MAIN ROADS
WESTERN AUSTRALIA

ALBANY HIGHWAY
BEDFORDALE HILL SECTION
DUPLICATION

CONSULTATIVE ENVIRONMENTAL REVIEW

ecologia
ENVIRONMENTAL CONSULTANTS

INVITATION

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

The Consultative Environmental Review (CER) proposes the duplication of the Albany Highway Bedfordale Hill Section by construction of a four lane divided highway based on duplicating the existing road.

In accordance with the Environmental Protection Act 1986 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 8 July 1996 closing on 5 August 1996.

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: 5 AUGUST 1996.

Submissions should be addressed to:

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

Attention: Mr Todd Simms

CONTENTS

SUMMARY

BACKGROUND AND OBJECTIVE

The Albany Highway Duplication proposed by Main Roads Western Australia (MRWA) for Bedfordale Hill in the City of Armadale occurs between Straight Line Kilometre (SLK) 27.57 and SLK 35.19. The proposal comprises the construction of a four lane dual carriageway by duplication of Albany Highway between the end of the existing dual carriageway and the Road Train Assembly Area.

This Consultative Environmental Review (CER) aims to identify the potential environmental impacts which may arise from the new works and to recommend methods of reducing their effect on the environment. The objective of the CER is to provide the Department of Environmental Protection (DEP) and the Environmental Protection Authority with information about the proposal as a basis for its assessment of the project, and to inform interested parties about the project so that they are in a position to contribute to the environmental impact assessment process if they so wish.

PROJECT DESCRIPTION AND JUSTIFICATION

Project Description

The 7.6 km duplication will be constructed within land either already acquired for the purpose, or within an area previously identified within the Metropolitan Region Scheme as being required for road widening. The second carriageway will generally be constructed on the western side of the existing carriageway, except where topographical and environmental constraints require otherwise.

The scope of works includes road reconstruction, construction of a dual use path (DUP), a DUP underpass beneath Albany Highway, amended intersections and median breaks, changes to public utilities and water pipes, fully contained road drainage, and landscaping compatible with the existing character of Albany Highway.

Project Justification

The Bedfordale Hill Section of Albany Highway has been the subject of ongoing planning and design. The Albany Highway Planning Study for Duplication Options at Bedfordale Hill examined three alternatives:

(i) four lane undivided road;

(ii) four lane divided road; and

(iii) retention of current single carriageway.

This planning study found that the level of service of the existing road was approaching the unstable flow where most drivers are severely restricted from selecting their desired speed; any small increases in traffic flow would therefore cause operational problems. The recommendation of this study was that a four lane divided carriageway option be adopted to improve driver safety and create a more pleasing environment.

A traffic study was undertaken to project future traffic volumes between now and the year 2021. The projections show that over the next 25 years traffic volumes are expected to approximately double due to increased demand in the local area, as well as increased travel between the Metropolitan Area and the South-west. Existing traffic flow and safety problems exist in the study area, and these will be exacerbated by an increase in traffic volumes. The current proposal has been developed in response to these factors.

Project Benefits

The construction of a four lane divided road will provide improvements in aspects of public safety and transport efficiency. Additional benefits of the proposal include:

- a high level of service for the road user;
- geometric improvements resulting in a safer and more pleasing road environment;
- avoidance of the cost of constructing passing lanes as an interim measure;
- economic benefits resulting from laden long vehicles being allowed to travel down, as well as up, Bedfordale Hill; and
- alleviation of uncertainty over future property acquisition requirements.

Evaluation Of Alternatives
One alternative route for heavy haulage has been considered by MRWA as an alternative to upgrading Albany Highway to four lanes through Bedfordale. The route comprised the Jarrahdale Road, between Albany Highway and the Armadale-Bunbury Road, and then from that intersection up to Armadale Road. The alternative route consists of 39 km, and would cost in the order of 8 - 10 times the duplication proposal outlined in this CER.

Based on traffic figures, the volume of traffic requiring an upgrade will occur on the Bedfordale Hill Section of Albany Highway within three to 12 years. The interim measure of constructing passing lanes could be utilised to maintain current operating conditions. However, the predicted continual increase in traffic will require the level of duplication currently proposed.

The option for a four-lane undivided road provided a cheaper solution than a divided road. The choice of creating a divided road is based upon its greater safety and more pleasing road environment.

No alteration to the existing situation will result in increasing traffic volumes accompanied by a decrease in the level of service provided by the roadway. The outcome of this scenario is the likelihood of an increased rate of accidents, including potential for fatalities.

Selection of the Preferred Alignment
The process of developing the four lane divided road proposal for the Albany Highway Bedfordale Hill Section duplication, the subject of this CER, has been based upon a number of objectives. These are:

- minimisation of intrusion into Bungendore Park;
- avoiding where possible significant vegetation and buildings adjacent to the existing road;
- minimisation of impact on Neerigen Brook; and
- minimising requirements for land acquisition.

ROAD DESIGN PARAMETERS

General
The Bedfordale Hill Section of the Albany Highway duplication is planned to be constructed as a kerbed four lane, median separated dual carriageway. The road is to be bordered on the western side with a dedicated DUP for cyclists and pedestrians. The horizontal and vertical alignments of the duplication are to meet the engineering requirements for a design speed of 80 km/hour (SLK 27.57 to 32.2) and 90 km/hour (SLK 32.2 to 35.19).

Median openings are required to provide access to local roads and properties from Albany Highway. A total of 13 median openings are proposed, occurring on average approximately every 600 m.

Drainage
To accommodate subsurface waterflow in the area, it will be necessary to incorporate subsurface drainage into the design and construction of cut sections of the road. Subsurface drainage is to be collected and discharged into culverts.

Catchment areas and water flows have been determined, and culvert requirements calculated on a 20 year design rainfall intensity. Culvert locations, inlet and outlet levels have been incorporated into the road design. The design incorporates existing culverts, and provides additional culverts along the length of the duplication. The culverts will discharge into Neerigen Brook at regular intervals.

Two options have been identified in relation to road runoff. The preferred option is that of collection and containment, with an additional option suggested by the City of Armadale for whole of site dispersal for runoff.

EXISTING ENVIRONMENT

General

Albany Highway climbs into the Darling Scarp via a re-entrant valley and reaches the crest around Bedfordale. The existing road is contained within a road reserve 25 to 40 metres wide. The reserve is bordered on the north and south by residential and agricultural holdings, as well as State conservation reserves. In addition, Neerigen Brook runs along the northern boundary of the reserve for almost the entire length of the proposed widening.

The immediate landscape surrounding the proposed road works is characterised by a semi-rural atmosphere because of the large rural blocks, orchards, a brook and period farm houses. The definition of the road reserve is achieved by large stands of both exotic and indigenous trees lining both the road verge and road reserve boundary.

The area contains a number of orchards and vineyards, semi-rural paddocks, hobby farms, commercial premises, pastures concerned with horse agistment and racing, and a Road Train Assembly Area. In addition the alignment also passes adjacent to Bungendore Park, and enters into State Forest to the east of the Road Train Assembly Area.

The main features of the study area are discussed below.

Hydrology

For the entire length of the proposed works, Neerigen Brook traverses the reserve on the northern side of Albany Highway. This brook originates in the vicinity of Springfield and Dmietrieff Roads and has some minor tributaries near Armadale before ending in Wungong Brook near Lake Road 3 km west of Armadale. The brook is used as a source of potable water by some residents and as such is of special concern. Neerigen Brook has a catchment of 10 km^2 between the Road Train Assembly Area and Bedfordale Hill Road.

With the exception of some minor gullies which carry concentrated stormwater from the local road system, the remainder of the project site is well drained with water shedding evenly off the slopes.

Vegetation

The Bedfordale area lies within the Darling Botanical District System in the Dale Subdistrict. The Darling System encompasses the northern Jarrah forest which is associated with the laterite-capped plateau. Prior to widespread clearing and colonisation, the study area was mainly Jarrah forest with river gums and paperbarks occurring in wetter areas. Using the Beard-Webb Formula the intact native vegetation of the Bedfordale study area is classified as *Eucalyptus* (jarrah and marri) medium trees (10 - 30 m tall) with a mid to dense canopy.

Fauna

Limited information is available on fauna of the Darling Scarp, due to the lack of comprehensive biological surveys undertaken. There are no known species in the Darling Ranges that are restricted to that area, however marked changes in abundance and distribution of fauna populations, including local extinctions of mammal species, and severe reductions in population size of bird and reptile species has occurred.

In the areas of the proposed duplication, there are no species with a declared conservation status. However Southern Brown Bandicoots *Isoodon obesulus* are known to exist in Bungendore Park.

Bungendore Park
Bungendore Park is situated to the south of Albany Highway, is an 'A' Class Reserve (↑A4561), falls within System 6 Area M80, and is a component of the proposed Darling Regional Park.

Bungendore Park also contains the Southern Brown Bandicoot *Isoodon obesulus*. The Bandicoot is considered to be of State conservation significance, by virtue of the current Schedule 1 Wildlife Conservation Act 1950 status. Any removal of habitat that is of significance to the Bandicoot would be detrimental to the population in the area. Bungendore park also has two orchid species within it's boundaries that are listed on the Declared Rare and Priority Flora List (Atkins, 1995). These are the Dwarf Bee Orchid *Diuris micrantha* and the Star Orchid *Thelymitra stellata*.

Visual Amenity
As a component of the Darling Range Regional Park planning study, a visual resource assessment of the Darling Range sub-region was undertaken. The study area falls into the Darling Plateau Landscape Character Type, Sub Type: Darling Upland. The alignment of Albany Highway falls within a category of high scenic quality from the commencement of the study area (Triton Crescent) to the point at where the Highway diverges from the Bungendore Park boundary. The remainder of the alignment subject to the duplication proposal is classified as having moderate scenic quality. The alignment has a High Priority Landscape Management Zone categorisation, the objective of which is one of maximum retention of existing Landscape Character. Under this classification, any visual alterations should be designed to have a minimum visual impact as far as practical to an observer after a period of five years from the initial alteration.

PUBLIC CONSULTATION PROGRAMME

A major public consultation programme has been undertaken to understand the community concerns and to address those concerns within the project design wherever possible. The programme has included:

(1) Consultation on the Concept Plan;

(2) Consultation on the Preliminary Design; and

(3) Establishment of a Community Liaison Group.

The outcome and recommendations of the consultation programme concluded that there was wide community support for the project, with a number of specific issues requiring resolution through the planning process.

ANTICIPATED ENVIRONMENTAL IMPACTS

As the route traverses a near metropolitan semi-rural landscape within the Darling Scarp the potential exists for the proposed roadworks to impact on both the biophysical and social environment.

