Corella (Chapman *et al.*, 1977). A small number of fauna surveys have been conducted in surrounding areas. In a survey of the Southern Beekeepers Reserve, south of Jurien, Carnaby's Black Cockatoo was the only species of priority status recorded (Burbidge and Boscacci, 1989). Burbidge, Hopper and van Leeuwen (1989) state that the Lesueur National Park (less than 20 km north-east of Jurien) has a diverse fauna of nine frog, 48 reptile, 124 bird and 15 native mammal species. None of the mammal species recorded in that report are listed as rare or in need of special protection nor do any have restricted distributions.

### 5.2.1 Vegetation

The vegetation of the project area is described in Appendix B. The vegetation was classified into associations on the basis of structure and species composition.

The 3.5 km southern portion of the Western Alignment (Option 1) lies within the Jurien Vegetation System which occupies the older coastal dunes of the Spearwood Dune System (McArthur and Bettenay, 1960). Jurien System 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). Within the area to be traversed by the proposed road, the vegetation is characterised by Proteaceous associations including open *Banksia prionotes* low woodlands and *Banksia sphaerocarpa* var. *sphaerocarpa* dominated heaths. The Jurien System as a whole is diverse and supports a high number of DRF and priority flora species, however these tend to occur on the shallow sand over limestone areas characteristic of the more easterly regions of the project area. No significant flora were found within the area of Jurien System vegetation to be traversed by the proposed road.

The remaining 11 km of the Western Alignment and the remainder of Option 1 lie within the coastal Guilderton Vegetation System which occupies the recent dunes and sands of the coastal belt. The climax community of the dunes appears to have been *Callitris preissii* low forest, however due to frequent burning it occurs only in small patches and was not observed within the study area (Beard, 1979). The survey area is instead characterised by heaths often dominated by *Melaleuca acerosa* and *Acacia lasiocarpa* associations or *Melaleuca cardiophylla*. Other components include *Acacia cuneata, Anthocercis littorea, Eremophila glabra, Grevillea* sp., *Hakea prostrata, Hemiandra pungens, Leptomeria spinosa, L. preissiana, Lechenaultia linarioides, Melaleuca huegelii, Myoporum gracile, Olax phyllanthii, Olearia axillaris, Ptilotus stirlingii, Senecio lautus, Templetonia retusa* and *Tersonia brevipes* (Beard 1979).

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 Beekeepers 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 and Boscacci, 1989). Thus the limestone of the Jurien System supports more complex vegetation formations than the relatively depauperate coastal formations of the Guilderton System. These findings are reiterated in the current survey, in which 30% of the total species recorded occurred in the two Jurien System sites (6% of all sites), with 1 % recorded only at these two locations. In contrast, while 53% of all sites were within the heath association, only 44% of all species were recorded within these heaths and only 8% were recorded only within these associations. A larger proportion of Option 2 and the majority of Option 3 lies within the Jurien System. Thus the preferred route Option 1 is expected to have the least impact on the more diverse vegetation associations of this System.

The surveyed area specific to route Option 1 contained a mosaic of vegetation types. In general however, dune systems dominated by *Acacia lasiocarpa - Melaleuca acerosa* heath encompass most of the area. Eight major associations were identified by multivariate analysis (the distribution of the associations is illustrated in Appendix B):

- **Samphire Communities**
  This low open vegetation type occurs on the gypseous saline soils which surround the playa lakes. Species diversity is usually low and dominated by Chenopodiaceous shrubs below 0.5 metres and sedges. Common shrub species include *Halosarcia halocnemoides* ssp. *halocnemoides, Halosarcia indica* ssp. *bidens* and *Suaeda australis*, while the most common sedges present are *Juncus kraussii* ssp. *australiensis, Gahnia trifida, Leptocarpus aristatus* and *Leptocarpus tenax.* Also characteristic, although present at lower densities, are the species *Frankenia pauciflora, Samolus repens* and *Wilsonia humilis.*

- **Coastal fore-dune vegetation**
  Typical coastal vegetation was restricted to the white sand dunes immediately adjacent to the coast. Vegetation on the western side can be distinguished from that on the eastern side, presumably due to the localised influences of airborne salt spray and greater exposure to wind on the western side of the dunes. On the western side vegetation is predominantly below 0.5 metres. Low shrubs of *Olearia axillaris, Myoporum apiculatum , Scaevola crassifolia* and *Acanthocarpus preissii* dominate and at ground level *Conostylis candicans* ssp. *calcicola, Isolepis nodosa* and the grasses *Spinifex longifolius* and *Poa poiformis* form an open cover. On the eastern aspect of the dunes the taller shrub species are much more common, forming a moderately dense stratum above the dense 0-0.5 metre stratum. Dominant species in the taller stratum include *Acacia rostellifera, Allocasuarina lehmanniana, Hemiandra pungens* var. *glabra, Melaleuca acerosa, Myoporum apiculatum, Olearia axillaris* and *Spyridium globulosum.* The "beach spinifex" *Spinifex longifolius* is notably absent.

**GUILDERTON SYSTEM**

- ***Allocasuarina* / Myrtaceous scrub-heath**
  This association is characterised by a moderately dense to open shrubland in which *Allocasuarina lehmanniana* is common but not necessarily dominant. It appears localised to areas of shallow sand with exposed limestone. Griffin (1992) reported that *Allocasuarina lehmanniana* shrublands are typical of deflation basins in the area. The taller shrub layer also includes *Acacia rostellifera, Melaleuca huegelii, Spyridium globulosum* and *Santalum acuminatum*. A moderately dense lower shrub stratum tends to be more mixed, with species such as *Acacia lasiocarpa* var. *lasiocarpa, Acacia truncata, Acrotriche cordata, Leptomeria preissiana, L. spinosa, Melaleuca acerosa* and *Spyridium globulosum.* At ground level, an open to moderately dense cover of sedge-like plants includes species such as *Schoenus laevigatus, Gahnia lanigera* and *Leptocarpus aristatus.*

- **Tall *Acacia rostellifera / Melaleuca cardiophylla* thickets**
  This association features moderately dense to dense *Acacia rostellifera, Melaleuca cardiophylla* and *Melaleuca huegelii* present as tall shrubs/trees to more than 2 m in height. Commonly occurring shrubs within the understorey include *Acacia truncata, Cryptandra mutila, Dodonaea aptera, Leptomeria preissiana, Santalum acuminatum, Templetonia retusa* and *Thryptomene denticulata.* At ground level there is an open coverage dominated by sedge-like species such as *Loxocarya flexuosa, Loxocarya* sp. B and *Conostylis candicans* ssp. *calcicola* and *Lepidosperma angustatum.*

- **Tall dense *Allocasuarina* shrub/woodland**
  This association is localised to the fringes of playa lakes in dense gypseous soil. It is characterised by a moderately dense to dense overstorey of *Allocasuarina lehmanniana* ranging in height from two to four metres. In areas where the overstorey is open, tall shrubs of *Melaleuca cardiophylla* are also present, however in general the middle shrub stratum is largely absent. At ground level there is an open cover of *Conostylis candicans* and sedges such as *Lepidosperma angustatum, Leptocarpus aristatus* and *Gahnia trifida.*

- ***Acacia rostellifera / Acacia cyclops* shrubland over *Hemiandra pungens* dominated scrub.**
  This association was observed on the east-west transect which runs between the corner of Grigson's property and the western alignment and which is under consideration as an access route to a sandfill resource. It consists of an open to moderately dense shrub stratum in the one to two metre range of *Acacia rostellifera* and in some areas *Acacia cyclops.* Below one metre an open cover of *Melaleuca acerosa* and *Hemiandra pungens* occurs above *Conostylis candicans* and *Loxocarya flexuosa.*

- **Open *Calothamnus quadrifidus* shrubland.**
  This association is apparently localised to a small depression within an area of Tamala limestone on the western alignment south of Cockleshell Gully. It contains elements of the Jurien system, in particular the dominant *Calothamnus quadrifidus,* but more closely resembles the Guilderton associations which surround it. The open overstorey is dominated by *Calothamnus quadrifidus* shrubs approximately 2 metres tall with some *Santalum acuminatum* also present. Underneath, a dense to sparse shrub stratum contains *Calothamnus quadrifidus, Cryptandra mutila* and *Melaleuca acerosa,* with lower proportions of *Dodonaea aptera, Grevillea thelemanniana, Leucopogon oxycedrus, Beyeria cinerea, Stenanthemum ?pomaderroides* and *Acanthocarpus preissii.* The small shrub *Diplolaena leemaniana* ms. was found only within this association and the *Eucalyptus obtusiflora* mallee woodland.

### 5.2.2 Flora

In total, 172 vascular plant species were collected from the project area. Plants identified in this survey included members of 51 families, of which 23 were represented by a single species, and 114 genera. The families most numerously represented were Proteaceae (20 species), Myrtaceae (19 species), Cyperaceae (11 species), Asteraceae (9 species), Papilionaceae (9 species), Chenopodiaceae (8 species) and Restionaceae (8 species). The genera most numerously represented in the area were *Melaleuca* (8 species), *Acacia* (5 species) and *Eucalyptus, Hakea* and *Schoenus* (4 species each). Four naturalised annual species, **Erodium botrys, *Verbascum virgatum, *Anagallis arvensis* and **Hedypnois rhagadioloides,* were observed at low densities within the project area.

#### 5.2.2.1 Flora of significance

No Declared Rare Flora (DRF) species listed in the Department of Conservation and Land Management Rare Flora Schedule (1993) were located within the project area however two Priority species, *Olax scalariformis* (Priority 3) and *Grevillea olivacea* (Priority 4), and a recently described species, *Diplolaena leemaniana* ms., were recorded. The area within a 50 km radius of Jurien contains 114 species of flora listed as priority taxa including one presumed extinct species, *Platysace dissecta,* 15 species of Declared Rare Flora (including seven species of Eucalyptus) and 98 Priority species (Atkins, 1993). 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 area to be traversed by the preferred Western Alignment (Option 1).

***Olax scalariformis* (Priority 3)**

This species is a spindly shrub to 70 cm with erect, flattened, zig-zag branchlets with distichous linear leaves approx. 2 mm x 0.5 cm. Flowers are white, with flowering occurring between October and November. It has previously been collected from Eneabba, Jurien Bay, Cervantes, Arrowsmith River, the Gairdner Range and Moore River National Park. This species was recorded at only one site, a mixed shrubland with an open overstorey of *Acacia rostellifera* and *Allocasuarina lehmanniana,* at densities of less than 2% of the overall vegetative cover.

***Grevillea olivacea* (Priority 4)**

This species is an erect shrub to 4 m tall, with 3-8 cm long narrow-elliptic to oblanceolate olive-coloured leaves, the lower surface of which is appressed white pubescent. Flowers are red, in short terminal or axillary racemes which occur between July and September. Previously recorded from Drovers Cave, Leeman, Green Head, Jurien Bay and Dongara. Within the project area this species was recorded only at one site, an *Eucalyptus obtusiflora* woodland over dense heath, at densities of less than 2% of the overall vegetative cover.

***Diplolaena leemaniana* ms.**

*Diplolaena leemaniana* ms. is a species currently in the process of description. It is a spreading shrub to 70 cm, with broad ovate to circular leaves 20 mm x 35 mm, softly pubescent above with soft to velvety stellate hairs below. Flowers are approximately 2 cm diameter, with a grey to rusty indumentum and pink stamens and anthers. It is known from Dongara, Greenough and between Jurien and Green Head. While not a Priority flora species, *Diplolaena leemaniana* ms. does have a limited known distribution within this range. It appears to grow principally in sand over limestone. This species was recorded at densities below 2% of total cover at two sites, an *Eucalyptus obtusiflora* woodland over dense heath and a dense mixed scrub.

**Other species of interest**

While not having priority listing, *Eucalyptus obtusiflora* is at the limit of its geographic range in the Jurien area and is therefore of conservation significance (Griffin, 1992).

Most of the vegetation within the project area is in good condition however the salt lakes and foredune areas have suffered from uncontrolled vehicle access. Discussion of landscape treatment of road verge vegetation is included in Section 8.1.1.

### 5.2.3 Dieback Occurrence

The nearest areas infected with dieback disease due to *Phytophthora* species occur along Jurien East Rd 10 - 12 km east of Jurien and in a gravel pit on Cockleshell Gully Rd. *Phytophthora citricola* and *Phytophthora megasperma* have been identified from these locations. No dieback infections have been identified along the route to be traversed by the proposed Coastal Road - Jurien to Green Head, however construction of the road will need to incorporate the development and implementation of a comprehensive dieback hygiene management plan in order to minimise the spread of any potential infections (refer Section 8.0).

### 5.2.4 Fauna

This section describes the fauna associated with the various habitats which are generally defined by the vegetation of the proposed route (Section 5.2.1). Impacts of the proposal on fauna are judged to be relatively limited.

The project area lies within the boundary of the major zoogeographic regions of the mesic South West. The field survey recorded 37 species of bird, four native and four introduced mammals, six reptiles and two amphibians. On the basis of literature searches and known habitat preferences the project area may support approximately 145 bird, 17 native and eight introduced mammal, 49 reptile and nine amphibian species (Appendix A).

**Mammals**

Eight species of mammal from seven families were recorded during the field survey; of these four species were native and four introduced. On the basis of known habitat preferences and species distributions the project area may support 17 native and eight introduced species of mammals. This is in accordance with the recorded mammalian species richness of the Lesueur National Park, from which 15 indigenous species have been reported (Burbidge and Fuller, 1989). These authors suggest that the bat fauna has been undersampled and that a further three species could be expected to occur taking the total to 18 species for the reserve. All the mammals recorded during this survey within the project area have also been recorded from the Lesueur National Park.