Key topics in consideration of the project have been identified as:

- impact to Bungendore Park, an 'A' Class Reserve and System 6 area.
- the presence of Neerigen Brook adjacent to the road reserve. The brook is used as a potable water source by some local residents and contains significant visual and aesthetic values to the local community;
- requirement for diversion of sections of Neerigen Brook, with potential for raising sediment loads and therefore impacting on water quality;

- stands of remnant native vegetation occurring within the road reserve;
- potential for introduction, or spread of, dieback through the study area; and
- raised noise levels for some residents adjacent to the proposed alignment.

ENVIRONMENTAL MANAGEMENT PROGRAMME

The aim of the Environmental Management Programme is to document the methods by which the potential project impacts can be minimised. The recommendations for management of the road construction project are separated into three distinct phases, these being:

- Pre-construction Phase
- Construction Phase
- Post-construction Phase

Aspects of the project which require management strategies include:

Pre-construction Phase

Key Topics
Bungendore Park
Dieback
Vegetation Clearance
Noise Amelioration
Neerigen Brook Deviation

Other Topics
Project Induction
Land Acquisition
Aboriginal Heritage Sites
Cultural Heritage Sites

Construction Phase

Key Topics
Erosion/Siltation Control
Dieback Procedures
Vegetation Clearing
Dust Control
Contaminants from Stormwater
Noise Control
Water Quality in Neerigen Brook

Other Topics
Traffic Management
Aboriginal Heritage Sites
Services Relocation
Chemical Spillage
Hardstand Areas
Weed Control

Post-Construction Phase
Landscape Design Guidelines
Landscaping and Rehabilitation Requirements
Completion Criteria
Funding

PROPONENT COMMITMENTS

MRWA Metropolitan Division is responsible for the construction of the Albany Highway Bedfordale Hill Section Duplication in an environmentally and socially responsible manner. MRWA is committed to implementing the environmental management procedures detailed in this document. All aspects of the management programme will be complied with throughout the design and construction of the project, according to the phase in which they occur.

In addition to implementation of the Environmental Management Programme, MRWA will undertake action in the following areas:

Implementation Schedule
The project is scheduled to be constructed in two stages between December and May 1996/97, and between November 1 and May 31 in 1997/98. The commencement of construction is subject to attainment of all necessary approvals.

Pre-construction management recommendations are to be carried out prior to commencement of site works. Strategies documented for the construction phase are to apply between the dates specified, and apply to both stages of construction. Post-construction requirements are to apply from June 1, 1997 for Stage 1 of construction and be ongoing, and from June 1, 1998 for Stage 2.

Monitoring and reporting requirements for the landscaping and rehabilitation aspects of the project may be separated for the two phases.

Landscape Establishment Program
A Landscape Establishment Program with an appropriate budget will be included as part of the original works program and should be over and above the regular maintenance procedures undertaken by the Division. It should include the following:

- a semi-annual works or establishment program for the first five years after construction;
- measures which address the problems and suggested solutions as outlined in the Post Construction Reports; and
- a record of the procedures employed and their success rate.

Rehabilitation Monitoring
Post Construction Monitoring of the works should be carried out by a biological scientist, botanist or landscape architect twice a year for at least three years. The monitoring is to include:

- site visits every six months;
- a Post Construction Report detailing the status of the project at the time of the site visit; and
- a photographic record should be made at the time of the site visit.

Auditing of the Environmental Management Programme
The EMP documents completion criteria for landscaping and rehabilitation. In order to determine that the set completion criteria have been satisfied requires a monitoring and audit programme. MRWA utilise Environmental Assessment and Management Plans (EAMP) to implement environmental management

recommendations for road projects. An Environmental Assessment and Draft Management Plan currently exists for this project, and this will be amended to be consistent with the outcome of the formal environmental assessment process.

The final EAMP will include a commitment and implementation schedule similar to that produced through the environmental assessment process. This schedule will form a component of the contract for the Works Contractor and will be subject to audit through the Landscape and Environment Branch of MRWA.

Audit of the CER
MRWA will undertake auditing of the Conditions of the Minister for the Environment on the Albany Highway Bedfordale Hill Section Duplication project CER assessment. Reporting will occur at the completion of each major phase of the project, or an annual basis where any one phase extends over more than 12 months.

CONCLUSION

In conclusion, the planning and consultation for this project has been extensive, and a detail environmental management strategy developed to mitigate impacts. With implementation of the project as documented within this CER there should be no long term negative impact on the site, nor its inhabitants.

A summary of the key issues and management strategies for the project is provided in the following table.

Summary of key topics

Category	Topics of Concern	Present Status	Proposed Action	Proposed Management	Predicted Outcome
Biophysical	System 6 Area M80	Bungendore Park is adjacent to Albany Highway and is not currently affected by the roadway.	Ingress into Bungendore Park boundaries due to requirement for earthworks for batter slopes.	•Use of 1:3 batter slopes proposed in order to provide a suitable slope for rehabilitation purposes. •Implementation of rehabilitation programme.	Successful rehabilitation of the Park boundary within 5 years.
	Rare flora and fauna	No rare flora or fauna have been recorded in the road corridor. Two species of Declared Rare Flora and one Schedule 1 fauna species are found within Bungendore Park.	Priority flora search to be undertaken in the area of impact of Bungendore Park during Spring 1996.	Management strategy developed according to the results of the flora search.	Dependent on results of DRF search. Minimise impact on any rare flora. No impact on rare fauna species.
	Remnant vegetation	Remnant vegetation consists of Jarrah and Marri woodland in the current road reserve of the study area. Remnant vegetation is not considered to be of regional significance.	Clearing of vegetation within area required for road construction and earthworks for batter slopes.	Designation of limit of works for clearance according to limit of site disturbance required for earthworks.	Vegetation clearance limited to that vegetation occurring within direct impact area of road and earthworks.
	Erosion	Minor erosion of road batters evident in some locations.	Construction of batters and incorporation into drainage system to minimise erosion risk.	•Step cutting of batters and use of interceptor drains to reduce stormwater runoff • Implementation of rehabilitation measures as soon as practical following completion or roadworks	A rehabilitated and stable surface in all areas of roadworks.
	Dieback	Study area classified as Not Effectively Quarantined in reference to presence of dieback.	Dieback analysis in study area to confirm any presence and location of dieback within the works area.	Dieback management strategy to be developed according to results of dieback survey. Based upon exclusion from the site and containment within the site, and in accordance with CALM policy and procedures.	Prevention of spread of dieback either into, from or throughout the study area.

Summary of key topics

Category	Topics of Concern	Present Status	Proposed Action	Proposed Management	Predicted Outcome
	Vegetation Clearing	Vegetation clearing has occurred historically for development of semi-rural and residential land, and for road construction.	Clearing of vegetation within area required for road construction and earthworks for batter slopes.	Designation of limit of works for clearance according to limit of site disturbance required for earthworks.	Vegetation clearance limited to that vegetation occurring within direct impact area of road and earthworks.
	Water Supply	Neerigen Brook currently with constant water flow.	Construction requiring two section of the Brook to be diverted.	Diversion timed to occur over summer when flow is at lowest. Relocated channel to be fully constructed prior to diversion of water occurring.	Minor interruptions to water flow during connection of diverted channel to existing channel.
Pollution	Dust Control	Not an issue under normal conditions.	Clearing and roadworks having potential to generate dust.	•Spraying with potable water while construction activities are occurring. •Use of paper mulch if dust nuisance occurs causing complaints from residents.	Limited amount of dust generation during earthworks. No nuisance caused to residents, and no detrimental impact on vegetation.
	•Contaminants from Stormwater •Water quality in Neerigen Brook	Stormwater currently drains directly from the road, and enters Neerigen Brook. Any contaminants from the road surface can therefore enter the drainage system.	Separation of overland flow from road runoff by separating these components of the drainage system.	•Road runoff to be channelled to a discharge point below Bedfordale Hill Road. • Water quality protected during construction to prevent erosion during rainfall events in the construction phase.	Prevention of road contaminants entering Neerigen Brook prior to it becoming a drainage reserve. Possible improvement in water quality where separation of drainage occurs.
	Noise	The existing traffic flow is resulting in a noise level of 64 dB(A) (L10 18 Hour) at 20 metres from the road edge.	Noise amelioration measures for three residences which will be subject to noise increases above MRWA criteria.	Noise walls in front of affected properties will be investigated during the design phase for appropriate construction materials.	Noise impact on the three properties will be mitigated by use of barriers.

Summary of key topics

Category	Topics of Concern	Present Status	Proposed Action	Proposed Management	Predicted Outcome
	Hydrology of Neerigen Brook	Neerigen Brook runs adjacent to Albany Highway in the study area, and in the drainage channel or a 10 km 2 catchment. The Brook is used as a water source by local residents.	Neerigen Brook to experience diversion in two locations; sections of 250 m and 80 m to be diverted.	•Channel parameters of relocated channel bed to be derived from existing channel characteristics. •Design and construction to minimise erosion potential and siltation during construction.	Hydrology of Neerigen Brook maintained at pre-construction levels. Minor reduction in volume due to removal of road runoff from the existing drainage pattern.
	Environmental values of Neerigen Brook.	Neerigen Brook supports local vegetation and serves as an aesthetic feature of the study area.	Neerigen Brook to experience diversion in two locations; sections of 250 m and 80 m to be diverted.	•Volume of road runoff removed from Neerigen Brook catchment negligible. •Diversion to be managed to minimise siltation. • Rehabiliation to restore the aesthetic qualitites of the brook.	Neerigen Brook to be rehabilitated to reflect its current aesthetic and environmental values. Some alteration to the vegetation expected along the diverted channel areas.

1.0 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVE

The Albany Highway Duplication proposed by Main Roads Western Australia (MRWA) for Bedfordale Hill in the City of Armadale occurs between Straight Line Kilometre (SLK) 27.57 and SLK 35.19. The proposal comprises the construction of a four lane dual carriageway by duplication of Albany Highway between the end of the existing dual carriageway and the Road Train Assembly Area.

The project is to be constructed in two stages; over summer and autumn of 1996/97, and between November 1 and May 31,1997/98. Rehabilitation and landscaping will be timed to coincide with the construction schedule.

The goals and benefits of the proposal are:

- to provide a safer route for traffic along Albany Highway in the region of Bedfordale Hill; and
- to retain or improve existing visual and environmental qualities of the area.

This Consultative Environmental Review (CER) aims to identify the environmental impacts which may arise from the new works and to recommend methods of reducing their effect on the environment. The report also incorporates the results of an acoustic assessment (Herring Storer Acoustics, 1996), the recommendations from a landscape design concept (Hames Sharley, 1996), and an Environmental Assessment and Management Plan specifically prepared for the Bedfordale Hill Duplication project (*ecologia*, 1996).

The CER has been prepared in accordance with the guidelines issued by the Environmental Protection Authority (EPA) for the project. The guidelines are included in Appendix A.