The Bush Rat *Rattus fuscipes* appears to be relatively abundant within the project area with a total of 42 trap records from five of the six trapping sites. Signs of Echidna *Tachyglossus aculeatus* were recorded at one site within the project area. Western Grey Kangaroos *Macropus fuliginosus* were present in all habitat types within the project area except for the samphire communities fringing the salt lakes.

The greater proportion (60%) of the native mammals which occur or are expected to occur in the project area are Bassean in biogeographic affinities with the major proportion of their distributions in south west of Western Australia. The only predominately mesic south western species which may occur in the area is the Fat-tailed Dunnart *Sminthopsis crassicaudata.* The project area lies on the northern limits of this species distribution. Of the Eyrean species the Little Cave Eptesicus and the Wongai Ningaui *Ningaui ridei* are near the southern limits of their range. Another six species, such as the Echidna and Dingo, have Australia wide distributions.

Eight species of introduced mammal are potentially present in the project area. All are widespread in distribution. Two feral cats *Felis catus* were sighted during the survey however it is highly probable that the area would support a much larger population. Only three House mice *Mus domesticus* were trapped over the duration of the survey. Evidence of rabbit *Oryctolagus cuniculus* activity was reported from each of the survey grids and transect lines.

**Birds**

Bird surveys of the project area recorded 37 species including 14 non-passerines and 23 passerines. Based on known habitat preferences and species distributions the area may support up to 145 species including 82 non-passerines and 63 passerines. This total is higher than the 124 species recorded from the Lesueur National Park as it includes a greater number of waders. 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.

The low number of field records reflects the short duration of the survey and seasonal influences with winter being an unfavourable period for biological surveys. The species list for Lesueur National Park represents data collected over a number of years.

Many species are at the northern limit of the range within the project area, including the Western Rosella, Restless Flycatcher, Southern Emu Wren, Little Wattlebird, Spotted Pardalote and Dusky Woodswallow. Others, such as the Variegated Fairy Wren and Pied Honeyeater are at their southern limits (Burbidge *et al.,* 1989).

Of the species recorded within the project area, the passerines (particularly the honeyeaters) predominate in abundance (62%) with large numbers of New Holland Honeyeaters being present. Among the non-passerines the grainivorous parrots make up 71%, with the Galah and Carnaby's Black Cockatoo being the most common.

**Reptiles and Amphibians**

Pit trapping and opportunistic collecting yielded six reptile and two frog species from the project area. With examination of known species distributions and habitat preferences it is expected that up to 49 reptile and nine amphibians may occur in the area. However as with the bird observations, the limited survey duration and seasonal timing resulted in a low number of records.

The largely Bassean component of the mammal fauna is repeated in the herpetofauna. Twenty six species (62%) have Bassean biogeographic affinities only, while a further 11 species (20%) such as *Morelia stimsoni* and *Varanus gouldii* have a predominately arid distribution with range extension into the South West. Two species *Gehyra variegata* and *Lialis burtonis* have Australia-wide distributions occurring mainly in arid and semi-arid habitats.

Taxa such as *Aclys concinna, Lerista christinae* and *Delma greyii* have relatively restricted distributions. Species such as *Ctenophorus maculatus, Lerista planiventralis* and *Vermicella littoralis* occur at or near the southern boundary of their distribution.

### 5.2.4.1 Faunal Habitats

Faunal habitats are closely aligned with vegetation structure. Within the project area, six habitats were identified as follows:

- Jurien System
  - i) Proteaceous associations
- Guilderton System
  - ii) Mixed heaths
  - iii) Coastal foredunes
  - iv) Salt lake habitats
  - v) Dense thickets and woodlands
  - vi) *Eucalyptus* woodland over farmland

The Guilderton vegetation system comprised the majority of habitat within the project area and consequently was the most heavily sampled. However, the greatest species richness was recorded from within the Proteaceous heath characteristic of the Jurien vegetation system. This habitat provides the most structural diversity, with a high strata in the *Banksia* woodlands and dense shrublands of *Dryandra* sp. and *Banksia sphaerocarpa*. Such high habitat heterogeneity provides a rich array of ecological niches for exploitation by invertebrate and vertebrate fauna. The rich floristic nature of the association, with a preponderance of flowering shrubs at moderate density, attracts nectivourous and insectivorous bird species such as the honeyeaters, thornbills and robins. Additionally, the litter layer is rich in ground dwelling insects which in turn support a diverse reptile fauna.

The widely occurring coastal heathlands of the Guilderton System are expected to support fewer species of fauna than the Jurien System habitat types, as the vegetation is structurally less complex. The Western Alignment of Option 1 impacts the least amount of area within the Jurien System vegetation of the three options considered. The coastal foredune and samphire communities are expected to support the least number of fauna species due to the homogeneity of habitats and less favourable conditions within these areas.

### 5.2.4.2 Rare Fauna

A total of six priority species of fauna are potentially present within the Jurien to Green Head project area (Department of Conservation and Land Management, 1994). Of these Carnaby's Black Cockatoo was the only scheduled fauna to be recorded during the Consultative Environmental Review field survey.

Four priority species of birds potentially occur in the Jurien - Green Head project:

- The Long-billed Corella *Cacatua pastinator pastinator* is listed as Schedule 1, "fauna which is rare or likely to become extinct". 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. Habitats include open forest, woodland and grassland.
- The Peregrine Falcon *Falco peregrinus* is listed as Schedule 4, "other specially protected fauna". It is uncommon but widespread throughout Australia and ranges widely over numerous habitats, including inland watercourses, woodland, pasture, swamps and eucalypt forest.
- Baudin's Black Cockatoo *Calyptorhynchus baudinii* is also listed as Schedule 4. It has 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 widely in heaths and nests in woodlands.
- Carnaby's Black Cockatoo *Calyptorhynchus funereus latirostris* is also listed as Schedule 4. These birds undertake a definite migration between the drier inland woodlands which are used for nesting and the coastal heaths. A single flock of this species was recorded in the current survey.

Two reptile species of Schedule 4 status, the Woma and the Carpet Python, may occur in the area (Department of Conservation and Land Management, 1990) however there was no evidence of either species during the field survey:

- A specimen of the python species Woma *Aspidites ramsayii*, was collected 8 km north of Badgingarra in 1966. This species occupies a wide range of habitats from humid coastal forests to the arid interior. The Woma is rare and locally declining and is unlikely to be found in the project area.

- The Carpet Python *Morelia spilota imbricata* is widespread but uncommon in southwest WA and occurs in numerous conditions, including a variety of semi-arid coastal and inland habitats.
- The skink *Lerista christinae,* while not listed as a priority species, is poorly collected. This species occurs on Rottnest Island and in the Eneabba - Lesueur - Badgingarra region in heath.

The proposed Coastal Road - Jurien to Green Head is not considered to present any significant impact to any of these species due to limited impact on preferred habitats.

### 5.2.5 Wetlands

Lagoonal depressions in the area may be filled with a variety of materials (e.g. gypsum) or may remain as swamps and salt lakes. These lakes feature unique vegetation associations in the form of the samphire communities on the surrounding saline flats. In terms of importance to fauna, salt lakes form summer refuges for several waterbirds (e.g. Mountain Ducks) and are used by resident and migratory waders as feeding places. These lakes are also important breeding places for species that utilise dense reeds or rushes (e.g. Little Grassbirds) (Burbidge and Fuller, 1989).

Griffin (1992) states that the lakes between Jurien and Coolimba (north of Green Head) are of high conservation significance but little has been documented about them. These habitats are particularly susceptible to and slow to recover from disturbance and thus every attempt must be made to avoid or minimise disturbance to them.

The preferred alignment for the proposed road runs adjacent to the Cockleshell Gully salt lake complex for some 2 km. At no point does it directly impact on the wetlands. Option 2 directly traverses salt lakes of the complex for 1 km and additional access roads to the North Head - Sandy Point area would also run through the wetlands unless rerouted around. While Option 3 does not directly impact wetlands, the access roads through to the coast would unless redirected as for Option 2.

### 5.2.6 Summary

From this assessment it is evident that the biological environment of the area to be traversed by the proposed Coastal Road - Jurien to Green Head is similar to the general region. In addition, the overall impacts of Option 1 on the biological environment are expected to be the least of the three options considered.

## 5.3 HUMAN ENVIRONMENT

### 5.3.1 Aboriginal Habitation

The Jurien - Green Head 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.

There have been no previous systematic surveys for Aboriginal sites within the Jurien - Green Head area, and only a few existing studies document information of relevance to Aboriginal sites within the area (e.g. O'Conner, Quartermaine and Bodney, 1989; Quartermaine, 1989; O'Conner, 1992; Quartermaine, 1992). However, several sites of Aboriginal significance have been recorded within the general project area, and can provide some information about the patterns of traditional land and resource use by the Noongars (both pre- and post-European settlement). Already recorded sites within five (5) km of the project area are shown in Table 3.

**Table 3: Archaeological sites within 5 kilometres of the proposed Jurien - Green Head Road.**

**Previously recorded archaeological sites near survey area (within 5 kilometres of the eastern and western alignments)**

1: 250, 000 Map ref. SH50-9

| WA Museum Site No. | Grid reference | Site type | Site name |
|---|---|---|---|
| S2657 O | 303.672 | Midden/artefacts | Green Head Midden |
| S1003 O | 303.672 | Midden/artefacts | Green Head |
| S1004 O | 307.672 | Midden/artefacts | Sandland Island |
| S0941 O | 311.650 | Midden/artefacts | Middle Head Midden |
| S2343 O | 319.657 | Yam ground | Padbury Yam Ground |

O = Open access to site files

Investigations undertaken in preparing the Consultative Environmental Review included detailed archaeological and ethnographic surveys of the project area. The results from these surveys are summarised hereunder and the full reports from the surveys are included as Appendices C and D of this report.

#### 5.3.1.1 Archaeology

Regional dated evidence for prehistoric Aboriginal occupation comes from a coastal shell and stone artefact scatter at Middle Head, near Jurien, dated to 6,000 years ago (Morse, 1982) and from human occupation of Hastings Cave, dated from 6,000 to 8,000 years ago (Baynes, 1979).

In the vicinity of the project area five Aboriginal sites have been recorded and registered with the W.A. Museum as a result of previous surveys and independent research (Table 3). Four of these are shell middens/artefact scatters on the coastline and the other is a yam ground, S2343, which is five kilometres to the east of all alignments.

For the purpose of this investigation, an archaeological site is defined as "any place containing traces of past human activity". This is commonly manifested as surface artefact scatters, quarries, art sites, stone arrangements, rockshelters with evidence of occupation, grinding patches, shell middens, burials and marked trees.

No archaeological sites were located as a result of the archaeological survey of the proposed alignments undertaken. The results of this investigation, coupled with the ethnographic information, indicate that this particular area is unlikely to contain any major archaeological sites.

Recommendations made as a result of the archaeological survey are:

1. On the basis of the findings of this investigation, no archaeological sites are expected to occur in the area of the proposed Coastal Road - Jurien to Green Head alignments and the development may proceed.

2. It is pointed out that human interference to Aboriginal sites is an offence, unless authorised under the Aboriginal Heritage Act, 1972 - 1980 (Section 17). As no Aboriginal sites will be affected by any of the route options, this issue has no implications for the project.

#### 5.3.1.2 Ethnographic Sites

The sandplain between the Moore and Irwin Rivers is renowned for its aridity, and was sparsely populated prior to European contact. Three Aboriginal linguistic groups, the Ngaanda, Amangu and Jued, inhabited distinct ecological zones within the area from north of Geraldton to south of Moore River.

Examination of the existing information database prior revealed that no Aboriginal ethnographic sites had been previously recorded in the designated survey area.

The aims of the ethnographic consultative field trip were as follows:

i) to identify any Aboriginal sites, as defined by the Aboriginal Heritage Act, 1972 - 1980 within the designated survey area; and

ii) within this area, to ascertain whether or not any such sites will be disturbed by the proposed roadworks.

Two distinct groups of Aboriginal people have retained contact with the general area in which the survey was carried out: namely elderly people who grew up at Moore River Mission and descendants of Murrambah and Josie Isaacs, who had a permanent camp at Mullering Brook. The late Mr Ned Mippy of Moora was the senior elder of the first group until his death three years ago: he made no mention of any Aboriginal sites between Drovers Cave National Park and the coast during a number of occasions on which he worked with the consultant (Rory O'Connor). The present senior elders are Mr and Mrs R. Dalgety, Mr and Mrs B. Dalgety and Mr A. Franks: the opinion of all persons was that no sites of significance existed within the designated survey area.

The descendants of Murrumbah and Josie Isaacs set up the Billinue Aboriginal Corporation Inc., of which Mr J. Ryder and Mrs D. Ryder are the elders. Mr J. Ryder is unaware of any sites of Aboriginal significance in the path of the proposed road route.

As a result of this survey, it has been established that there are no known sites of significance to Aboriginal people within the designated survey area. Aboriginal significant sites should therefore not be deemed an impediment to the granting of any necessary statutory permission for the proposed development.

### 5.3.2 European Settlement

Initial European settlement within the Central Coast Region for agricultural purposes (essentially livestock grazing) occurred in the early 1850's. The region's primary production base has progressively developed, and now includes:

- agriculture: grazing and cropping, wildflower and honey production, and horticulture;
- mining: extractive industry, oil and gas production;
- fishing: rock lobster and finfish.

The region is also attracting increasing interest as a tourist destination and for retirees.

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, including Green Head, were upgraded to legal townsite status. However, squatter settlements remain a significant feature of the overall development pattern within the Central Coast Region. As of January 1994, 154 squatter shacks remain within the North Head - Sandy Point area approximately mid-way between Jurien and Green Head. The Shires of Dandaragan and Coorow are committed to the removal of these shacks in accordance with the State Government Squatter Policy.

Development within the immediate area affected by the proposed Coastal Road - Jurien to Green Head is dominated by the two townships. Jurien, within the Shire of Dandaragan, developed as a legal townsite in the 1950's and 60's with growth of the rock lobster industry but it is also growing in popularity as a tourism/recreational and retirement destination. The Central Coast Regional Strategy (Department of Planning and Urban Development, 1994a) establishes Jurien as the single major service centre for the region and provides for a number of initiatives to promote its development as such.

Green Head also developed in the late 1950's and early 1960's as a centre servicing the rock lobster industry and like Jurien has attracted increasing interest as a recreation and retirement centre. The Central Coast Regional Strategy (Department of Planning and Urban Development, 1994a) identifies Green Head as a minor local centre.

Several sites of heritage significance occur within the project area. The Mount Lesueur Reserve and Drovers Cave National Park have been entered on the Register of the Natural Estate, although seemingly because of their biological conservation values rather than their cultural heritage value. However, the actual Drovers Cave in conjunction with the adjoining remnant of the Old North Road Stock Route are of historic significance in terms of European settlement and agricultural development within the overall region. The significance of the Stock Route is recognised in the Central Coast Regional Strategy. It is designated as a regional heritage trail, to be developed for hiking and associated activities that would be compatible with protecting its historic/heritage values and managed in conjunction with the adjoining Crown land including Drovers Cave National Park (Department of Planning and Urban Development, 1994a).

### 5.3.3 Existing Landuse

Beyond the gazetted townsites of Jurien and Green Head, Crown land of varying status and purpose predominates, although the majority is allocated for conservation purposes. The general landuse pattern within the project area is shown in Figure 3 and is reviewed hereunder.

#### 5.3.3.1 Human Development

Privately owned rural lands (comprising part of the broader agricultural estate) extend into the north-eastern and south-eastern sectors of the project area. Some privately owned rural land also occurs along Cockleshell Gully within the central portion of the project area. Horticulture, floriculture (based essentially on commercial picking from Crown land) and apiculture (based essentially in the Beekeepers Reserves) are also significant activities within the general region.

The Central Coast Regional Strategy (Department of Planning and Urban Development, 1994a) does not propose material change to the general pattern of landuse.

A number of tenements under the Mining Act, 1978 - 1987 and extractive industry sites occur within the project area, the minerals and raw materials of interest include gypsum, diatomite, limestone and limesand. Only a few of these tenements are actively worked at present. The entire project area is encompassed by two Petroleum Permits and contains several abandoned test wells.

A new road link between Jurien and Green Head based on Option 1 (the Western Alignment) will have a generally beneficial effect on human related landuses within the project area. The benefit arises by facilitating access to parts of the project area where such access is presently constrained. The proposed route will also be beneficial in the sense that it will enable better management of access within the environmentally sensitive coastal areas and provide a basis for more effective planning and management of the coastal zone.

#### 5.3.3.2 Conservation Estate

There are three main reserved areas in the Jurien to Green Head area, the "A" Class reserves of Lesueur National Park and Drovers Cave National Parks and the central portion of the "C" Class reserve known as Beekeepers Reserve. All are vested in the National Parks and Nature Conservation Authority (NPNCA).

Of these reserves only the central portion of Beekeepers Reserve will be directly impacted by the construction of the Coastal Road - Jurien to Green Head along the preferred Western Alignment (Option 1). Within the study area it is apparent that the areas of Jurien System vegetation are more diverse and support a larger number of rare and priority flora species than the coastal Guilderton System areas. Where possible, it is

thus preferable to restrict disturbance to the latter areas. Option 1 traverses the central portion of Beekeepers Reserve which features predominantly Guilderton System vegetation: while some disturbance is inevitable it is preferable that it will be confined within this System.

The Lesueur National Park will increase in size once its western boundary is established by Option 1 of the Coastal Road - Jurien to Green Head and will then contain large areas of both the Jurien and Guilderton Vegetation Systems

Drovers Cave National Park (Reserve A↑31302) is located in the diverse limestone associations of the Jurien Vegetation System and will not be affected by construction of Option 1 for the proposed Coastal Road - Jurien to Green Head.

### 5.3.4 Population Density

Only limited population data are available for the project area. The Central Coast Planning Strategy (Department of Planning and Urban Development, 1994a) provides the following information:

- the populations of Jurien and Green Head recorded at the August 1991 census were 813 and 213 respectively;
- the projected 1996 population for these centres was 1,000 (Jurien) and 250 (Green Head);
- the census date creates anomalies because the township populations may double during the fishing season and at peak tourist times; and
- the population data do not include the informal squatter settlements.

Based on information provided by the Shires of Dandaragan and Coorow (as a basis for the community consultation programme), population (both permanent and seasonal) within the project area would approximate 1,100. Jurien (800) and to a lesser degree Green Head (250) are obviously the dominant centres. However, these figures again do not include the squatter settlements.

As previously indicated, as at January 1994 154 squatters' shacks occurred within the North Head - Sandy Point area. The squatter settlements do not constitute a permanent population and will be removed in accordance with the State Government Squatter Policy.

Beyond the designated townsites, aggregate population and population density is low, consistent with the existing broadacre landuse. Being Crown land, there would be no permanent population within the area traversed by the proposed new route.

### 5.3.5 Local Access Patterns

The only gazetted and formed roadways within the project area are those servicing the Jurien and Green Head townships and adjoining areas. Access to rural properties within the project area is generally based on the existing route linking Jurien and Green Head. Gazetted road reserves provide legal (but not constructed) access from Jurien East Road to ↑19759 (Camping) at Sandy Point.

The only other formal accessway within the project area is the haul road servicing the active gypsum mining operation within Mining Tenement M 70/750. The haul road is covered by a Miscellaneous Licence under the Mining Act (L 70/23) and is subject to conditions imposed through the license. A network of informal access tracks has been established within the western portion of the project area, essentially to provide access to the coastal squatter settlements and activity points between Jurien and Green Head.

### 5.3.6 Recreation and Tourism

Development of recreational and tourism activities premised on the region's diverse marine and terrestrial attractions is an important objective in terms of economic diversification within the Central Coast Region (Department of Planning and Urban Development, 1994a).
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 lands within the project area are of considerable importance.

Jurien and to a lesser degree Green Head offer a range of facilities servicing the recreational and tourism industries. In this regard, the squatter settlements between Jurien and Green Head might be perceived by some as contributing to recreational opportunity within the project area. However in accordance with the State Government Squatter Policy, the Shires of Dandaragan and Coorow are committed to removal of these settlements. Due to their impending removal, the settlements cannot be regarded as significant in terms of recreational activity within the region.

### 5.3.7 Landscape Character

The project area lies to the west of the Gingin Scarp, and occurs mostly within the Coastal Foreplain Physiographic unit as outlined in Department of Planning and Urban Development (1994b). The western extremity of the Coastal Foreplain is dominated by the ocean, beach and immediately adjacent formations. More generally however, this unit is characterised by the Safety Bay Sand and Tamala Limestone formations, but includes substantial lagoonal deposits (encompassing the Cockleshell Gully salt lakes) between North Head and Green Head. Landform of the Coastal Foreplain is dominated by dunes of the Quindalup System which mainly parallel the coast. In places these dunes reach a maximum elevation of about 200 m above sea level. The combination of landform and the generally low heathland vegetation of the Guilderton System create a relatively uniform and open landscape, within which the dune ridges are exposed while the interdunal swales are well screened.

The eastern portion of the project area extends into the Coastal Backplain physiographic unit (as described in Department of Planning and Urban Development, 1994b) comprising dunes of the Bassendean System. These dunes again roughly parallel the coast and form low hills with a maximum elevation of about 100 m above sea level. The combination of landform and the characteristically low woodland/tall scrub-heath vegetation of the Jurien System again create a relatively open landscape. Due to the more moderate topography, natural screening within this unit is less than within the foreplain unit.

The north-eastern extremity of the project area extends into the Hill and Valley Breakaway physiographic zone (as described in Department of Planning and Urban Development, 1994b) comprising undulating landform with variable (sandy and lateritic) soils. Vegetation is characterised by low shrubland of the Jurien System. Landscape is more internalised within this part of the project area (compared with the coastal units), essentially because of the more localised topographic variation.

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.

Factors affecting the perceived quality of a particular landscape include:

- unity - the degree to which the visual elements comprising the landscape fit together;
- identity - the extent to which a particular landscape has a distinct character;
- diversity - the degree of contrast within the landscape;
- visibility - the extent to which the landscape can be seen; and
- naturalness - the extent to which the landscape has been modified by human development (Vant, 1987).

The landscape of the project area exhibits these characteristics and undoubtedly contributes to overall environmental quality. Although the aesthetic quality of a particular landscape is an essentially subjective perception, the character of the landscape within the project area undoubtedly contributes to overall environmental quality.

# 6.0 PUBLIC CONSULTATION PROGRAMME

The proponents recognised the importance of effective community consultation during the project, both in terms of enhancing public understanding and acceptance of the proposed road and in facilitating participation in the Environmental Protection Authority's formal environmental impact assessment of the project. A concerted community consultation process as outlined hereunder was therefore implemented as part of the overall project programme.

## 6.1 Aims and Objectives

The community consultation programme had the following objectives:

- to inform the community about the proposal;
- to provide information to the community derived from the specialist investigations undertaken;
- to seek comment from the community about the respective route options considered and the selection of Option 1 (the Western Alignment) as the preferred alternative;
- to seek input from the community on any issues, interest or concerns considered to warrant particular attention in progressing the project;
- to identify any sources of local knowledge that would represent a valuable input to the project; and
- to provide preliminary information to the community about the Environmental Protection Authority's assessment process for the project.

The consultation programme was directed towards both the local communities within the project area (i.e. within the townships of Jurien and Green Head and their environs) and the broader regional and State communities. This was considered necessary because of the significant seasonal and otherwise non-permanent component of the project area population and because of the widespread interest in the project area in general due to its high conservation values.

## 6.2 Method

The consultation programme entailed a Proactive Phase were community input was sought via the following:

- initial liaison with the Shires of Dandaragan and Coorow to identify key community organisations and members with whom there should be direct contact;
- placement of advertisements in The West Australian, regional newspapers and local newsletters, outlining the project and advising of forthcoming public information displays;
- direct mailout of an information brochure (including a reply-paid response form) based on address lists derived from the Shire Councils' rate records (a total of 933 brochures were mailed and a copy of the brochure is included in Appendix E); and
- public information displays at Jurien and Green Head community centres on Saturday 2nd July 1994, and the Jurien Library from Monday 4th July to Friday 8th July 1994.

These initiatives occurred following completion of the PAS but prior to the commencement of preparation of the Consultative Environmental Review, thereby ensuring that input from the community could be assessed during the formative stages of the project.

The public displays at Jurien and Green Head included information on the Central Coast Regional Strategy, both to help place the proposed Coastal Road - Jurien to Green Head in a regional context and more generally to inform the community about the regional strategy. Representatives from the proponent Shires, Main Roads Western Australia and the consultants engaged to prepare the Consultative Environmental Review attended the public displays to respond to enquiries and expand on display material as required. People attending the displays were encouraged to provide written comments about the proposal, reply-paid forms again being supplied to facilitate responses.

The community consultation programme culminated in a Reactive Phase which responded to public input from the earlier Proactive Phase. This phase entailed the circulation of a second brochure (with the same distribution as the earlier one) providing follow-up information about the project, including responses to issues raised in submissions received (a copy of this brochure is also included in Appendix E). Additionally individual letters were forwarded to all respondents.

### 6.3 Results

The public information display at Green Head was held between 9.00 am and noon on Saturday 2nd July 1994 and was attended by about 70 residents. The display at Jurien ran from 3.00 pm to 9.00 pm on the same day and was attended by about 45 residents. The number of people who viewed the display material while at the Jurien Library is not known.

A total of over 150 written submissions were received as a result of the brochure mailout and the information displays. Issues raised in the submissions received are summarised in Table 4. As can be seen, strong support for Option 1 (the Western Alignment) was expressed (77 respondents), although there was also some support for the other alternatives (Option 2 - 16 respondents and Option 3 - 3 respondents). There was no expression of outright opposition to the project (i.e. support for doing nothing) and in fact a number of respondents urged early construction of the improved link between Jurien and Green Head.

The issue of greatest interest identified through the consultation process was the proposed southern access road into Green Head from the proposed Coastal Road Jurien to Green Head. Concerns expressed related to potential impacts on the adjoining residential areas from traffic using the proposed southern access road. Twenty four respondents were of the opinion that the southern access road was unnecessary and that the only link into Green Head from the proposed new road should be in the vicinity of the present junction of the Coorow - Green Head and Green Head - Leeman Roads. Retention of the southern access road into Green Head is however considered necessary. An alternative alignment of this link has been identified and put to the community by the Shire of Coorow. This matter is discussed in Section 4.4.2.