1.2 PROJECT LOCATION

Bedfordale is located on the Darling Scarp approximately 5 km to the east of Armadale, 35 km south-east of Perth, close to the junction of the Albany Highway and the South-Western Highway. It lies 40 km inland and Bedfordale Hill reaches a height of 300 m.

The proposed roadworks extend between SLK 27.57 (Triton Crescent) and SLK 35.19 (Road Train Assembly Area) on Albany Highway in the vicinity of Bedfordale Hill (Figure 1).

1.3 THE PROPONENT

The proponent for the Albany Highway Bedfordale Hill Section Duplication is:

Main Roads Western Australia
Metropolitan & Traffic Operations
2 Adams Drive
Welshpool WA 6106

1.4 APPROVALS PROCESS

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

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

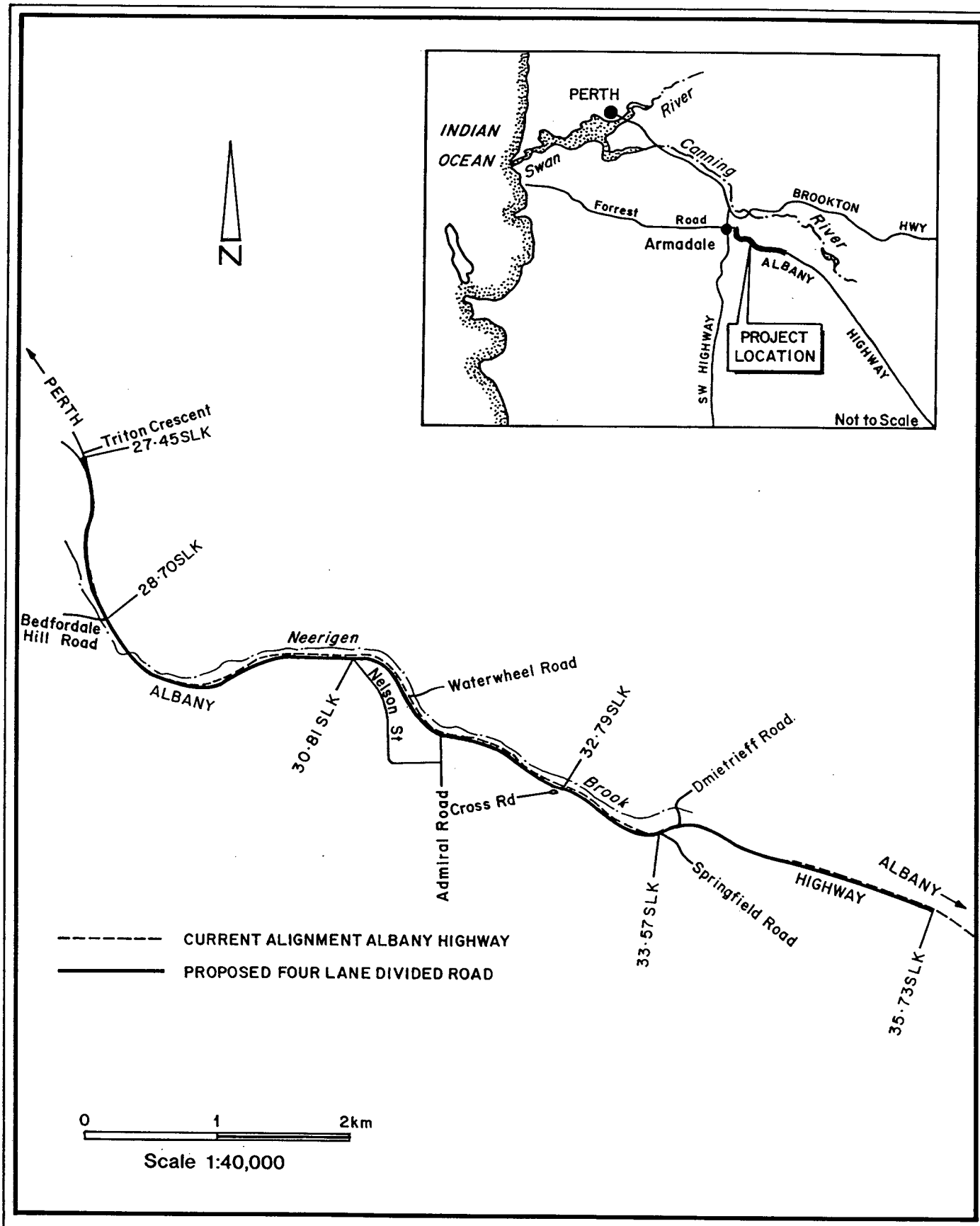
In setting the level of formal environmental impact assessment for the proposed Albany Highway Bedfordale Hill Section Duplication at CER, the EPA has required that the document be released for a four (4) week public review period during which time any interested individual, community group or organisation,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

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

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

Thus, in order for the proposed Albany Highway Bedfordale Hill Section Duplication project to proceed, the following statutory requirements need to be completed:

- a CER to be prepared and submitted to the Department of Environmental Protection (DEP) (which must be satisfied that the document contains sufficient information on, and responses to, topics and objectives identified in the project guidelines (Appendix A) before it can be released for public review);
- release of the CER for a four (4) week public review period;
- DEP prepare a summary of submissions received from Government Agencies and members of the public;
- proponents provide the DEP with written responses to all issues raised in submissions received during the public review period;
- the EPA 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 EPA's Report and if the proposal is regarded as environmentally acceptable, sets legally binding conditions on the proponent.
- the project is commenced according to the Ministerial Conditions and Proponent Commitments set out in the Statement that a Proposal may be Implemented (Pursuant to the Provisions of the Environmental Protection Act 1986).



ALBANY HIGHWAY

BEDFORDALE HILL DUPLICATION

LOCALITY PLAN

Figure 1

1.5 LEGAL FRAMEWORK

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

Aboriginal Heritage Act 1972

Conservation and Land Management Act 1984

Heritage of Western Australia Act 1990

Land Act 1933

Local Government Act 1960

Main Roads Act 1930

Metropolitan Region Town Planning Scheme Act 1959

National Trust of Australia Act 1964

Property Law Act 1969

Public Works Act 1902

State Planning Commission Act 1985

Town Planning & Development Act 1928

Wildlife Conservation Act 1950

1.6 MRWA ENVIRONMENTAL MANAGEMENT PRACTICE

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

MRWA has developed policies and procedures for environmental assessment and management of its activities. This includes an Environmental Management Manual (MRWA, 1992) which documents:

(i) an Environmental Management Strategy which covers:

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

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

- Aboriginal sites;
- Aesthetics;
- Bicycle and pedestrian facilities;
- Biological surveys;
- Clearing of vegetation;
- Cultural heritage places;

- Dieback;
- Drainage and hydrology;
- Noise;
- Rare flora and fauna;
- Rehabilitation; and
- Social effects.

1.7 SCOPE, PURPOSE AND STRUCTURE OF THE CER

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

This CER is the second document produced as part of the process of evaluating the environmental acceptability of this proposal. The first of these documents entitled an Environmental Assessment and Management Plan (EAMP) assessed impacts on the biological and human environments within the overall project area and produced management strategies to minimise any predicted impacts (*ecologia*, 1996). This report was produced according to the requirements of the MRWA Environmental Management Policy for road projects, as documented in the MRWA Environmental Management Manual (MRWA, 1992).

This CER is based on the material presented in the EAMP, and from other specialist studies undertaken for the project, including an extensive community consultation programme.

The structure of the CER is as follows:

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

Chapter 2 of the CER describes the scope of the project, and the justification for the proposal to proceed, while Chapter 3 details the design aspects of the proposal, and specialist studies undertaken to contribute to the engineering, planning and detailed design of the duplication project.

Chapter 4 describes the existing biological and human environments within the project area.

Chapter 5 canvasses predicted environmental impacts associated with the proposed route, while Chapter 6 details the environmental management plan developed to mitigate these impacts.

Chapter 7 discusses implementation requirements for the Environmental Management Plan, and commitments made by the proponent to ensure the effectiveness of impact amelioration techniques.

Chapter 8 forms the conclusion to the CER.

2.0 PROJECT DESCRIPTION AND JUSTIFICATION

2.1 PROJECT DESCRIPTION

The 7.6 km duplication will be constructed within land either already acquired for the purpose, or within an area previously identified within the Metropolitan Region Scheme as being required for road widening.

The second carriageway will generally be constructed on the western side of the existing carriageway, except where topographical and environmental constraints require otherwise. The new carriageway would be created from cut sections of the hillside. Fill will be used to improve vertical geometry in substandard sections, and to construct the second carriageway in selected locations.

Stabilised embankments are to be used within the verge to match the road level with surrounding natural land levels. Retaining walls have been proposed in four locations to avoid the need for land acquisition at these sites.

The scope of works comprises:

(i) Reconstruction of the existing two lanes into a four lane divided highway;

(ii) A dual use path (DUP) along the western side of the highway south of Bedfordale Hill Road and extending to Springfield Road, and on local roads to Topaz Court;

(iii) a DUP underpass beneath the highway between Topaz Court and Triton Crescent;

(iv) a footpath along the eastern side of the highway north of Bedfordale Hill Road to Triton Crescent;

(v) at-grade intersections at Waterwheel Road, Admiral Road, Springfield Road and Dmitrieff Road;

(vi) amended intersection at Bedfordale Hill Road to provide for a left turn only to Albany Highway and right turn only from Albany Highway;

(vii) median breaks at 9 mid-block locations to provide for U-turning traffic, in addition to median breaks at intersections;

(viii) landscaping compatible with the existing character of Albany Highway and incorporating an entry statement to Armadale at the bottom of the Hill;

(iv) provision of highway lighting at intersections;

(x) changes to public utilities as required for the duplication of the Highway;

(xi) conduits for private water pipes crossing the Highway for authorised residents to draw water from Neerigen Brook;

(xii) fully contained road drainage piped to discharge into the Neerigen Brook drain reserve at the northern end; and

(xiii) overland drainage taken across the road through culverts.

2.2 PROJECT JUSTIFICATION

2.2.1 Project History

Albany Highway forms the principal route to the southern wheatbelt and the major regional centres of Katanning and Albany. The Bedfordale Hill section of Albany highway is being affected by a growth in

traffic volume, and the frequency of heavy haulage vehicles which cause frustration and delay when descending Bedfordale Hill in low gear. Overtaking opportunities are restricted by numerous horizontal curves and crests.

The Bedfordale Hill Section of Albany Highway has been the subject of ongoing planning and design. The Albany Highway Planning Study for Duplication Options at Bedfordale Hill (GB Hill & Partners, 1994) examined three alternatives:

(i) four lane undivided road;

(ii) four lane divided road; and

(iii) retention of current single carriageway.

This planning study found that the level of service of the existing road was approaching the unstable flow where most drivers are severely restricted from selecting their desired speed; any small increases in traffic flow would therefore cause operational problems.