Other issues raised through the consultation process were:

- location of the proposed road closer to the coast to provide ocean views;
- intrusion of the preferred route option (Option 1 - the Western Alignment) upon a conservation reserve (the central portion of Beekeepers Reserve); and
- concern regarding the sourcing of construction materials.

Concerns regarding intrusion upon the Beekeepers Reserve and the sourcing of construction materials are specifically addressed in Sections 3.2.3 and 5.3.3.2 and in Section 4.6 respectively.

The suggested more westerly alignment for the proposed alignment has been considered but has not been adopted for the following reasons:

- due to the substantial foredunes within the immediate coastal environs, ocean views would not be available unless the road was aligned along the dune crest and this would be inappropriate in terms of maintaining soil and landform stability;
- alignment of the road close to the coast would increase development and recreational pressures on the inherently sensitive coastal environs and impose greater difficulties in managing access through the dune formations; and
- a near-coastal alignment would diminish landscape quality and general amenity and potentially future planning and management options.

Although the alternative alignment has not been adopted, the desirability of accommodating ocean views has been accepted. A stable elevated site well suited for development as a scenic lookout has been identified adjacent to the Western Alignment (refer to Figure 3). Commanding views in all directions are available from this site and it will be developed as part of the proposed road.

Table 4: Summary of responses received as a result of the community consultation programme.

| | Public Submission | Goverment Authority | Community Group | Totals |
|---|---|---|---|---|
| Preferred Route Option | | | | |
| Option 1 | 70 | 2 | 5 | 77 |
| Option 2 | 15 | 0 | 1 | 16 |
| Option 3 | 3 | 0 | 0 | 3 |
| Overall support | 12 | 1 | 1 | 14 |
| No preference indicated | 15 | 1 | 0 | 16 |
| Overall opposition | 0 | 0 | 0 | 0 |
| | | | | |
| Social Issues | | | | |
| Green Head access road | 26 | 0 | 0 | 26 |
| Jurien access alignment | 2 | 0 | 0 | 2 |
| Heavy vehicle usage | 5 | 0 | 0 | 5 |
| Access to Nature Reserves | 3 | 0 | 0 | 3 |
| Coastal management | 3 | 1 | 0 | 4 |
| Squatter management | 4 | 0 | 0 | 4 |
| Coastal access | 15 | 0 | 2 | 17 |
| Ocean views | 10 | 0 | 0 | 10 |
| Tourism | 1 | 0 | 0 | 1 |
| Reduced milage benefits | 6 | 0 | 0 | 6 |
| Mining operations | 0 | 1 | 0 | 1 |
| Road materials sources | 2 | 0 | 0 | 2 |
| | | | | |
| Environmental Impacts | | | | |
| Spread of noxious weeds | 2 | 0 | 0 | 2 |
| Impact to Aboriginal sites | 0 | 1 | 0 | 1 |
| Impact to Nature Reserves | 12 | 0 | 0 | 12 |
| Natural landscape impact | 5 | 0 | 0 | 5 |
| | | | | |

# 7.0 ENVIRONMENTAL IMPACT ASSESSMENT

## 7.1 Introduction and Objectives

In assessing the implications of the development of the preferred route option, Option 1 the Western Alignment, impacts on the biophysical and human environments by a number of factors were considered:

Biophysical Factors
- Clearing
- Habitat disturbance
- Declared Rare Flora (DRF)
- Dieback
- Erosion potential
- People pressures on biophysical environment
- Potential for pollution of water resources

Human Factors
- Disturbance of Aboriginal sites
- Disturbance of Heritage sites
- Visual impact
- Severance of private land, Crown land, access and other services/infrastructure
- Diminution of amenity
- Intrusion upon existing dwellings

Some potential impacts on the biophysical and human environments will occur only during the pre-construction phase or during actual construction of the project. Other potential impacts can be regarded as "operational" or post-construction impacts in that they may arise throughout the life of the proposed route following construction.

This section of the CER details the potential environmental impacts which may arise during the three phases of the life span of the proposed project. Thus the following discussion of impacts is divided into pre-construction, during construction and post-construction phases. The impacts themselves are considered in terms of the biophysical and human environments with the area of the preferred alignment, the Western Alignment.

### 7.1.1 Biophysical Environment

The preferred alignment has significant implications for the conservation estate in that about half of the route traverses the Beekeepers Nature Reserve. Particularly important issues in this context relate to:

- clearing of vegetation and consequent disturbance of flora and fauna habitat;
- disturbance of Declared Rare Flora species; and
- dieback occurrence and spread.

In liaising with the Department of Environmental Protection as part of the process of considering the alternative route options, maintaining the hydrological integrity of the Cockleshell Gully salt lake complex was identified as an important issue. Although the preferred route does not directly traverse the salt lake complex, it does closely skirt the eastern margins of the most south-western of the salt lakes (which is isolated from the remainder of the system) and the Sandy Point access road effectively skirts the remainder of this salt lake. The implications of the proposed route and the Sandy Point access roads for surface water hydrology of the salt lake must therefore be considered in evaluating potential biophysical impacts associated with the proposed route.

The inherent fragility of the near coastal formations is emphasised by the substantial mobile dune system to the south of Green Head. Although the mobilisation and ultimate restabilisation of coastal dunes is a natural geomorphological process, human related activity can decrease dune stability through disturbance of their vegetation cover. Vegetation plays a key role in maintaining dune stability. Human induced dune mobilisation is in itself an adverse environmental impact, but can also be compounded through habitat loss resulting from the burial of adjoining vegetation.

Construction of the proposed route will inevitably entail the clearing of some dune vegetation, thereby enhancing erosion hazard. More generally, increased human activity can also contribute to vegetation disturbance and dune destabilisation (e.g. from off-road vehicle activity) and thus erosion hazard. This must therefore be considered in evaluating potential impacts associated with the project.

The project area is diverse in both flora and fauna and encompasses vegetation associations which are widespread throughout the general region. Of the habitat types surveyed within the project area, the salt lakes are believed to have significant conservation value, having limited representation elsewhere.

The route advocated in this Report is proposed to form the western boundary of the Lesueur National Park. It is anticipated that much of the traffic currently using the circuitous route which passes directly through the National Park will use the Coastal Road once constructed. Thus traffic flow through the Park will decrease, reducing the number of road kills etc.

The proposed road will pass directly through the central portion of the Beekeepers Reserve. This central portion lies within the Guilderton Vegetation System and thus is characterised by relatively depauperate coastal heaths compared to the vegetation which the other options would traverse.

Potential biophysical environmental impacts that require specific consideration in terms of establishing the proposed route on the Western Alignment can thus be summarised as adverse effects on features of conservation significance, such as conservation reserves, fauna, flora and salt lakes, from:

- clearing of vegetation and habitat disturbance, and their effects on rare flora and fauna;
- introduction/spread of dieback; and
- people pressures;
- noise, dust and light; and
- potential contamination.

No significant environmental impacts to the wetland complex in the project area are likely to arise due to the location of the preferred alignment being distant to the east.

### 7.1.2 Human Environment

Due to the low level of formal development within the project area, construction of the proposed road could be regarded as a potentially intrusive unnatural feature within a relatively undisturbed environment. As such the proposed road could detract both directly and indirectly from the human-related intrinsic values of the project area. For instance, should the alignment of the proposed road intrude upon or closely adjoin an area or site of particular significance, direct physical disruption could result, or indirect human pressures could as previously discussed contribute to their progressive degradation. In addition if the route was visually prominent it could be an obtrusive, unnatural feature within the landscape and therefore detract from visual amenity.

Potential impacts upon the human environment associated with construction of the proposed Coastal Road - Jurien to Green Head relate to the physical severance or direct disturbance of established activity patterns, land use, development potential, services and infrastructure.

Particular considerations in these regards include:

- logistical and operational difficulties resulting from the physical partitioning of either privately owned or Crown land (including the need to formally acquire the route);
- disruption of existing movement and activity patterns and functional processes, and of established services and infrastructure;
- direct and/or progressive degradation of particular human-related intrinsic values (e.g. amenity, landscape quality) resulting from the route's physical existence or as a function of increased human access to the area it traverses; and
- spillover effects from the route upon existing dwellings within adjoining areas (e.g. from traffic noise and other emissions, dust, light spill and perceived hazard).

Potential human environmental impacts that require specific consideration in terms of establishing the proposed route on the Western Alignment can be summarised as:

- severance of:
  - private land
  - Crown land
  - access
  - services/infrastructure
- direct/indirect disturbance of sites of particular value
- diminution of landscape quality (visual impact)
- diminution of general amenity
- spillover effects on existing dwellings.

## 7.2 PRE-CONSTRUCTION PHASE

Pre-construction impacts are environmental or social impacts which occur before the commencement of road construction. Activities undertaken during the Pre-construction phase which may give rise to environmental or social impacts include;

- land acquisition;
- environmental, biological, geotechnical and hydrological surveys (if required);
- road alignment and design surveys; and
- road materials sourcing and testing surveys.

### 7.2.1 Biophysical Environment

Negligible negative impacts will occur to the biophysical environment during the Pre-construction phase of the project. A limited amount of vegetation clearing is undertaken for the placement of aerial photography control markers. The markers occupy a space of 4 $m^2$ and are widely distributed along the project route. Environmental, biological, geotechnical and hydrological surveys will not produce any significant impacts to the natural environment. Similarly, the preliminary road materials sourcing and testing surveys consist of small samples of soil material obtained from potential sourcing sites. Potential road material sources are detailed in Section 4.6.

### 7.2.1 Human Environment

The only real impact to the human environment arising from the Pre-construction phase is that of land acquisition. Resumption of land for the road reserve is required along the entire length of the proposed alignment. A 100 m road reserve is proposed for the alignment which will entail land resumption from predominately Crown Land. Clearly the extent to which the preferred route option impinges upon Crown land can be regarded as an undesirable impact, particularly as much of this land is already designated for conservation purposes. However the preferred alignment, the Western Alignment, has been endorsed by the major agency involved, the Department of Conservation and Land Management.

The preferred route option will also require land resumption from the north-eastern extremity of a privately owned property (Location 8836) at North Head (refer to Figure 2). The land is currently undeveloped and since the extent of land required from the property is minimal the degree of impact to the landholder is minor.

## 7.3 DURING-CONSTRUCTION PHASE

Impacts arising during the construction phase of the project result from activities typical of the construction of a major road. These activities include clearing vegetation, earthworking, excavation and transportation of road construction materials such as sand and gravel, road surface formation and stabilisation, culvert and drainage construction and the placement of the sealed road surface.

This section assesses the significance of both environmental and social impacts which may arise from the construction of the preferred alignment, Option 1, the Western Alignment.

### 7.3.1 Biophysical environment

#### 7.3.1.1 Clearing

Some disturbance and loss of vegetation during the construction of the proposed road is unavoidable. During the construction phase of the proposed road, clearing will result from:

- clearing of borrow pits and accessways for the sourcing of construction material;
- clearing of the immediate area of the proposed road route.

Impact on declared rare flora

The preferred Western Alignment (Option 1) is expected to have fewer impacts on Declared Rare and priority flora than the other options as there are fewer of these species within the Guilderton System of vegetation which makes up the majority of the route, DRF and Priority species tending to be restricted to or more frequent within the Jurien System vegetation. Two Priority species of flora, *Olax scalariformis* (Priority 3) and *Grevillea olivacea* (Priority 4), were recorded in the vicinity of the proposed road route.

Impact on declared rare fauna

The only scheduled fauna recorded during the field survey was the Carnaby's Black Cockatoo. Clearing of vegetation is expected to have negligible effects on this species due to the minimal impact on preferred habitats. The principal impacts of clearing on other fauna will be the loss of vegetated area through clearing and the consequent decrease in fauna habitats. There may also be some direct impact on slow-moving, fossorial and localised territorial fauna species.

Impact on Nature Reserves

Clearing within the Beekeepers Reserve during construction of the proposed Coastal Road - Jurien to Green Head along the Western Alignment (Option 1) is unavoidable. However this Reserve is mainly within the Guilderton System of vegetation, and disturbance of this vegetation type is believed preferable to construction of the other route options and their associated access roads to the North Head - Sandy Point area, given that these routes would disturb larger proportions of more diverse Jurien System vegetation and would directly impact the Drover's Cave and Lesueur National Parks.

#### 7.3.1.2 Dieback

Dieback caused by *Phytophthora* species have only been known to occur in the Northern Sandplains region since 1986. Prior to 1986 it was believed that these fungi could not survive in such a harsh environment. The only known outbreak of *Phytophthora cinnamomi* north of Moore River was at Eneabba in 1989, and six other species are now known to occur in the northern kwongan. 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.

Thus despite the sparse current distribution of *Phytophthora* species in the northern kwongan, their potential presence cannot be ignored due to the devastating effects that could occur if the fungi become successfully established in large areas. Construction activity within the project area could 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. Given the proximity of the two National Parks and the high number of species of conservation significance in the surrounding area, it is important to minimise the spread of any potential dieback infections.

#### 7.3.1.3 Exotic Weeds

During the biological survey of the project area (Ecologia, 1994) four species of naturalised exotic weed species were recorded; **Erdium botrys, * Verbascum virgatum, *Anagallis arvensis* and **Hedypnois rhagadioloides*. None of the these weeds are at present locally widespread and all four were recorded at low densities. To avoid any risk of spreading construction would have to be restricted to the period from January to May and such a restriction is not justified. The risk of introducing other weeds if strategies for vehicle hygiene are not adhered to, or from infected borrow pit areas is greater. Adherence to dieback hygiene procedures and the proposed borrow pits weed infestation management techniques are all that is necessary. As part of the monitoring of the road usage and rehabilitation of impacted areas, checks for any weed spread subsequent to the roadworks should occur. If any weed, including those above is spreading aggressively some intervention may prove necessary.

#### 7.3.1.4 People Pressures

During construction of the proposed road, intrusion by the construction workforce into areas adjoining the route alignment is the most likely cause of human activity-related impacts.

#### 7.3.1.5 Noise and Dust

Noise and dust generated as a result of development of the proposed road may be a minor problem during the construction phase:

- Noise may have some localised effect on animal communities, causing dispersal away from the areas being developed.
- Dust created during the construction phase may also have a negative effect on surrounding vegetation.

It should be noted that a relatively large network of access tracks already exists within the project area. Construction of a new road would ultimately lead to a reduction in impacts with respect to noise and dust by confining traffic to a smaller defined area and to a sealed surface.

#### 7.3.1.6 Potential contamination

During the construction phase, various potentially polluting waste materials will inevitably be produced. These would include:

- excess spoil that could not be used in construction or rehabilitation processes;
- sewage produced by the construction workforce;
- used engine oil and unserviceable parts from construction vehicle/machinery servicing and maintenance;
- spillage of hydrocarbon products (e.g. during the refuelling and/or servicing of vehicles and machines);
- general construction debris and litter discarded by the workforce; and
- introduced weeds.

Unless effectively disposed of, all forms of waste generated have the potential to cause an environmental impact ranging from soil and water pollution to visual degradation. Various forms of waste material could also pose a threat to native fauna.

The greatest risk from waste materials and hydrocarbon spillage is the contamination of water resources. As the preferred route option is down-hydraulic gradient from the Jurien water supply borefield, it does not pose a pollution threat in that context. However, as it would skirt the eastern margins of one of the Cockleshell Gully salt lakes, and as the loop road servicing Sandy Point would also skirt this feature, there is some risk of contamination occurring, and safeguards are therefore necessary. Although the risk of environmental contamination is less elsewhere within the project area, safeguards would still be implemented.

### 7.3.1.7 Borrow Pit Locations

By far the most significant environmental impact which may arise from the proposed materials sources is the potential for the spread of dieback infection both from and to the sand and gravel borrow pits and surrounding areas. The proximity of the pits to the Drovers Cave and Lesueur National Parks makes the introduction of dieback into the area of particular significance. Additionally, there is some potential to aide the dispersal of noxious weeds which are known to be present on pastoral properties in the area.

The loss of native vegetation during clearing the sand fill borrow pits will be very minimal due to the small area to be disturbed. The proposed gravel borrow pit sites are either totally cleared or contain little remnant vegetation. No Declared Rare Flora or Fauna species are known to be present at any of the potential borrow pit sites.

The limited availability of gravel material in the Jurien - Green Head area restricts the placement of the gravel borrow pits to the locations previously identified in Section 4.6.2. However suitable sand fill material is available both on Crown Land within and adjacent to the proposed road reserve and on private property to the east. The potential exists to utilise either Crown Land or private sandfill sources, each of which provides benefits and disbenefits in terms of minimisation of potential environmental impacts.

**PRIVATE LAND**

**Pros**

- cleared land
- minimal loss of native vegetation
- no additional impact to undisturbed Crown Land / conservation areas
- simple rehabilitation program to achieve preexisting landuse

**Cons**

- extensive clearing to construct haul road
- long haul route with potential to introduce or spread dieback or noxious weeds
- source contaminated by noxious weeds
- exposed areas prone to wind erosion
- increasing activity area thus construction related impacts

**CROWN LAND**

**Pros**

- no dieback or noxious weed contamination
- short haul route
- containment of activity area and construction related impacts

**Cons**

- increasing area of disturbance to native vegetation
- increased impact to Crown Land / conservation areas

The impact of limited clearing associated with the utilisation of sand fill borrow pits on adjacent Crown Land is outweighed by the benefit of removing the threat of introducing either dieback or noxious weeds to high conservation value areas. The Proteaceous Jurien complex vegetation associations present within both Drovers Cave and Lesueur National Parks are highly susceptible to dieback and contain a high number of flora species of significant conservation value.

While the initial impact to sand fill sources within crown Land is significant, the Guilderton vegetation complex is simpler and more readily rehabilitated than the Jurien complex. It is likely that Post construction revegetation would achieve near pre-impact vegetation types after 5 years.

### 7.3.2 Human Environment

#### 7.3.2.1 Severance

The low intensity of human habitation and land use occurring beyond the Jurien and Green Head townsites reduces the potential for adverse impacts upon the human environment as a result of the severance of private land and public access, infrastructure and services. In fact for virtually all of its length the preferred route option is aligned through Crown land of varying status, although the severance of Crown land can in itself be regarded as an undesirable impact.

Particular impacts resulting from severance caused by construction of the proposed road on the preferred alignment are discussed hereunder.

- Private land
  The preferred route option intrudes upon the north-eastern extremity of a privately owned property (Location 8836) at North Head (refer to Figure 2). The extent of intrusion is not great and the site is presently undeveloped. At present, Location 8836 is accessible only via the informal Sandy Point Road. Construction of the proposed road will obviously enhance access to the site and could probably therefore be regarded as beneficial in terms of its development potential. The opportunity to integrate the route into future development of the site therefore exists and accordingly the potential for adverse impact would be low.

- Crown Land
  Clearly the extent to which the preferred route option impinges upon Crown land can be regarded as an undesirable impact, particularly as much of this land is already designated for conservation purposes (the Beekeepers Reserve) or has similarly high conservation values. Although the intrusion is an unavoidable consequence of the preferred route option and, as discussed elsewhere in this report, has important implications in terms of management of the Crown land, some ameliorating considerations can be identified.

  The Western Alignment would provide a sound basis for rationalisation of the interface between the conservation estate and other Crown lands (perhaps with more of a recreational orientation) between Jurien and Green Head. This alignment may in fact enable the addition of some presently unvested Crown Reserves and Vacant Crown land to the conservation estate. In addition the route is already being used (by the Shire of Dandaragan for example) as a premise for enhancing planning and management of sensitive coastal areas. As already pointed out, irrespective of whether the proposed road is constructed, a concerted programme to manage human pressures on environmental resources within the Jurien to Green Head area is necessary. The proposed road will assist in the process, both as outlined above and by facilitating an enhanced supervisory and management presence (by the two Shires and Department of Conservation and Land Management for example) within the area.

- Public Access
  The only formed, gazetted roads that would be materially affected by the proposed road are the Jurien East Rd, and Coorow - Green Head and Green Head - Leeman Roads at their present junction to the north of Green Head. Although there may be some disruption to traffic movements at this junction during the construction phase, the existing intersection will be replaced by two staggered T-junctions thereby preserving all desired traffic movements.

  Although the proposed road and the associated links into Sandy Point will sever existing informal access into the North Head - Sandy Point area, the level of public access within the overall project area will be enhanced. As such, no detrimental social impact will occur. The opportunity to rationalise the present network of essentially informal access tracks servicing the project area can in fact be regarded as a beneficial aspect of the proposal.

- Services/Infrastructure
  The preferred route option does not significantly interfere with any established services or other infrastructure. Minor adjustments may be required to Telecom and State Energy Commission Western Australia (SECWA) lines at each end of the alignment. In these areas service lines are provided to the townships along existing road corridors such as the Jurien East Road.

#### 7.3.2.2 Sites of particular value

As previously indicated in Section 5.3.1, there are no significant ethnographic and archaeological Aboriginal sites in the vicinity of the proposed route for the Jurien - Green Head Road (Appendices C and D). Thus sites of Aboriginal significance are not anticipated to be a factor in terms of determining the acceptability or otherwise of the proposal.

Although the road does not impinge directly upon the Mount Lesueur Reserve or Drovers Cave, both of which have been entered on the Register of the National Estate, in places its alignment is quite close to them. The implications of the proposed road for the conservation estate (in terms of people pressures and severance) have already been discussed and the comments made are also relevant in terms of its potential effects on the intrinsic values of the two registered areas.

The preferred route option impinges directly on the remnant of the Old North Road Stock Route immediately north of the existing Jurien East Road. Although the Stock Route is not formally classified as a site of historic or heritage significance, it is undoubtedly of some importance in terms of the broader region's agricultural development. This is recognised in the Central Coast Regional Strategy (Department of Planning and Urban Development, 1994a) which advocates development of the Stock Route as a regional heritage trail.

#### 7.3.2.3 Landscape quality

Although the spatial extent of development and disturbance that would result from construction of the proposed road might not be great compared with the overall extent of the project area, Vant (1987) cautions that regardless of its size and intensity, development can modify the aesthetic environment to the extent that its original "attractiveness" is lost. He also points out that safeguards in the following directions (inter alia) are needed to mitigate potential visual impact:

- the extent of earthworks;
- the location of roads; and
- the preservation of natural vegetation.

Landform within the western portion of the project area comprises a series of essentially north-south dune systems. Although the resultant topography is relatively uniform, it is sufficiently undulating to afford effective natural screening. In defining the preferred route option, an alignment relatively low in the landscape (i.e. within the interdunal swales) has wherever practicable been followed. Although the proposed road will inevitably cut across the dune systems at a number of points along its alignment, it is generally well screened from external viewpoints.

As previously indicated, a more westerly alignment for the proposed road was advocated through the community consultation process. However, this suggestion was not adopted, one of the reasons being that the route could become visually obtrusive because of the more substantial dune formations it would traverse within the near-coastal environs.

#### 7.3.2.4 Landscape Amenity

The project area can be characterised as a largely undeveloped, natural area with high biophysical and human environmental values. The consistency of constructing a road through the project area with maintaining these values can be considered doubtful. Thus, the proposed road could be regarded as likely to detract from the inherent character and amenity of the project area.

However it is necessary to acknowledge that because of the very environmental qualities that contribute to its inherent character and amenity, human pressures on the project area are increasing and producing change. These pressures and change are likely to continue as a function of development more generally within the broader Central Coast Region.

As previously indicated, a concerted programme to manage this process of change will be necessary if undesirable effects upon the intrinsic qualities of the project area are to be avoided. Although the proposed road will contribute to change within the project area, it can in effect be regarded as part of the programme for managing human pressures and therefore consequential change within the area.

#### 7.3.2.5 Noise, dust and light

Noise is considered to be undesirable sound levels which can adversely affect the health and well-being of individuals or populations. It is considered that the only potential noise impact associated with the proposed road would arise from the construction of the access road to Green Head, which is proposed to intersect with Green Head Road in the Green Head township to the north of and adjacent to Battersby Road.

It is possible that minor dust impacts upon Green Head may also result from construction of the access road, by earthworks and ground disturbance.

## 7.4 POST-CONSTRUCTION PHASE

Post-construction impacts are those impacts which arise during the life of the road once construction of the route is completed. Impacts arise during the Post-construction Phase from maintenance activities such as road verge clearing, minor re-contouring, revegetation and usage of the road by the general public. In addition the consequences of an increased human presence within the area traversed by the proposed road is an important factor in evaluating potential impacts on the environments of the project area. Increased human activity within the project area is an inevitable function of the improved level of access which the route will provide.

### 7.4.1 Biophysical Environment

Increased human presence would contribute to overall pressure on the biophysical environment and in particular the conservation estate, for example by contributing to an increased risk of:

- fire;
- stress on wildlife (e.g. from road trauma, predation by domestic animals); and
- illegal taking of wildflowers and possibly other natural resources.

#### 7.4.1.1 Dieback

During the Post-construction phase the potential for the spread of dieback to vulnerable areas of high conservation value could arguably be reduced with construction of the proposed Coastal Road Jurien - Green Head. Presently the existing road route via Cockleshell Gully Road has the potential to allow the disease to spread through a significant portion of Lesueur National Park. Locating the route to the west along the preferred Western Alignment through less vulnerable vegetation types reduces the potential for dieback impact. In addition, dirt roads such as those forming the present route through the National Park are known to transfer the dieback fungus more effectively than bitumenised roads. The extreme harshness of the bitumenised road environment greatly reduces the viability of *Phytophthora* spores. Following construction of the road, the spread of infection along a bitumenised road is minimal.

#### 7.4.1.2 People pressures

By enhancing the level of access through the project area, the proposed road has the potential to increase human activity therein and as a consequence human pressures upon the environmental resources of the area. Considerations in this context include:

- physical intrusion to gain informal or legitimate access to beachfront, resulting in the disturbance/loss of vegetation and displacement of wildlife;
- direct disturbance resulting from, for example, pilfering of vegetation and other environmental resources;
- consequential effects such as an increased risk of fire, erosion, and harassment of wildlife by domestic animals that can produce change within prevailing environmental conditions.

The physical manifestations and significance of such human-related pressures will vary depending on the characteristics of the area affected. In general, however, the overall effect is a progressive degradation of the intrinsic environmental qualities of the area.

In this instance, because of the high conservation values of the project area and the general sensitivity to disturbance of the prevailing environmental conditions, human-related pressures have the potential to produce significant environmental impacts. However, it should be noted that these areas have already suffered from uncontrolled vehicle access and provision of proper sealed accesses to coastal areas may actually reduce the current impacts.