The recommendation of this study was that a four lane divided carriageway option be adopted to improve driver safety and create a more pleasing environment.

In 1995 the Albany Highway Bedfordale Hill Justification of Proposed Works (L Millar & Associates, 1995) concluded that the optimum solution to the current situation is to construct a four lane divided road.

In furthering planning and design to pursue this recommendation, MRWA has commissioned the following studies:

(i) Albany Highway Bedfordale Hill Section Planning Review Report (Sinclair Knight Merz, 1995a);

(ii) Albany Highway Bedfordale Hill Section Concept Plan Report on Submissions (Sinclair Knight Merz, 1995b);

(iii) Albany Highway Bedfordale Hill Section Preliminary Design Report (Sinclair Knight Merz, 1996a);

(iv) Albany Highway Bedfordale Hill Section Preliminary Design Report on Submissions (Sinclair Knight Merz, 1996b);

(v) Albany Highway Bedfordale Hill Section Geotechnical Investigation Evaluation Report (Soil & Rock Engineering, 1996a);

(vi) Albany Highway Bedfordale Hill Section Geotechnical Investigation Factual Report (Soil & Rock Engineering, 1996b);

(vii) Albany Highway Bedfordale Hill Section Environmental Assessment and Management Plan (*ecologia*, 1996);

(viii) Road Duplication Bedfordale Hill - Albany Highway Acoustic Assessment (Herring Storer Acoustics, 1996);

(ix) Albany Highway Bedfordale Hill Landscape Design Concept (Hames Sharley, 1996);

(x) Albany Highway Bedfordale Hill Section Master Plan (Sinclair Knight Merz, 1996c).

2.2.2 Need for the Proposal

A traffic study was undertaken to project future traffic volumes between now and the year 2021. The results of the forecasting are contained in Table 1. The projections show that over the next 25 years traffic volumes are expected to approximately double due to increased demand in the local area, as well as increased travel between the Metropolitan Area and the South-west.

Existing traffic flow and safety problems exist in the study area, and these will be exacerbated by an increase in traffic volumes. The current proposal has been developed in response to these factors.

Table 1: Forecast traffic volumes (vehicles per day) for Albany Highway

Location	Existing Volume	Forecast volume for 2021
North Bedfordale Hill Road	5320 vpd	10640 vpd
South Bedfordale Hill Road	4680 vpd	9360 vpd
Road Train Assembly Area	2640 vpd	5280 vpd

2.2.3 Project Benefits

The construction of a four lane divided road will provide improvements in aspects of public safety and transport efficiency.

Public Safety
Accident risk is currently high on the Bedfordale Hill section of Albany Highway. The existing southbound overtaking lanes do not deter overtaking on sections of road with inadequate sight lines. The current design proposal overcomes this problem. In addition, service roads and shared driveways at median breaks have been incorporated where possible to improve the safety for residents accessing the highway.

Currently, there are no cyclist or pedestrian facilities on this section of Albany Highway. Consequently a DUP has been incorporated within the design to improve safety for cyclists and pedestrians.

There have been 34 accidents recorded on the Bedfordale Hill Section of Albany Highway between January 1990 and December 1995; two of these accidents have resulted in three fatalities. Although the accident rate of approximately 0.7 accidents per million vehicle kilometres is fairly typical for a two-lane rural road, the proposed improvements would reduce the risk of fatal accidents occurring on this section of road (L Millar & Associates, 1995).

Transport Efficiency
The lack of downhill overtaking facilities and an inadequate number of uphill overtaking facilities cause delays to local, district and regional transport as well as to freight transport. The proposed road duplication will allow overtaking of slower moving vehicles in both a southbound and northbound direction for the full 7.6 km section proposed for duplication.

Additional benefits of the proposal include:

- a high level of service for the road user;
- geometric improvements resulting in a safer and more pleasing road environment;
- avoidance of the cost of constructing passing lanes as an interim measure;
- economic benefits resulting from laden long vehicles being allowed to travel down, as well as up, Bedfordale Hill; and
- alleviation of uncertainty over future property acquisition requirements.

2.3 EVALUATION OF ALTERNATIVES

2.3.1 Alternative Heavy Haulage Routes

One alternative route for heavy haulage has been considered by MRWA as an alternative to upgrading Albany Highway to four lanes through Bedfordale. The route comprised the Jarrahdale Road, between Albany Highway and the Armadale-Bunbury Road, and then from that intersection up to Armadale Road.

The alternative route consists of 39 km, and would require upgrading of 21 km of Jarrahdale Road and 18 km of the Armadale-Bunbury Road to a standard suitable for heavy haulage. The Bedfordale Hill Section duplication of 7.6 km has an estimated project cost of approximately $13.85 million. The alternative route was assessed as being in the order of 8 - 10 times the cost of the duplication proposal outlined in this CER.

2.3.2 Alternatives For Level Of Upgrading

A traffic volume of 8000 - 9000 vehicles per day is used to assess when a two lane road in the outer metropolitan area requires upgrading to four lanes for a road situation on level terrain. When sloping terrain is involved, the rate is reduced by 2000 vehicles per day in order to achieve the same level of service. Based on these figures, the required volume of traffic will occur on the Bedfordale Hill Section of Albany Highway within three to 12 years (L Millar & Associates, 1995).

The interim measure of constructing passing lanes could be utilised to maintain current operating conditions. However, the predicted continual increase in traffic will require the level of duplication currently proposed. In addition, passing lanes do little to improve the geometry and safety of the road.

Of the remaining two options studied by GB Hill & Partners (1994):

(i) four lane undivided road; and

(ii) four lane divided road.

The option for a four-lane undivided road provided a more cost-effective solution than a divided road. The choice of creating a divided road is based upon its greater safety and more pleasing road environment.

No alteration to the existing situation will result in increasing traffic volumes accompanied by a decrease in the level of service provided by the roadway. The outcome of this scenario is the likelihood of an increased rate of accidents, including potential for fatalities.

2.3.3 Selection of the Preferred Alignment

The process of developing the four lane divided road proposal for the Albany Highway Bedfordale Hill Section duplication, the subject of this CER, has been based upon a number of biophysical and social environmental objectives. These are:

- minimisation of intrusion into Bungendore Park;
- avoiding where possible significant vegetation and buildings adjacent to the existing road;
- minimisation of impact on Neerigen Brook; and
- minimising requirements for land acquisition.

Options considered in settling on the alignment documented within this CER are discussed below.

Bungendore Park Boundary
To reduce the impact on Bungendore Park, a road alignment located further eastward was considered. Although this option had minimal impact on the park, the alignment required significant embankments on properties to the east of the existing pavement. The design affected seven properties, and each resident forwarded submissions opposing the route due to the impact on vegetation and gardens. One of the properties is a featured garden in the Open Garden scheme, and has local and possibly historical significance. The more eastern alignment in the Bungendore Park area would also result in deviation of Neerigen Brook in this locality.

In road safety terms, a road realigned to the east would have resulted in seven properties having direct access to the highway. The preferred alignment will provide these residents with a single access point from a service road created from the old carriageway.

Two western alignments were considered, one of which had little impact on residents but which caused significant intrusion into Bungendore Park. The mid-west alignment requiring earthworks within the Bungendore Park boundaries was considered to be preferable on the grounds of forming a compromise between significant social impact and significant impact on a System 6 area. Liaison with the Bungendore Park Management Committee has been undertaken on issues raised by the selected alignment.

Willow Heights and Norfolk Island Pines
Four alternatives were considered in order to try and prevent impact to Willow Heights, a building listed on the City of Armadale Register of Heritage Sites, and two adjacent Norfolk Island Pines.

(1) The recommended alignment which will result in the loss of the trees, and the necessity to relocate the heritage listed building.

(2) Working within the existing road reserve. This option would save Willow Heights and the Norfolk Island pines, however, this option produced constraints in reference to road safety, noise levels and impact to Neerigen Brook.

Road curvature would have been on the minimum design standards approved by MRWA. In addition, the median would only be 2 m in width, again on minimum design standards. The design would require a "broken back curve" which is considered undesirable from a road safety perspective.

This option would have located the roadway closer to three properties which would have experienced severe noise level increases. The affected residents were opposed to this option on these grounds.

To gain the required width to construct four lanes, the road would need to have been widened on the eastern side. This would have required clearing of adjacent vegetation and construction of a retaining wall alongside the Neerigen Brook at the base of the embankment. The Brook would need to be diverted during construction of the retaining wall, and it is doubtful that it could be returned to its original location.

(3) Splitting the carriageway to save the two pine trees. This option incorporated splitting the lanes around the trees which would have been located within the centre of the dual carriageway. The maximum distance between the trees and the roadways would have been between 3 - 4 m either side. This distance is below the safety standards required for lateral clearance to a fixed obstruction for a road of this design speed.

It is unsure whether the trees would survive the construction stage, or on-going traffic environment, due to their age and root system.

(4) A more western route was considered which would have avoided impact on the pine trees, but would require bisection of three properties. The topography in this locality is such that extensive cut and fill earthworks would be required to build the road into the hillside, and would have resulted in visual scarring of the area.

In consideration of the objectives for determining the alignment, and the potential impacts from the options considered and commented upon during the public consultation process, the preferred alignment is considered to provide the best option within the constraints existing within the study area.

3.0 ROAD DESIGN PARAMETERS

3.1 GENERAL

The Bedfordale Hill Section of the Albany Highway duplication is planned to be constructed as a kerbed four lane, median separated dual carriageway. The road is to be bordered on the western side with a dedicated DUP for cyclists and pedestrians.

The horizontal and vertical alignments of the duplication are to meet the engineering requirements for a design speed of 80 km/hour (SLK 27.57 to 32.2) and 90 km/hour (SLK 32.2 to 35.19).

A cross-section of the duplication proposal is included as Figure 2. Plans showing the alignment of the existing pavement and the alignment of the proposed duplicated highway are included in Appendix B.

3.2 DRAINAGE

3.2.1 Subsurface Drainage

To accommodate subsurface waterflow in the area, it will be necessary to incorporate subsurface drainage into the design and construction of cut sections of the road. Subsurface drainage is to be collected and discharged into culverts.

3.2.2 Overland Flow

Catchment areas and water flows have been determined, and culvert requirements calculated on a 20 year design rainfall intensity. Culvert locations, inlet and outlet levels have been incorporated into the road design.

The design incorporates existing culverts, and provides additional culverts along the length of the duplication. The system will include interceptor drains at the top of road batters to collect overland flow and pipe it into the culvert system. This will minimise erosion potential of roadside batters.

The culverts will discharge into Neerigen Brook at regular intervals. Culvert outlets will require energy dissipation to prevent erosion from flow velocities exceeding 1.0 m/sec.

3.2.3 Road Runoff

Two options have been identified in relation to road runoff. The preferred option is that of collection and containment, with an additional option suggested during the public consultation process for whole of site dispersal for runoff.