#### 7.4.1.3 Potential contamination

The proposed new Coastal Road Jurien - Green Head is to function essentially as a local link between Jurien and Green Head. As such the risk of spillage of potentially hazardous or polluting materials from traffic using the proposed road would be low. The road is unlikely to increase the movement of vehicles transporting hazardous materials between the two centres. Also it could be argued that as a shorter and demonstrably better route than the existing link between the towns, the proposed road would actually reduce the risk of accident and therefore potentially hazardous spillages.

#### 7.4.1.4 Noise and dust

Noise and dust generated during the Post-construction Phase of the proposed road is expected to represent a limited problem affecting the adjacent road buffer. The proposed road will be sealed for its entire length through the project area and should not cause significant dust generation following construction. Traffic noise may lead to the dispersal of larger and or more mobile fauna.

Some limited dust generation may occur through the usage of the Sandy Point access roads. The low traffic volumes which will utilise the roads should not produce significantly greater dust generation than that currently arising from the usage of the informal track system in the area. No significant impact to adjacent vegetation is expected.

### 7.4.2 Human Environment

#### 7.4.2.1 Traffic impacts on existing dwellings

Some concern relating to potential spillover effects was expressed during the community consultation process. The concern however focused on the proposed southern access road link into Green Head township. This concern essentially stemmed from perceptions about the nature and volume of traffic likely to use the access road into the township and its likely behaviour.

Although the concerns expressed related solely to spillover effects from traffic operating on the southern access road, it can be concluded that construction of the Coastal Road could also be perceived as likely to produce adverse spillover. The closest existing residential area to the preferred alignment for the proposed road is at its northern extremity within the Green Head townsite. However even here the proposed route is more than 1.5 km east of the residential areas so that it is unlikely to produce any adverse impacts within those areas.

- Noise
  Traffic volumes obtained through the Shire of Dandaragan for several roads in the study area indicate maximum average vehicles per day volumes in the vicinity of 500 during the busy January holiday period. Although volumes in excess of this would be expected associated with the road between Jurien and Green Head at peak times of the year, the amount of traffic involved is not expected to entail noise emission problems for the adjacent community.

- Dust
  The proposed road will be sealed for its entire length through the project area and should not cause significant dust generation following construction.
- Light
  Light spill from illumination of the proposed road is another form of potential visual impact associated with the project. However as the only points on the proposed route likely to warrant illumination will be the road junctions at its northern and southern extremities (which are within the immediate environs of the Green Head and Jurien townsites respectively) light spill will not be intrusive and will not therefore detract from visual amenity within the project area in general.

### 7.5 Synthesis

The area traversed by the proposed Coastal Road - Jurien to Green Head is of recognised high conservation value because of its biological and geomorphological diversity. The environmental features, characteristics and qualities that contribute to its high conservation value also render this area attractive for a range of recreational activities and afford natural resource based utilisation and development opportunities. The area affected by the proposed route is already experiencing human use related pressures and these will inevitably increase as population within the broader region grows and as the region develops as a recreation and tourism destination.

The coastal area between Jurien and Green Head is already experiencing change, simply because of its juxtaposition to those population centres and because of its environmental characteristics and resources. Although formal access to the area is limited, a network of informal access tracks has been established to cater for recreational and other uses and inevitably contributes to the overall level of human pressure the area presently experiences.

It can therefore be argued that establishment of the proposed direct road link between Jurien and Green Head will contribute to the process of human-induced change within the project area. However it is necessary to acknowledge that a specific programme of measures to manage change within this area (and in fact other areas within the broader Central Coast Region experiencing similar human pressures) is essential if its intrinsic environmental values are to be maintained. Irrespective of the route option selected for improving the level of road access between Jurien and Green Head, the need for such a management programme would remain.

Establishment of a more direct link between Jurien and Green Head is seen by the planning authorities as an essential part of this overall programme. For instance, the link is an integral part of the Central Coast Regional Strategy (Department of Planning and Urban Development, 1994a) and is seen by the Shire of Dandaragan as an essential precursor to the development of its coastal planning and management strategy for the North Head - Sandy Point area. An important objective of the strategy is the control of squatter settlements in accordance with established State Government policy.

In addition to the social benefits arising from the improved connection between Jurien and Green Head, the proposed road will enable rationalisation of the interface between the conservation estate, comprised of the Lesueur and Drovers Cave National Parks and the Beekeepers Nature Reserve, and the more specifically recreational Crown lands along the coast. This may afford an opportunity to extend the conservation estate over areas of currently unvested or Vacant Crown land.

While the proposed route does offer several environmental benefits, it also raises a number of potential environmental impacts, and these have been considered in the process of selecting the preferred option. In identifying the actual alignment of the preferred route, avoidance or minimisation of potential impacts has been a priority, and will continue to be so at the detailed route planning and design stage. Where it has not been possible to avoid potential impacts, strategies for their management have been developed. Management strategies are specifically addressed in the following chapter.

Thus although it is necessary to acknowledge that the proposed Coastal Road - Jurien to Green Head will contribute to the process of change within the project area, the route can be regarded as an important element of the overall programme to manage this change such that the intrinsic environmental qualities and values of the project area will be maintained.

# 8.0 ENVIRONMENTAL MANAGEMENT

The environmental management of proposed Coastal Road - Jurien to Green Head focuses on the preferred route alignment, Option 1, the Western Alignment. Although the management strategies and techniques have been formulated to address the environmental and social impacts identified for the Western Alignment they are also applicable to the management of impacts associated with the two other route options.

This chapter describes standard and dedicated management measures which are consistent with those outlined in the Main Roads Environmental Management Manual (MRWA, 1992). The management strategies have been designed to avoid, mitigate and/or ameliorate the impacts which have been identified in Section 7.0. The strategies will effectively manage the impacts to both the biophysical and human environments during the pre-construction, construction and post-construction phases of the development.

The major management issues considered for the proposed Coastal Road - Jurien to Green Head include;

(1) Biophysical environmental factors
- Clearing and habitat disturbance
- Rehabilitation of road verges/borrow pits
- Declared Rare Flora (DRF)
- Dieback
- Conservation estate
- Dust
- People pressures
- Potential contamination

(2) Human environmental factors
- Access/severance
- Noise, dust and light intrusions on existing dwellings
- Landscape quality
- Potential for contamination from wastes

It is important to minimise wherever possible, physical, environmental and social impacts relating to construction activities associated with the Coastal Road - Jurien to Green Head. Accordingly, the points listed below address the relevant issues:

## 8.1 PRE-CONSTRUCTION PHASE

### 8.1.1 Biophysical Environment

Impact

The pre-construction activities associated with development of the preferred alignment have negligible impact upon the biophysical environment. The requisite environmental and technical surveys do not require specific management outside normal field survey procedures.

Management

No management is required.

#### 8.1.1.1 Borrow Pits

Impact

Impact to gazetted conservation areas through utilisation of road materials sources located within conservation areas.

Management

Approval is sought within the current Consultative Environmental Review for access to utilise those borrow pit sites on private and Crown Land not within conservation areas. Separate approval will be sought under Section 46 of the Environmental Protection Act 1986 for those sites occurring within conservation areas, such as Beekeepers Reserve, which are to be utilised. An appropriate Environmental Management Plan will be formulated at the time approval is sought.

### 8.1.2 Human Environment

The impact to the human environment for the pre-construction phase of the development is limited to the acquisition of land for the proposed road reserve.

#### 8.1.2.1 Land Resumption

Impact

Acquisition of land affected by the preferred alignment, Option 1 Western Alignment.

Management

- Resumption of land for the proposed road reserve is required in the vicinity of the north-eastern extremity of a privately owned property (Location 8836) at North Head. Acquisition of that portion of Location 8836 required for the proposed road would occur through the normal processes which provide for adequate compensation of the affected landowner.
- The proponents will endeavour to minimise the impact from the land resumption by the adoption of a 100 m road reserve.
- The route of the road reserve will be located so as to minimise the amount of land required to be resumed while maintaining safe and economic road design practices.

## 8.2 DURING-CONSTRUCTION PHASE

There are a range of potential impacts to both the biophysical and human environments requiring management which will or may arise during the construction of the road.

### 8.2.1 Biophysical Environment

#### 8.2.1.1 Vegetation

Impact

The entire length of the proposed route will require the clearing of vegetation which is in near pristine natural condition.

Management

In general the earth works associated with road construction will be designed to minimise removal of existing vegetation. Management of clearing during the construction phase of the project involves:

- Confining clearing operations to the minimum width for required roadworks construction.
- Conservation of existing topsoil. Topsoil from construction or disturbed areas shall be stripped, stockpiled and respread to re-establish roadside vegetation. In-situ topsoil is a rich seed source and will assist in the regeneration of the roadside vegetation communities.

- Minimise embankments and batter slopes to facilitate and enhance revegetation.
- Revegetation will be carried out in all disturbed areas with suitable local native flora species from the project area.

#### 8.2.1.2 Significant Flora species

Only two priority flora species, *Olax scalariformis* (Priority 3) and *Grevillea olivacea* (Priority 4), were recorded in the vicinity of the proposed road route. Both species occur in low densities, less than 2 % of vegetative cover, at one site each within the project area. Both species are known to occur in numerous populations which are not under threat. Thus impact to significant flora species is minimal and requires no specific management strategies.

#### 8.2.1.2 Dieback

Introduction of the fungal disease known as dieback, especially into the Proteaceous communities of the Jurien System, must be avoided. While no dieback infections have been identified along the route to be traversed by the proposed Coastal Road - Jurien to Green Head, care must still be taken to ensure that soil borne fungus is not transferred from external infected areas.

Impact

Introduction and dispersal of soil borne fungal pathogens especially *Phytophthora* species.

Management

- Dedicated dieback hygiene management measures are to be developed in conjunction with the Department of Conservation and Land Management and according to Main Roads Western Australia guidelines. The hygiene management plan will be developed from the Main Roads Dieback Management Procedure Manual (Main Roads Western Australia, 1992) and the Department of Conservation and Land Management Dieback Disease Hygiene Manual (Department of Conservation and Land Management, 1992) utilising specific dieback knowledge for the Northern Sandplains (Freeman *et al.*, 1992).
- During the pre-construction phase all road materials sources external to the proposed road reserve will be surveyed and laboratory tested for the presence of soil borne fungal pathogens especially *Phytophthora* species.
- Road materials such as sand fill and gravel will not be utilised from sites which have been confirmed to contain soil borne fungal pathogens especially *Phytophthora* species.
- Transport to/from construction areas will occur on established tracks wherever possible and/or along designated routes approved by the Department of Conservation and Land Management and the Environmental Protection Authority.
- Where possible construction should not take place in the months with major rainfall, typically May to September.

#### 8.2.1.3 Noxious Weeds

Impact

Introduction and dispersal of noxious weeds to the road reserve.

Management

- Undertake eradication and control procedures of all borrow pit sites which are on or adjacent to cleared agricultural areas to remove noxious weed stocks, including seed, plant and root material.

#### 8.2.1.4 People Pressures

Effective management of impacts from the construction workforce is dependent upon clear definition of the corridor within which construction-related impacts are regarded as acceptable.

Impact

Degradation of habitat adjacent to road construction corridor

Management

- Definition of the construction corridor will occur in conjunction with detailed pre-construction cadastral and level surveys for the project prior to clearing.
- The construction corridor will be limited to the minimum practicable consistent with construction requirements.
- The limits of the corridor will be clearly marked by prominent flagging prior to clearing operations.

#### 8.2.1.5 Dust

Impact

Dust impacts during construction caused by earthworks and ground disturbance

Management

- Earthworks are to be undertaken within suitable ground conditions where practicable.
- The construction authority will follow standard dust suppression techniques throughout the construction phase of the project.

#### 8.2.1.6 Potential Contamination

Impact

Spillage and dispersal of human wastes and potential industrial contaminants such as hydrocarbons.

Management

- Use of portable chemical toilets to cater for sewage.
- Collection and off-site disposal (at an approved disposal facility) of all waste materials including used oil and unserviceable vehicle/machinery parts and excess spoil.
- Refuelling/servicing of vehicles/machines daily by fuel tanker. All hydrocarbons will be stored offsite in Jurien township. Any minor spillage during refuelling would be removed (for disposal at an approved site) on completion of utilisation of that area.

### 8.2.2 HUMAN ENVIRONMENT

#### 8.2.2.1 Severance

Impact

Construction related inconvenience to road or track users where the proposed alignment crosses existing roads and tracks. Construction of the coastal route and/or the Green Head and Sandy Point access roads may result in restricted accessibility for local/regional traffic movement

Management

- Provision of alternative routes where required, the temporary re-routing of any affected road/track and if necessary appropriate signage indicating locations of alternative and/or re-routed networks.

#### 8.2.2.2 Visual Impact

Impact

Visual impacts on landscape amenity associated with earthworks, embankments and the road structure.

Management

- Minimisation of earthworks and vegetation clearing consistent with vertical and horizontal landscapes during the construction phase.
- Reduce visual impacts through re-contouring, landscaping and revegetation of disturbed areas with local native plant species.
- Culvert and drainage structures to be constructed to compliment surrounding environment and associated embankments to be re-contoured to appropriate gradients and revegetated.

#### 8.2.2.3 Noise

The major noise impacts associated with the project are considered to be the adverse effects of machinery use and construction activities upon Green Head residents associated with construction of the Southern Access Road.

Impact

Adverse effects of machinery movements and construction activities on residents in Green Head township.