The first option is based on the concept of road runoff being prevented from entering Neerigen Brook, in order to prevent contamination of the water resource from hydrocarbon or other spilled contaminants on the roadway. Road runoff would be piped and discharged at two locations. The first would be a point in Neerigen Brook below Bedfordale Hill Road, where scheme water is available. The other would be an existing drain network at the commencement of the project area at Triton Crescent. Side entry gullies are to be placed in accordance with the maximum permissible water spread across the pavement, which is 2 m for a dual carriageway.

The second option is to maintain the existing system for road runoff, which allows water to drain directly into Neerigen Brook. This option is discussed further in Section 5.3.2.

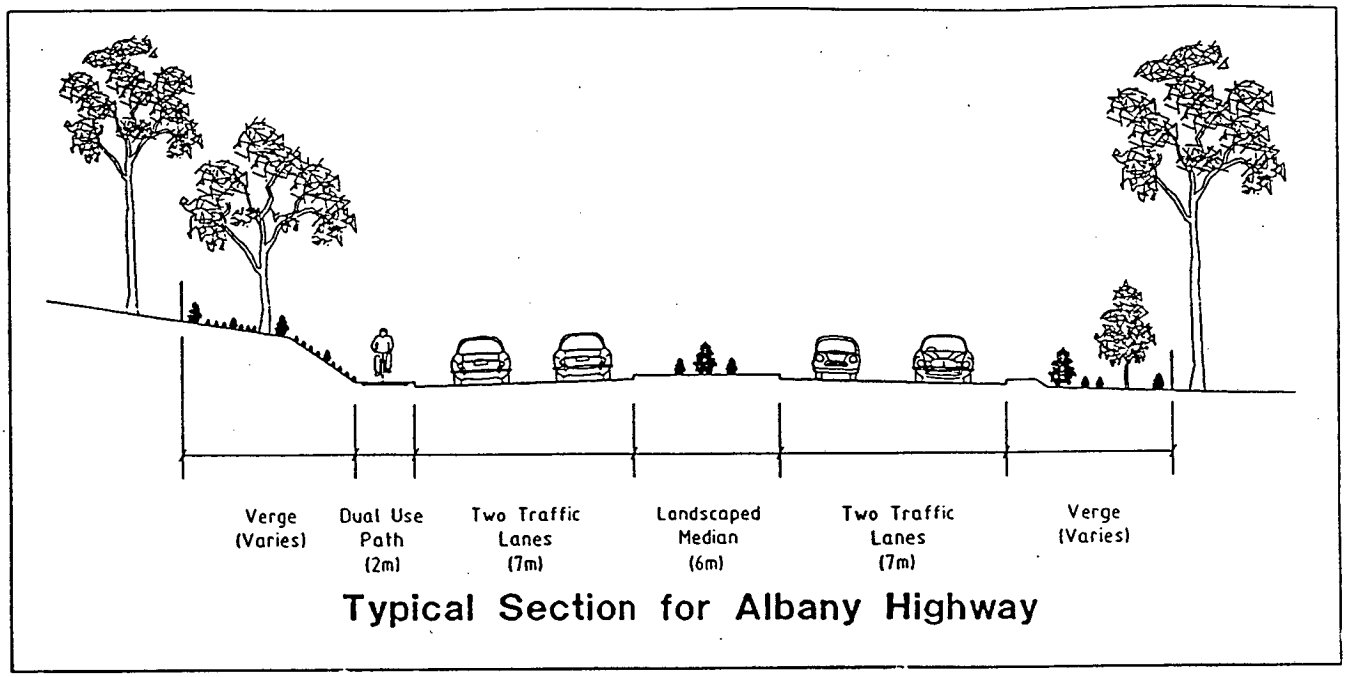


Figure 2 Typical cross section of Albany Highway duplication

3.3 LAND ACQUISITION

Wherever possible, the duplication road design has been contained within the existing road reserve. However, there are 44 lots affected outside the road reserve, including the section of Bungendore Park immediately adjacent to Albany Highway. MRWA currently owns seven lots, with another allotment in the ownership of the State Planning Commission. Bungendore Park is Crown land vested with the City of Armadale for management. The remaining lots are in private ownership.

3.4 MATERIAL SOURCING

All material required for road base and aggregate will be obtained from pre-existing quarry operations. Responsibility for material sourcing is likely to be a component of the construction contract. There will not be a requirement for development of a specific source of construction materials for this project.

The construction contract is to require certification from the materials supplier that sourced construction materials are clean and originate from dieback free areas.

3.5 ROAD BATTERS

Road batters for areas requiring cut and fill are to have a gradient of 1.5:1. The batters for the cut edge of Bungendore Park is proposed to have batters of 3:1 to provide a more suitable surface for rehabilitation. The extent of batters into Bungendore Park will be finalised as part of the detailed design stage of the project.

3.6 PUBLIC CONSULTATION

A comprehensive consultation programme was undertaken during the development of this proposal, which included consultation on the concept plan and the preliminary design, and establishment of a Community Liaison Group.

Environmental issues were raised by the public and interested agencies during the consultation programme. Where possible these issues have been addressed in preparation of the proposal documented within this CER. A summary of the results of the consultation programme is included in Appendix C.

No consultation has occurred directly concerned with this CER. The public review period for this document will form the public consultation exercise specifically concerned with environmental issues.

4.0 EXISTING ENVIRONMENT

4.1 THE BEDFORDALE REGION

The City of Armadale consists of five wards and currently has a population of approximately 50000 people. The percentage of semi-rural inhabitants is unavailable but it must be noted that the average size of the rural holdings in the City of Armadale has decreased over the years from 42 ha (1945) to 28 ha (1974) (unpublished report, City of Armadale). This is attributed to the spread of urban development.

Tourism is a major industry in the South-west of Western Australia, and as such access to the towns of the South-west should be as easy and pleasant as possible. All changes to access roads should be as beneficial as possible to both the residents of the Armadale municipality and the tourism industry in the South-west of Western Australia.

Albany Highway climbs into the Darling Scarp via a re-entrant valley and reaches the crest around Bedfordale. The existing road is contained within a road reserve 25 to 40 metres wide. The reserve is bordered on the north and south by residential and agricultural holdings, as well as State conservation reserves. In addition, Neerigen Brook runs along the northern boundary of the reserve for almost the entire length of the proposed widening.

The project area consists of a semi-rural landscape situated approximately on the crest of the Darling Scarp. The immediate landscape surrounding the proposed road works is characterised by a semi-rural atmosphere because of the large rural blocks, orchards, a brook and period farm houses. The definition of the road reserve is achieved by large stands of both exotic and indigenous trees lining both the road verge and road reserve boundary.

The land use in this area is varied, with the main use being horticultural and agricultural concerns associated with the semi-rural atmosphere. The area contains a number of orchards and vineyards, semi-rural paddocks, hobby farms, commercial premises, pastures concerned with horse agistment and racing, and a Road Train Assembly Area. In addition the alignment also passes adjacent to Bungendore Park, and enters into State Forest to the east of the Road Train Assembly Area.

The visual quality throughout the project area is attractive and there are no areas which require special screening. There is enough variety in the landscape to provide interest for both the local inhabitants and the tourist. Intermittent views of the surrounding Swan Coastal Plain are obtained at high points of the Darling Scarp closer to Armadale.

4.2 CLIMATE

The climate for the region in which Bedfordale is situated is classified as "dry Mediterranean", with a wet winter and a generally dry summer. The dry Mediterranean climate is characterised by 5-6 dry months (Beard, 1979). The rainfall comes from predominantly westerly winds off low pressure cyclonic fronts. Bedfordale receives a mean annual rainfall of 1200 mm due to its proximity to the crest of the Darling Scarp.

The temperatures are generally mild, with an average maximum of 21.6 °C and an average minimum of 9.5 °C. January is the hottest month and July is the coldest. The proximity to the ocean moderates the temperature extremes providing the Bedfordale area with a pleasant mild climate.

4.3 GEOLOGY, SOILS AND LANDFORM

The study area occurs on the Darling Scarp, which forms the interface between the Swan Coastal Plain and the Darling Plateau. The Darling Scarp extends from Muchea in the north, to Dardanup in the South (Department of Planning & Urban Development, 1993a). Around Bedfordale the Scarp rises to a height of 300 m.

The Darling Plateau overlays the Archaean rocks of the Yilgarn Block. Typically, the geology consists of granites, gneisses and migmatites with some intrusive dolerite dykes. The bedrock is usually overlain by a lateritic layer and associated gravels (Department of Planning & Urban Development, 1993a).

Within the study area, the northern end of the alignment overlays granitic materials, consisting of course-grained granites and finer grained dolerites. The central section of the study area passes through alluvial clays overlying lateritic soils. The southern end of the alignment is located over lateritic soils, comprised of sands, gravels and minor clays (Soil & Rock Engineering, 1996a).

The soils in the Darling Scarp are of two distinct patterns: the western part is characterised by laterite gravels and block laterite, while the eastern part is mainly ironstone gravels (Beard, 1979). The presence of clay results in high water holding capacity so the soils are waterlogged in winter but extremely hard when they dry out in summer.

Soil sampling for geotechnical investigations have shown that the soil types vary from silty clays through to gravelly sands according to the base geology. The typical soil types are:

Sandy Gravel / Gravelly Sand: medium dense to dense, orange/brown, medium grained sand, medium to course grained gravels, minor cobble to boulder (up to 1.5 m) size laterites throughout, becoming more predominant at depth, clay traces at depth, and extending to depths of 1.9 - 3.8 m.

Silty Clay / Sandy Clay: very stiff to stiff, predominantly pale grey, mottled yellow, pink, medium grained sands, minor medium quartz grains at depth, becoming stiff to firm and moist to very moist with depth and grading to predominantly white, and extending to the depths investigated between 6.0 - 7.0 m.

Full testpit and borehole logs, including soil characteristic descriptions are contained in Soil & Rock Engineering (1996b).

The history of soil use in the Scarp is mainly agricultural and horticultural with low scale cultivation of fruit trees. It is expected that levels of fertilisers, herbicides and pesticides would be relatively high in areas of the Scarp, where the clay accumulates solutes such as salts, chemical toxins and effluent.

In the road reserve, the soils may have been modified over time with the use of soil additives, land fill and fertilisers. This may have an adverse effect on the re-establishment of native species in these areas. However, there are still significant stands of remnant vegetation where the soil is expected to be relatively undisturbed.

The northern edge of the road reserve in the study area is delimited by Neerigen Brook which runs adjacent to the reserve along the entire length of the proposed works area. Albany Highway runs along the southern edge of the brook, and the reserve then continues to climb in elevation to the south.

4.4 HYDROLOGY

For the entire length of the proposed works, Neerigen Brook traverses the reserve on the northern side of Albany Highway. This brook originates in the vicinity of Springfield and Dmietrieff Roads and has some minor tributaries near Armadale before ending in Wungong Brook near Lake Road 3 km west of Armadale. The brook is used as a source of potable water by some residents and as such is of special concern.

Neerigen Brook has a catchment of 10 km^2 between the Road Train Assembly Area and Bedfordale Hill Road. The catchment extends between 750 m - 1.5 km on either side of Neerigen Brook and Albany Highway. The boundary of the Neerigen Brook catchment is shown in Figure 3.

With the exception of some minor gullies which carry concentrated stormwater from the local road system, the remainder of the project site is well drained with water shedding evenly off the slopes.

4.5 VEGETATION AND FLORA

4.5.1 Regional Description

The Bedfordale area lies within the Darling Botanical District System in the Dale Subdistrict. The Darling System encompasses the northern Jarrah forest which is associated with the laterite-capped plateau. The predominant catena in the Darling System is comprised of the following plant communities, as described by Speck (1958) and Beard (1979):

(A) The open vegetation of granite rock outcrops which protrude through the laterite mantle.

(B) Jarrah forest on the laterite plateau and screes descending from its edges.

(C) Marri - Wandoo woodland on the younger red soils of the scarp and the slopes of the deeply excavated Avon, Helena and Chittering Valleys.

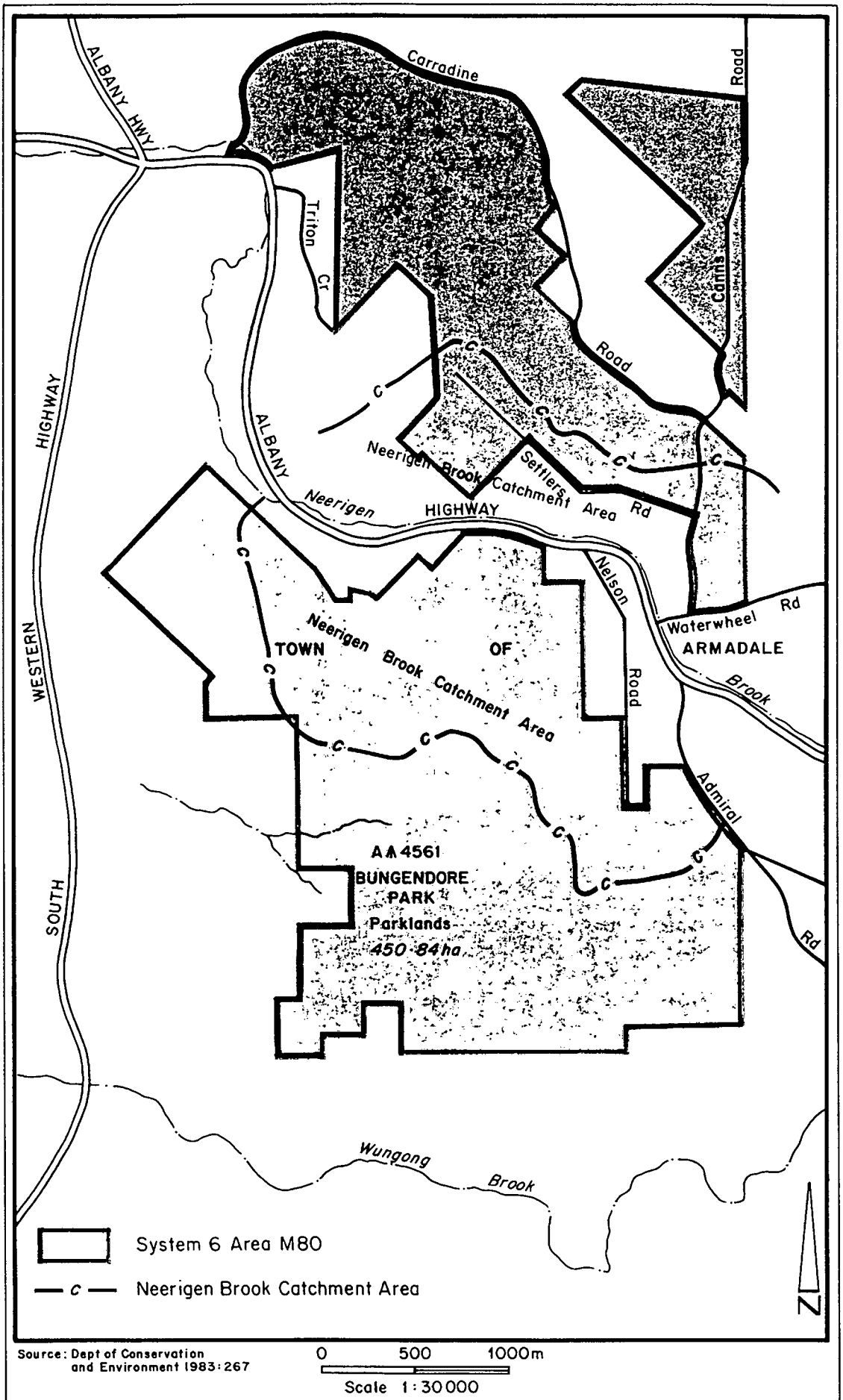
(D) River gums and paperbarks along the watercourses.

Minor catenas occur within the undulations of the major catena. Havel's (1975) studies delineated the specific "site-vegetation types" occurring within the minor catenas, finding that the presence and distribution of plant communities closely reflect local soil types, topography and moisture conditions. Due to the general nature of this study, only the plant communities linked to the major catena are employed, with the exception of two very basic divisions in the Jarrah forest community.

4.5.2 Site Description

Prior to widespread clearing and colonisation, the study area was mainly Jarrah forest with river gums and paperbarks occurring in wetter areas. Using the Beard-Webb Formula the intact native vegetation of the Bedfordale study area is classified as *Eucalyptus* (jarrah and marri) medium trees (10 - 30 m tall) with a mid to dense canopy (Beard & Webb, 1974).

In the proposed road works area, *ecologia* Environmental Consultants have identified one major native vegetation type with variations in understorey. Vegetation types throughout the study area are described by means of specific reference points. Mapped associations are shown in Figures 4 - 7.



Neerigen Brook Catchment Area and Portion of System 6 Area M80

Figure 3

Reference Point 1:
This area is characterised by a dense tall shrubland dominated by *Dryandra sessilis* and *Agonis linearifolia*. Patches of *Allocasuarina fraseriana/Eucalyptus calophylla* over *Acacia pulchella* are also present. Some non-native grasses are present, particularly adjacent to the roadside (Figure 7).

Reference Point 2:
This area is dominated by a row of tall introduced *Eucalyptus* trees over introduced grasses (Figure 7).

Reference Point 3:
This area is characterised by an overstorey of *Eucalyptus calophylla* (Marri) with an open shrubland which includes *Dryandra sessilis, Dryandra nivea, Xanthorrhoea preissii, Agonis linearifolia, Acacia pulchella, Hakea undulata* and *Hibbertia hypericoides*. The ground layer is dominated by sedges with *Lepidosperma* species common (Figure 7).

Reference Point 4:
This area contains an open overstorey of *Eucalyptus calophylla* (Marri) over a relatively low, dense shrubland (0.5 - 1.5 m in height) which includes, *Hakea undulata, Hakea amplexicaulis, Hibbertia hypericoides, Petrophile striata, Xanthorrhoea preissii and Acacia pulchella,* over predominantly sedges including *Lepidosperma* species, *Mesomelaena tetragona,* and Restionaceae species. This vegetation is in good condition and relatively diverse (Figure 5).

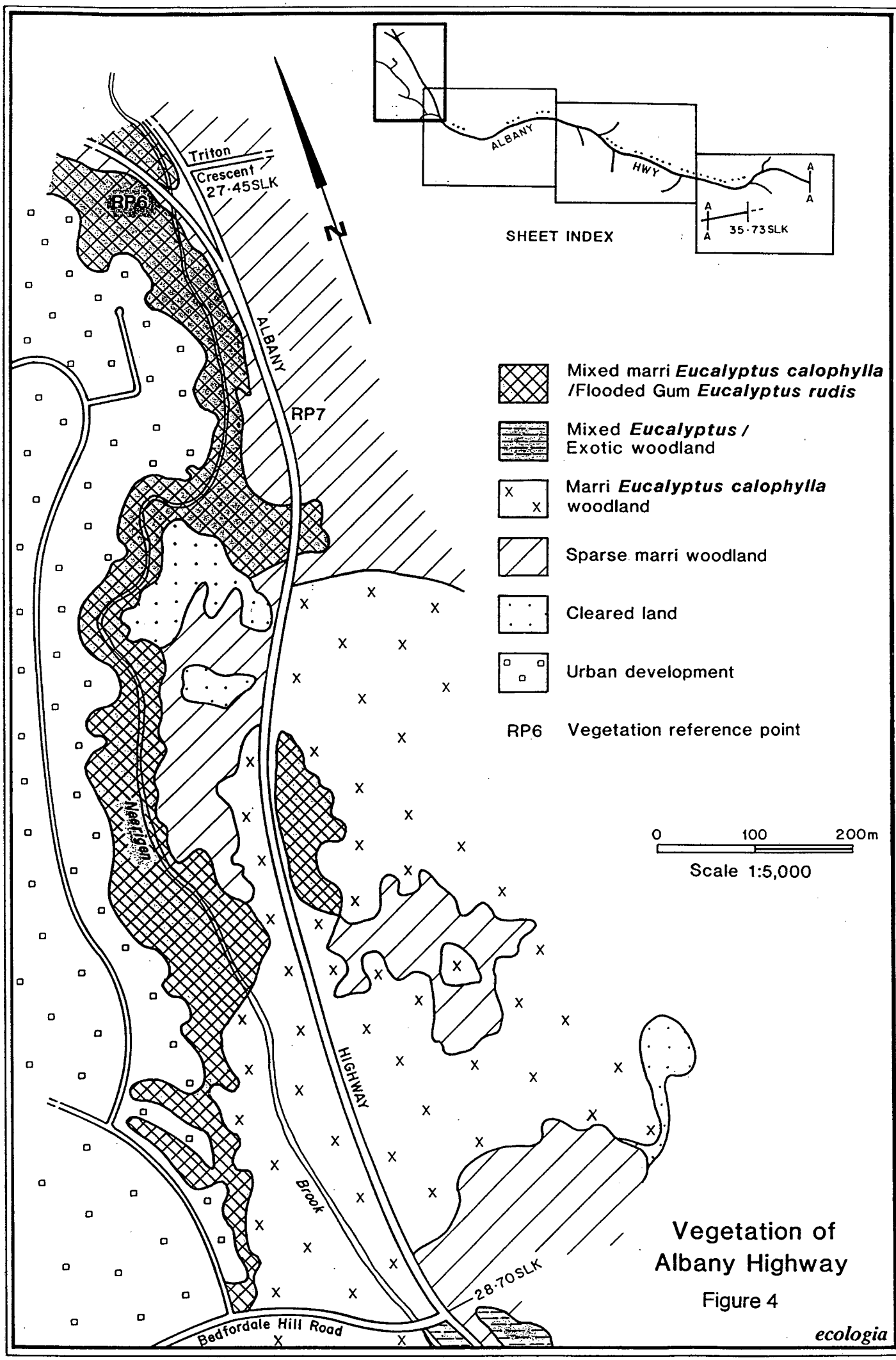
Reference Point 5:
This area is characterised by a dense shrubland of *Agonis linearifolia* over dense sedges and **Paspalum dilatum.* (This tall weed grass is particularly dominant on the edge of this verge). The area was still swampy at the time of survey with a small channel of water ranging from 0.5 to 1 m in width. This shrubland extends 4-6 m. Behind it an open *Eucalyptus calophylla* woodland, similar to Reference Point 3, occurs over *Dryandra sessilis, Hakea trifurcata, Xanthorrhoea preissii* and *Agonis linearifolia* (Figure 6).