Management

- Construction activities adjacent to residential areas will be limited to reasonable daytime hours to mitigate noise impacts in adjacent localities.
- Noise levels will comply with DEP Pollution Prevention Division standards.

## 8.3 POST-CONSTRUCTION PHASE

### 8.3.1 Biophysical Environment

#### 8.3.1.1 Landform and Soils

Impact

Erosion around any re-contoured embankments and batters not included for management during the construction phase.

Management

- Revegetate batters and embankments with local native plant species.

#### 8.3.1.2 Vegetation

Impact

Loss of vegetative cover in those areas disturbed during the construction phase and not successfully revegetated.

Management

- Periodically monitor establishment of revegetation areas and implement remedial measures, such as re-seeding or container planting, if necessary.

#### 8.3.1.3 Dieback

Impact

Facilitation of introduction and spread of soil borne fungal pathogens especially *Phytophthora* species

Management

- In order to minimise the potential for spread of dieback during the operational lifetime of the road, drainage and design considerations must be implemented in the planning phase of the project. The design considerations are to form a component of the dedicated dieback Management Plan developed during the construction phase (Section 8.2.1.2).

#### 8.3.1.4 Noxious Weeds

Impact

Introduction and dispersal of noxious weeds to the road reserve.

Management

- Undertake control measures should populations of noxious weeds become established within the road reserve. Control measures may be by manual, mechanical or chemical means to remove noxious weed stocks, including seed, plant and root material.

#### 8.3.1.5 People Pressures

Although the proposed road will increase the level of access to the project area, it provides a basis from which existing informal and legitimate public access within the project area can be rationalised. This rationalisation process affords a mechanism by which potential people pressures and related impacts can be managed.

Impact

Increased uncontrolled public access to project area, in particular near coastal areas.

Management

- All existing informal access tracks intersected by the proposed new roads would be effectively closed.

- The tie-ins of closed informal access tracks are to be rehabilitated and revegetated within the confines of the road reserve.

- Track closure and rehabilitation in conservation areas within the road reserve will be undertaken in consultation with the Department of Conservation and Land Management

#### 8.3.1.6 Potential Contamination

The transportation of potentially hazardous substances is controlled by established procedures and statutory regulations. These include emergency response procedures for dealing with spillages of such substances during transportation, and with traffic accidents involving vehicles carrying these substances. Key responsibility for the emergency response rests with a combination of State Government agencies.

### 8.3.2 Human Environment

#### 8.3.2.1 Traffic Impacts on Existing Dwellings

Community concerns have highlighted that the major post construction human environmental impact associated with the project is the limited adverse effects of vehicle use of the Southern Access Road upon Green Head residents in adjacent areas.

Impact

Adverse effects of vehicle movements on residents in Green Head township, principally impacts arising from increased vehicle noise and light.

Management

- Landscaping and revegetation of the intervening buffer strip between the Southern Access road and nearby residential areas.

#### 8.3.2.2 Sites of Particular Significance

The only sites of particular significance to be impacted by the proposed Coastal Road - Jurien to Green Head are the Beekeepers Nature Reserve and the Old North Road Stock Route.

Impact

Disruption of access sites of significance, in particular Beekeepers Nature Reserve and the Old North Road Stock Route

Management

- Establish access to existing tracks leading to Beekeepers Nature Reserve and the Old North Road Stock Route.

- Provide clear signage indicating the location of the sites.

#### 8.3.2.4 Landscape Amenity

Impact

Visual impacts on landscape amenity associated with earthworks, embankments and the road structure.

Management

The important principles underlying the safeguards identified by Vant (1987) will be pursued to the fullest extent possible and accordingly the potential for adverse visual impacts will be minimised:

- Detailed route planning and design during the pre-construction phase will be made to minimise the extent of earthworks and vegetation clearing required for route construction consistent with maintaining acceptable vertical and horizontal geometric design standards and sight distances.

- Where earthworks are unavoidable, final contours will be melded with the adjoining terrain to avoid creation of an obviously artificial landform and all earthworked areas will be revegetated using endemic species.

## 9.0 SUMMARY OF COMMITMENTS

The proposed Coastal Road - Jurien to Green Head will be developed according to all relevant Government statutes and agency requirements and to the satisfaction of the Environmental Protection Authority. The proponents will adhere to the proposal as assessed by the Environmental Protection Authority and will fulfil the commitments made below.

The commitments ascertain what management strategy is required, who will implement the strategy and the timing of implementation. Where appropriate, commitments which are required to be undertaken to the satisfaction of a regulatory authority, will have the abbreviation of the approval body in brackets after the commitment e.g. (EPA), Environmental Protection Authority.

In this section, commitments given in the Consultative Environmental Review are restated in a consolidated listing, together with a reference to the appropriate page of this Report.

The commitments have been categorised into;

- ✶ Pre-construction commitments;
- ✶ During construction commitments;
- ✶ Post-construction commitments;

### 9.1 Pre-construction Commitments

(1) Approval to utilise those borrow pit sites occurring within gazetted conservation areas will be sought under Section 46 of the Environmental Protection Act 1986 A dedicated borrow pit Environmental Management Plan will be formulated at the time approval is sought. (EPA, CALM) (P26, P55)

(2) The proponents are to commission a dieback survey and laboratory testing of all materials sourcing sites to determine the prevalence of soil borne fungal pathogens especially *Phytophthora* species (EPA, CALM). (P55)

(3) The proponents to commission the development of dedicated dieback hygiene management measures. The hygiene management plan will be developed from the MRWA Dieback Management Procedure Manual (1992) and CALM Dieback Disease Hygiene Manual (1992) utilising specific dieback knowledge for the Northern Sandplains (EPA, CALM). (P55, P60)

(4) Incorporated within the dieback management programme will be appropriate drainage design considerations which will minimise the facilitation of the introduction and spread of soil borne fungal pathogens especially *Phytophthora* species (EPA, CALM). (P58)

(5) Only road materials sourcing sites found to be free of soil borne fungal pathogens especially *Phytophthora* species will be utilised (EPA, CALM). (P55)

(6) The proponents will negotiate with affected landholders, where land resumption is required, in order to arrange equitable agreement and compensation for loss of property if required. (P53)

(7) The proponents to undertake a public notification informing the local community should the preferred alignment, Option 1 Western Alignment, be approved by all relevant authorities and pursued for construction (EPA).

(8) In all borrow pit areas where noxious weeds are present sterilisation and or removal and burial of affected topsoils is to be undertaken prior to excavation of road construction materials (EPA) (P55)

(9) The proponents will undertake detailed route planning and design during the pre-construction phase aimed at minimising the extent of earthworks and vegetation clearing required for route construction consistent with maintaining acceptable vertical and horizontal geometric design standards and sight distances (EPA). (P60)

(10) Where earthworks are unavoidable, final contours will be melded with the adjoining terrain to avoid creation of an obviously artificial landform and all earthworked areas will be revegetated using endemic species (EPA, CALM). (P60)

**9.2 During Construction Commitments**

(11) The proponents are to make all workforce associated with the construction of the route alignment aware of environmental commitments aimed at protecting the environment during construction (EPA).

(12) The proponents are to restrict vegetation clearing and machinery movements to within the road reserve excepting for sourcing road construction materials (EPA). (P55)

(13) The proponents are to reduce clearing of vegetation to essential minimum consistent with safe and efficient operations (EPA, CALM). (P54)

(14) The approved dedicated dieback hygiene and control measures developed for the project are to be strictly adhered to during construction (EPA, CALM). (P55)

(15) The proponents are to prepare a rehabilitation and revegetation programme outlining key areas to rehabilitated, selected local flora species (EPA, CALM). (P54)

(16) The top soil, vegetation and litter layer of all areas to be disturbed is to be stockpiled for later rehabilitation programmes. The duration of stockpiling should kept to a minimum to optimise seed viability (EPA). (P54)

(17) All areas to be rehabilitated are to have top soil respread, ripped, reseeded and replanted using local species. Standard MRWA practices currently recommended for the planning, operation and rehabilitation of disturbed areas should be utilised (EPA, CALM). (P54)

(18) Vegetation debris, logs, topsoil and rocks are to be returned to areas which have been disturbed and are in need of rehabilitation. These substrates will assist with rehabilitation by providing seed stores, moisture traps and fauna micro-habitats (EPA). (P54)

(19) All Embankment and batter slopes are to be minimised and prepared to appropriate MRWA standards to facilitate successful establishment of typical local vegetative cover (EPA).

(20) The proponents are to stabilise embankments and batter slopes susceptible to short term erosion impacts during the construction phase of the project (EPA, CALM). (P57)

(21) Silt traps are to be installed where necessary to collect run-off and prevent sediment from entering drainage systems (EPA).

(22) The proponents are to ensure that noise levels associated with construction comply with standards set by the EPA Pollution Control Division (EPA). (P59)

(23) Construction activities adjacent to residential areas will be limited to reasonable daytime hours to mitigate noise impacts in adjacent localities (EPA). (P59)

(24) The proponents will ensure inconvenience caused by severing access roads and tracks during construction will be kept to a minimum and provide appropriate signage where necessary to achieve this (EPA). (P56)

(25) Construction and earthworking is to be undertaken during suitable ground conditions otherwise dust suppression measures will be employed when dust levels become problematic (EPA). (P56)

(26) Portable chemical toilets will be used to cater for sewage (EPA). (P56)

(27) The proponents will undertake the collection and off-site disposal (at an approved disposal facility) of all waste materials including used oil and unserviceable vehicle/machinery parts and excess spoil (EPA). (P56)

### 9.3 Post Construction Commitments

(28) Erosion around any re-contoured embankments and batters during the post construction phase will be managed by the proponents with re-construction and revegetation with local native plant species (EPA, CALM) (P58)

(29) All existing informal access tracks intersected by the proposed new roads will be effectively closed (EPA, CALM). (P59)

(30) The tie-ins of closed informal access tracks are to be rehabilitated and revegetated within the confines of the road reserve (EPA, CALM). (P59)

(31) Track closure and rehabilitation within conservation areas will be undertaken in consultation with the Department of Conservation and Land Management (EPA, CALM). (P59)

(32) Disused access road construction tracks, detours, side roads, borrow pits or other abandoned works areas are to be rehabilitated and revegetated with local native plant species (EPA, CALM). (P54)

(33) Access links will be maintained and signed to sites of significance such as Beekeepers Nature Reserve and Drovers Cave National Park (EPA). (P59)

(34) If revegetation is not progressing to the satisfaction of approval authorities, the proponents will implement appropriate measures to remedy revegetation establishment (EPA, CALM). (P58)

(35) The proponents are to carry out eradication programmes should any noxious weed species be introduced to the proposed road reserve (EPA, CALM). (P58)

(36) Appropriate landscaping and revegetation will be undertaken to reduce noise impacts to resident with Green Head Township (EPA). (P59)

(37) The proponents will monitor the establishment of revegetation annually for a period of 2 years after the practical completion of the route construction. Results of monitoring will be included in the Annual Monitoring Report (EPA, CALM). (P58)

## 10.0 CONCLUSION

This Consultative Environmental Review has presented a proposal by the Shires of Dandaragan and Coorow to construct a new Coastal Road linking the towns of Jurien and Green Head. Construction of an improved road link between Jurien and Green Head is an integral part of the overall coastal route between Lancelin and Dongara. Described in the Central Coast Planning Strategy (Department of Planning and Urban Development, 1994a) this coastal route is designed to improve access between the respective townships. The Planning Strategy also aims to develop Jurien as the single regional centre for the Central Coast Region: as such, an efficient road network system to neighbouring towns is a priority.

Benefits from the development of a more direct route between Jurien and Green Head would include increased economic development and social interaction due to improved access between the townships, demarcation of the western boundary of the Lesueur National Park and consequent opportunity to rationalise access to and management of the Park, formalisation of access to the North Head - Sandy Point area which will facilitate coastal management initiatives therein, including recreational and tourism development, and enhance access for current mining operations and increased tourism and recreational activity.

The proposal was determined after an examination and comparison of three alternative route options through the study area. The comparison was based on environmental and social factors to determine the route alternative which best served the interests of the community within the study area, its natural environment and the community of users of the road. Community input achieved through direct mailouts and Public Information Sessions has allowed early identification of critical concerns of affected parties.

The proposal will have both social and environmental impacts on the study area. The social impacts relate principally to the issue of access to the Green Head township via the proposed southern access. Environmental impacts of the road will result, principally in relation to the loss of vegetation through clearing, impact on Beekeepers Nature Reserve, disturbance of fauna habitat in cleared areas and the expected improved environment of the Lesueur National Park due to removal of traffic.

The proponent is committed to minimising adverse impacts and specific commitments in each area of impact have been given. Given that the project area, and particularly the Beekeepers Reserve, includes vegetation associations widely distributed throughout the region this is not expected to represent a significant impact to the environment.

It should be recognised that the reason for the route selection study was to identify a route capable of minimum disruption to the natural and human environments. Some unavoidable loss of roadside vegetation will occur. Whilst this is regrettable, it will be offset by replanting of an increased area of roadside vegetation for the new road.

Drainage, erosion and siltation prevention measures are to be incorporated in the design and construction specification for the road. Furthermore, maintenance of road drainage facilities will be part of an on-going management programme.

In conclusion, the benefits of the proposal in terms of reduced travel times and distances between Jurien and Green Head, avoidance of significant natural resources, minimisation of adverse social impacts by route selection and commitment to mitigation and enhancement of regional planning objectives, are considered to outweigh the possible disadvantages due to development of the proposal.