Reference Point 6:
The vegetation of Neerigen Brook at this point consists of dense woodland dominated by Marri *Eucalyptus calophylla,* together with an open cover of Flooded Gum *Eucalyptus rudis.* The latter species becomes progressively less common as the ground becomes drier. Paperbark *Melaleuca* species are present in places, and may form a moderately dense tall shrub layer. The ground is dominated by a dense cover of grasses and sedges which are favoured by the damp to wet conditions (Figure 4).

Reference Point 7:
This vegetation type features an open woodland dominated by *Eucalyptus calophylla.* The shrub understorey has been largely cleared and is now sparse. A dense cover of soft grasses, including introduced species such as **Briza maxima,* replaces the low shrubs as the dominant ground cover vegetation (Figure 4).

Reference Point 8:
This area has an open cover of Marri *Eucalyptus calophylla* over a moderately dense low shrub understorey (*i.e.* less than 1 m in height). The low shrub layer includes a variety of species such as *Acacia pulchella, Dryandra nivea, Hakea undulata, Petrophile striata* and *Xanthorrhoea preissii.* At ground level there is an open cover of sedges including species of *Lepidosperma* (Figure 5).

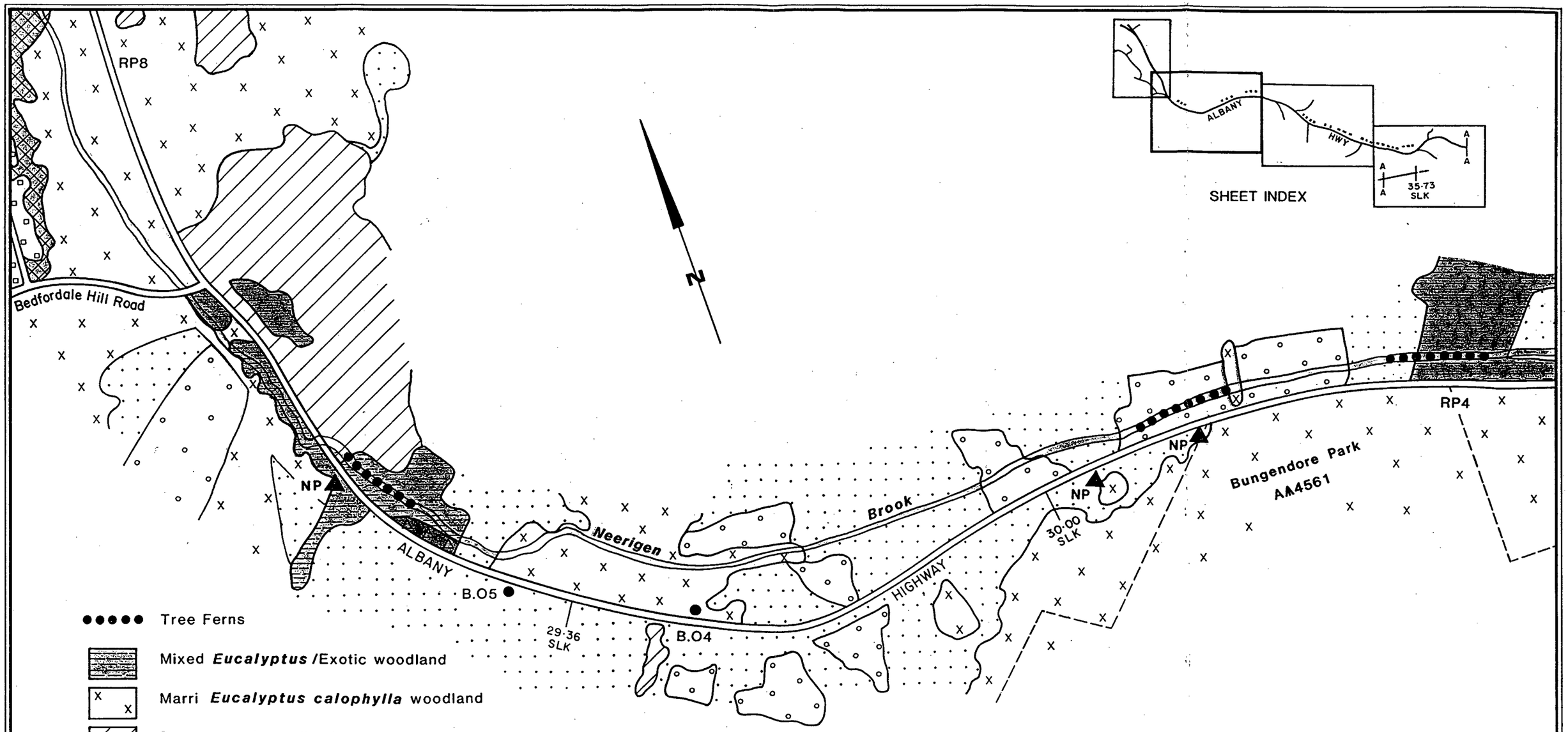
The remaining vegetation units have been modified by human activities and are divided into disturbed mixed jarrah and marri woodland, disturbed marri woodland, orchards, exotic conifer plantations and cleared land. A vegetation list for the study area is included in Appendix D.



Vegetation of Albany Highway

Figure 4

ecologia



●●●●● Tree Ferns

Mixed ***Eucalyptus*** /Exotic woodland

Marri ***Eucalyptus calophylla*** woodland

Sparse marri woodland

Orchards

Exotic conifer plantations

Cleared land

▲NP Norfolk Island Pine

Mixed marri ***Eucalyptus calophylla/*** Flooded Gum ***Eucalyptus rudis***

Urban development

RP4 Vegetation reference point

● B.04 Heritage site

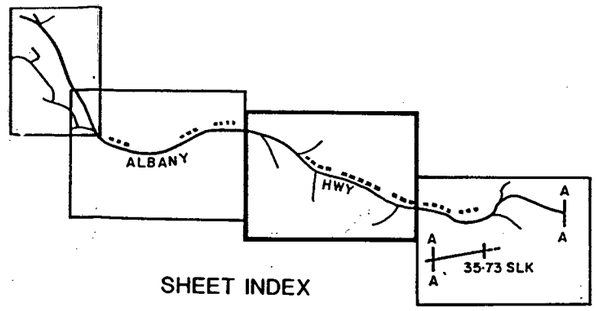
0 50 100 400m

Scale 1:5,000

Vegetation of Albany Highway

Figure 5

ecologia



SHEET INDEX

N

RP5

Nelson Road

Waterwheel Road

ALBANY HIGHWAY

LC

Neerigen Brook

B.03

32·30SLK

Admiral Road

NP

Cross Road

- Tree Ferns
- Mixed *Eucalyptus*/Exotic woodland
- Marri *Eucalyptus calophylla* woodland
- Sparse marri woodland
- Orchards
- Exotic conifer plantations
- Cleared land
- NP Norfolk Island Pine
- LC Lebanese Cedar