## REFERENCES

Atkins, K.J. (1993) Declared Rare and Priority Flora List. Department of Conservation and Land Management. 1993

Bagnouls, F. and Gaussen, H. (1957) Les climats écologiques et leur classification. *Annls. Geogr.* **66:** 193-220.

Baynes, A. (1979) The analysis of late Quaternary mammal fauna from Hastings Cave, Jurien. Unpublished Ph.D. thesis. Perth, UWA.

Beard, J.S. (1976) An Indigenous Term for the Western Australian Sand Plain and its Vegetation. *J. Roy. Soc. West. Aust.* **59:** 55-57.

Beard, J.S. (1979) Vegetation Survey of Western Australia: The Vegetation of the Moora and Hill River Areas. Map and Explanatory Memoirs, 1: 250, 000 series. Vegmap Publications, Perth.

Burbidge, A.H. and Boscacci, L.J. (1989) A Spring Reconnaissance Survey of the Flora and Fauna of the Southern Beekeepers Reserve. Conservation and Land Management Technical Report No. 22, March 1989.

Burbidge, A.A. and Fuller, (1989) Fauna. in Nature Conservation, Landscape and Recreation Values of the Proposed Lesueur National Park. Dept. C.A.L.M., Occasional Paper No. 3 / 89. July, 1989.

Burbidge, A.A., Hopper, S.D. and van Leeuwen, S. (1989) Nature Conservation, Landscape and Recreation Values of the Proposed Lesueur National Park. Dept. C.A.L.M., Occasional Paper No. 3 / 89. July, 1989.

Conservation and Land Management (1994) Scheduled Fauna Listing. Government Gazette, W.A. 16 November, 1990.

Conservation and Land Management (1992) Dieback Disease Hygiene Manual. Revised July 1992 Edition. The Department of Conservation and Land Management, Perth.

Chapman, A., Dell. J., Johnstone, R.E. and Kitchener, D.J. (1977) A vertebrate survey of Cockleshell Gully Reserve, Western Australia. Rec. West. Aust. Mus. Suppl. no. 4.

Conservation Through Reserves Committee (1974) Conservation Reserves in Western Australia. Report to the Environmental Protection Authority - "Green Book".

Diels, L. (1906) Die Pflanzenwelt von West-Australian sudlich des Wendekreises. *Vegn. Erde* 7, Leipzig.

Department of Planning and Urban Development (1994a) Central Coast Regional Strategy. Prepared by the Department of Planning and Urban Development for the Central Coast Planning Study Steering Committee as part of the strategic planning program of the State Planning Commission. June, 1994.

Department of Planning and Urban Development (1994b) Central Coast Regional Profile. April, 1994.

*ecologia* Environmental Consultants (1994) Coastal Road Jurien to Gren Head Biological Survey Report. Unpublished report to the Shiresof Coorow & Dandaragan and Main Roads Western Australia.

Environmental Protection Authority (1993) Red Book: Status Report (1993) Conservation Reserves for Western Australia. Environmental Protection Authority (1976-1984)

Freeman, M.J., Hart, R. & Ryall, M. (1992) Dieback - What is the future ? Papers presented at a Seminar in Perth 23rd September 1992. The Northern Sandplains Dieback Working Party.

Froend, R. (1987) Investigations into Species Richness Patterns in the Northern Sandplain Region of Western Australia. Ph.D. Thesis, The University of Western Australia.

Gardner, C.A. (1942) The vegetation of Western Australia with special reference to climate and soils. *J. Proc. Roy. Soc. West. Aust.* **28:** 11-87.

Griffin, E.A. and Burbidge, A.A. (1989). Description of the region. Chapter 3, pp. 17-26 in Burbidge, A.A., Hopper, S.D. and van Leeuwen, S. (1989) Nature Conservation, Landscape and Recreation Values of the Proposed Lesueur National Park. Dept. C.A.L.M., Occasional Paper No. 3 / 89. July, 1989.

Griffin, E.A. and Hopkins, A.J.M. (1985) The flora and vegetation of Mt. Lesueur, Western Australia. *J. Roy. Soc. W.A.* **67 (2):** 45-57.

Griffin, E.A. and Associates (1992) A Brief Assessment of Proposed Access Road from Jurien Road to Sandy Point. Unpubl. Report to Peter Woods and Associates.

Griffin, E.A., Hopkins, A.J.M. and Hnatiuk, R.J. (1983) Regional variation in Mediterranean shrublands at Eneabba, south-western Australia. *Vegetatio,* **52:** 103-27.

Hopkins, A.J.M., Keighery, G.J. and Marchant, N.G. (1983) Species-rich uplands of south-western Australia. *Proc. Ecol. Soc. Aust.* **12:** 15-26.

Lowry, D.C. (1974) Explanatory Notes, 1: 250, 000. Geological Series. Dongara - Hill River. Aust. Govt. Publishing Service, Canberra.

McArthur, W.M. and Bettenay, E. (1960) The development and distribution of the soils of the Swan Coastal Plain, Western Australia. C.S.I.R.O. Soil Pub. 16. C.S.I.R.O., Melbourne.

Morse, K. (1982) Middle Head: a prehistoric Aboriginal shell midden on the Southwestern Australian coast. *Australian Archaeology,* **15:** 1-7.

Main Roads Western Australia (1990) Lancelin to Dongara coastal route: Jurien to Green Head Section: Initial Planning Study.

Main Roads Western Australia (1992) Dieback Management Procedure Manual. Feb. 1992 Draft. Main Roads Western Australia, Perth.

Main Roads Western Australia (1994) Jurien - Green Head Road Project - Preliminary Materials Investigation. June, 1994

O'Conner, R. (1992) Report on an Ethnographic Survey of the Proposed Telecom Australia Optic Fibre Cable Route: Perth - Geraldton Region. Prepared for Telecom Australia.

O'Conner, R., Quartermaine, G. and Bodney, C. (1989) Report on a survey for Aboriginal Sites at the First Priority Area near Mt. Bernia, Jurien, Western Australia. Prepared for CRA Exploration Pty. Ltd.

Petersen, A.E. (1992) Dieback management at RGC Mineral Sands Limited's Eneabba operations. pp. 51-56 in Dieback - What is the Future ? Papers presented at a seminar in Perth, 23rd Sep., 1992. The Northern Sandplains Dieback Working Party.

Playford, P.E., Cockbain, A.E. and Low, G.H. (1976) Geology of the Perth Basin, Western Australia. Geol. Surv. W.A. Bull. 124

Quartermaine, G. (1989) Report on a Preliminary Investigation of Aboriginal Heritage Significance of a Borefield and Waste Water Pipeline for the Proposed Jurien Power Station. Prepared for Australian Groundwater Consultants.

Quartermaine, G. (1992) Report on a Survey for Archaeological Sites of the Proposed Yanchep to Geraldton and Geraldton to Nabawa Sections of the Telecom Optic Fibre Cable Route. Prepared for Telecom Australia.

Seddon, G. (1972) Sense of Place. University of Western Australia Press, Nedlands. 274 pp.

Speck, N.H. (1958) The vegetation of the Darling-Irwin Botanical Districts. Ph.D. Thesis (Botany), University of Western Australia.

Vant, W.N. (ed.) (1987) Lake Managers Handbook. Water and Soil Miscellaneous Publication Number 103, Water Quality Centre, New Zealand Ministry of Works and Development.

GIS Maps referred to in text:

GIS Map 1: Subsurface Geology and Deep Aquifers: Central Coast Region: Jurien to Green Head. 1: 100,000 scale GIS Map. Geology by A.J. Mory, 1989-1993, D.O.M.E. Seismic Interpretation by R.P. Lasky, 1992.

GIS Map 2: Superficial Geology: Central Coast Region: Jurien to Green Head. 1: 100, 000 scale GIS Map. Information from 1: 250, 000 scale Dongara - Hill River, Moora and Perth Series Maps, Geological Survey of Western Australia, simplified by D.P.U.D. in conjunction with D.O.M.E. December 1992.

**STUDY TEAM**

The Consultative Environmental Review for the Coastal Road - Jurien to Green Head project was planned, coordinated and executed by;

***ecologia*** Environmental Consultants
165 Walcott St.,
Mount Lawley W.A. 6050

In association with

Paul Holmes & Associates
BSD Consultants
Quartermaine Consultants

Project staff

*ecologia* Environmental Consultants

| | | |
|---|---|---|
| G. W. Connell | BSc. (Hons.) (Zool) | Project Manager, Biologist |
| C. J. Macpherson | BSc. (Hons.) (Bio) | Botanist |
| M. Maier | BSc. (Zool/Bot) (Hons.) (Zool) | Biologist |
| M. A. Humphreys | Dip. Draft. | Drafting |

Paul Holmes & Associates

| | | |
|---|---|---|
| Paul Holmes | BA (Urban & Regional Planning) | Project Manager, Environmental Scientist |

BSD Consultants

| | | |
|---|---|---|
| P. A. Nelligan | BA (Urban & Regional Planning) | Traffic Planner |

Quartermaine Consultants

| | | |
|---|---|---|
| G. S. Quartermaine | BA (Hons) (Anthrop. & Prehistory) | Archaeologist |

# APPENDIX A

## EPA CER Guidelines

# PROPOSED ROAD REALIGNMENT - COAST ROAD, JURIEN TO GREENHEAD

## CONSULTATIVE ENVIRONMENTAL REVIEW

## GUIDELINES

### Overview

In Western Australia all environmental reviews are about protecting the environment. The fundamental requirement is for the proponent to describe what they propose to do, to discuss the potential environmental impacts of the proposal, and then to describe how those environmental impacts are going to be managed so that the environment is protected.

If the proponent can demonstrate that the environment will be protected then the proposal will be found environmentally acceptable; if the proponent cannot show that the environment would be protected then the Environmental Protection Authority (EPA) would recommend against the proposal.

Throughout the process it is the aim of the EPA to advise and assist the proponent to improve or modify the proposal in such a way that the environment is protected. Nonetheless, the environmental review in Western Australia is proponent driven, and it is up to the proponent to

identify the potential environmental impacts and design and implement proposals which protect the environment.

For this proposal, protecting the environment means that the natural and social values associated with coastal and associated habitat between Jurien Bay and Greenhead are protected. Where they cannot be protected, proposals to mitigate the impacts are required.

### Purpose of an CER

The primary function of an CER is to provide the basis for the EPA to provide advice to Government on protecting the environment. An additional function is to communicate clearly with the public so that EPA can obtain informed public comment. As such, environmental impact assessment is quite deliberately a public process. The CER should set out the series of decisions taken to develop this proposal at this place and time and why.

### Objectives of the review

The Consultative Environmental Review should have the following objectives:

- to place this project in the context of the regional environment and the proposed coastal route between Lancelin and Dongara;
- to explain the issues and decisions which led to the choice of this project at this place at this time;
- to set out the environmental impacts that the project may have; and
- for each impact, to describe any environmental management steps the proponent believes would avoid, mitigate or ameliorate that impact.

The CER should focus on the major issues for the area and anticipate the questions that members of the public will raise. Data describing the environment should be directly related to the discussion of the potential impacts of the proposal. Both should then relate directly to the actions proposed to manage those impacts.

## Key issues

The critical issue for the proposal is likely to be the impact of the road and the extraction of road making materials on areas of high conservation value, in particular but not confined to, the Mt Lesueur and Drovers Cave National Parks. It is critical therefore that the CER shows a detailed understanding of conservation, landscape, and social values in the whole area. The conservation values of areas to be disturbed should he examined in detail, and their representation in secure conservation reserves determined.

The key issues for this project should be clearly identified and the content of succeeding sections determined by their relevance to these issues.

In this case the key issues should include:

- the reasons for selection of the preferred alignment, and the alternatives considered;
- flora, fauna and ecosystems:
  - rare and poorly known flora, fauna and communities;
  - inter-relationships of the biota and environment;
- wetland impacts:
  - description of wetlands and wetland types;
  - representation in secure conservation reserves; and
  - likely impacts of the road;
- sources of construction materials, and transport of construction materials and product;
- coastal impacts:
  - impact on unstable coastal landforms; and
- impact of any coastal spur road to be constructed as part of this proposal and related impacts;
- landscape and recreation values affected by the road;
- impact on recreational and tourist users;
- cultural impact on Aboriginal people with traditional affiliation to the land;
- water management issues:
  - impact on the groundwater and associated impacts on flora and wetlands; and
  - maintenance of surface water drainage patterns particularly overland flow;
- management of the road reserve and its interaction with conservation reserves (national parks and/or nature reserves); and
- construction management issues:
  - feral fauna, weed, access and fire control;
  - dust control;
  - overburden and topsoil management rehabilitation and final land use; and
  - contingency plans for accidents such as fuel spills discharges and fires.

plus any other key issues raised during the preparation of the report.

## Public participation and 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 and individuals involved and the objectives of the activities. Cross reference should be made with the description of environmental management for the proposal which should clearly indicate how community concerns have been addressed. Where these concerns are dealt with via other departments or procedures, outside the EPA process, these can be noted and referenced here.

## Detailed list of environmental commitments

The commitments being made by the proponent to protect the environment should be clearly defined and separately listed. Where an environmental problem has the potential to occur, there should be a commitment to rectify it. They should be numbered and take the form of:

a who will do the work;

b what the work is;

c when the work will be carried out; and

d to whose satisfaction the work will be carried out.

*NOTE* *All actionable and auditable commitments made in the body of the document should be numbered and summarised in this list.*