- B.03 Heritage site
- RP5 Vegetation reference point

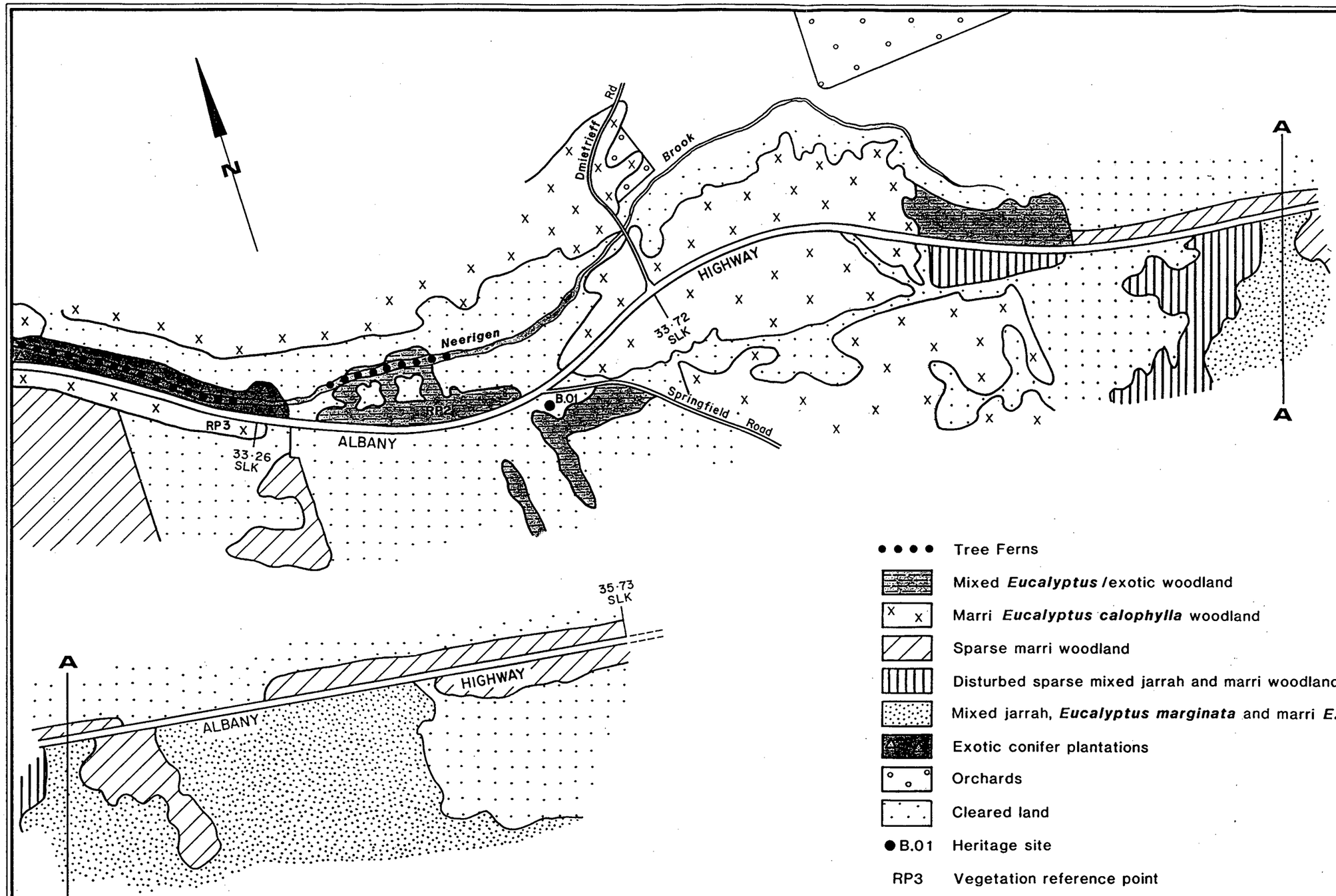
0 50 100 400m

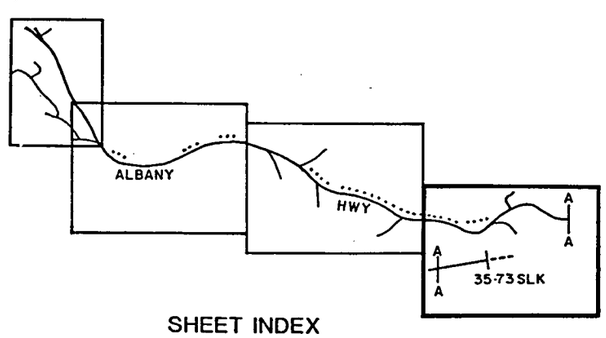
Scale 1:5,000

Vegetation of Albany Highway

Figure 6

ecologia





SHEET INDEX

- Tree Ferns
- Mixed *Eucalyptus* /exotic woodland
- Marri *Eucalyptus calophylla* woodland
- Sparse marri woodland
- Disturbed sparse mixed jarrah and marri woodland
- Mixed jarrah, *Eucalyptus marginata* and marri *E. calophylla* forest
- Exotic conifer plantations
- Orchards
- Cleared land
- B.01 Heritage site
- RP3 Vegetation reference point

0 50 200m

Scale 1:5,000

Vegetation of Albany Highway

Figure 7

ecologia

4.6 DIEBACK

"Dieback" refers to the impact of soil borne fungal plant pathogens such as *Phytophthora cinnamomi*, which result in root rot disease. However the visual effects of dieback or stress may be the result of several factors such as fire, insect attack (especially on *Eucalyptus marginata*) and age (for older trees), as well as fungal plant pathogens. Irrespective of the causal factor, the expression of physiological stress in a plant community is usually perceived as defoliation or discolouration, in particular, chlorosis of foliage. The degree of physiological stress evident in the plant communities was assessed by ranking as follows:

Rank		Physiological Stress
0	-	No evidence of stress.
1	-	Odd plant showing signs of stress, none dead.
2	-	One or two stressed plants, usually under severe stress, near death.
3	-	Scattered stressed and dead plants.
4	-	Susceptible plants dying or dead.
5	-	"Graveyard" death, most trees dead.

Subjective attempts were made to define the possible stressors, but no verification by analytical techniques was undertaken.

Examination of the vegetation remnants of the Bedfordale Hill project area revealed that the vegetation communities present were subject to a low physiological stress level of ranking 0 or 1. Some *Eucalyptus calophylla* appear to be affected by *Armillaria* infection. Clearing, intensive grazing and fires over a protracted period have eliminated the majority of good understorey "dieback" indicator species from disturbed areas. However, dieback infections would be quite old and spread extensively, particularly in the cleared areas along the drainage line. Although no active dieback fronts were noted in the vegetation remnants, the disease is almost certain to be present, if only at very low levels, due to the extreme degree of historical disturbance and proximity of transport vectors.

4.7 FAUNA

Limited information is available on fauna of the Darling Scarp, due to the lack of comprehensive biological surveys undertaken. Within the Darling Scarp fauna habitats are closely aligned with landform - vegetation associations. On the basis of known habitat preferences, the project area may potentially support approximately 100 bird species, 17 native (including nine bat species) and five introduced mammals, 41 reptiles and 11 amphibian species.

There are no known species in the Darling Ranges that are restricted to that area, however marked changes in abundance and distribution of fauna populations, including local extinctions of mammal species, and severe reductions in population size of bird and reptile species has occurred (Department of Planning & Urban Development, 1993a).

In the areas of the proposed duplication, there are no species with a declared conservation status. However Southern Brown Bandicoots *Isoodon obesulus* are known to exist in Bungendore Park.

The Bungendore Park Management Committee has indicated that there is a population of King Skinks *Egernia kingii* which are located within the impact area for this proposal. King Skinks are olive brown to black in colour, and can grow to 50 cm in length. They are distributed throughout the south-west of Western Australia and its offshore islands. When occurring away from coastal areas, King Skinks occupy rock outcrops (Cogger, 1992). This species is not listed as protected fauna by the Department of Conservation and Land Management (CALM), and as such has no special protection status.

4.8 BUNGENDORE PARK

Bungendore Park is situated to the south of Albany Highway (see Figure 3). An 'A' Class Reserve (↑A4561), the park was vested in 1897 with the Armadale Kelmscott Road Board which was renamed the Armadale City Council in 1965. With an area of 498 hectares, the park has four listed bush walks and two information display shelters.

In addition to being an "A" Class Reserve, Bungendore Park forms a component of the System 6 Area M80 - Darling Scarp - as recommended by the EPA in their assessment of conservation reserves in Western Australia (Department of Conservation and Environment, 1983). This assessment classifies the southern and western slopes of Bungendore Park as the most floristically important within the park boundaries.

The recommendations made for the M80 area in the assessment were:

M80.1 That the general recommendations on planning and management of Regional Parks be applied to this area.

M80.2 That the Metropolitan Region Planning Authority consider "reserving" those portions not already reserves for Parks and Recreation under the Metropolitan Region Scheme.

M80.3 That the vacant Crown land adjacent to Reserve ↑A4561 be declared an 'A' Class Reserve for Parklands and that the Reserve be vested in the Town of Armadale.

M80.4 That the operators of quarries be required to produce assessments of the environmental implications of existing and future quarries and plans for their rehabilitation and restoration.

M80.5 That roads be excluded entirely from the valley south of Crystal Brook, and the Ellis Brook valley, and that no further roads be constructed in the Bickley Valley and Mills Road Valley.

(Department of Conservation and Environment, 1983:261).

As a component of the System Six area M80, Bungendore Park is also within the boundaries of the Darling Range Regional Park; one of the areas of regional open space which has been identified by planning procedures as having outstanding recreation and conservation values (Department of Planning and Urban Development, 1993b).

Bungendore Park also contains the Southern Brown Bandicoot *Isoodon obesulus*. The Bandicoot is considered to be of State conservation significance, by virtue of the current Schedule 1 Wildlife Conservation Act 1950 status. Any removal of habitat that is of significance to the Bandicoot would be detrimental to the population in the area.

Another issue is that of Flora Management, mainly in reference to protection of native and exotic species. Bungendore park has two orchid species within it's boundaries that are listed on the Declared Rare and Priority Flora List (Atkins, 1995). These are:

- Dwarf Bee Orchid *(Diuris micrantha)*: The Dwarf Bee Orchid is confined to a small swampy area south of Perth, where it grows in shallow water amongst dense native sedges (Hoffman & Brown, 1992).

- Star Orchid (*Thelymitra stellata*): The Star Orchid occurs in isolated colonies between Three Springs and Pinjarra. Near Perth, it is found amongst shrubs in the lateritic loams of the Jarrah forest (Hoffman & Brown, 1992).

Both of these orchids are now Declared Rare Flora, having been upgraded from Priority 2 status. Declared Rare Flora are taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such (CALM, 1995).

4.9 HERITAGE TOPICS

4.9.1 Aboriginal Sites

The Aboriginal Affairs Department has three sites of significance recorded in the vicinity of the Albany Highway Bedfordale Hill project area. Two of these sites are related to Neerigen Brook; one is a mythological site associated with the Waugal and the other is recorded as a water source and camp site overlooking the Neerigen Brook. The third site is an artefact scatter located near the northern end of the study area.

4.9.2 Cultural Heritage

Currently there are no listings in the Bedfordale area with either The National Trust of Australia or the Heritage Council of Western Australia. However there is a local Municipal Heritage Inventory, managed by the City of Armadale, that has four listings for the project area: Adderley's Residence, Mount Paradise, Paradise Cottage and Willow Heights.

4.9.3 Visual Amenity

The Darling Scarp and Ranges comprises a major landscape unit which forms a distinctive visual feature. The significance of the landform is twofold; a backdrop to Metropolitan Perth, and as a viewing point for the coastal plain and Indian Ocean.

As a component of the Darling Range Regional Park planning study, a visual resource assessment of the Darling Range sub-region was undertaken (DPUD, 1993c). The assessment entailed the application of the Visual Resource Management System, which requires definition of:

(1) Landscape Character Types;

(2) Scenic Quality Assessment;

(3) Seen Area Assessment and Public Sensitivity Level; and

(4) Landscape Management Zones and Visual Quality Objectives.

The study area falls into the Darling Plateau Landscape Character Type, Sub Type: Darling Upland. This unit includes the scarp face, areas of undulating uplands with gently sloping hills and valleys, deep V-shaped valleys and fast flowing rivers.

The alignment of Albany Highway falls within a category of high scenic quality from the commencement of the study area (Triton Crescent) to the point at where the Highway diverges from the Bungendore Park boundary. The remainder of the alignment subject to the duplication proposal is classified as having moderate scenic quality.

Albany Highway as it passes through Bedfordale has a viewshed of up to about 500 m, which provides a seen area of foreground only. The Darling Range visual resource assessment indicated major travel routes with the highest public sensitivity levels. Albany Highway within the City of Armadale was not included within this category. However, the alignment was allocated as a High Priority Landscape Management Zone.

The visual quality objective for the High Priority Landscape Management Zone is one of maximum retention of existing Landscape Character. Under this classification, any visual alterations should be designed to have a minimum visual impact as far as practical to an observer after a period of five years from the initial alteration.

5.0 ANTICIPATED ENVIRONMENTAL IMPACTS

5.1 GENERAL

As the route traverses a near metropolitan semi-rural landscape within the Darling Scarp the potential exists for the proposed roadworks to produce negative impacts on both the biophysical and social environment.

During the early feasibility stages of the project, and according to the CER guidelines issued by the DEP, the key topics identified are:

(1) Biophysical
- System 6 Area M80: impact to Bungendore Park, an 'A' Class Reserve and System 6 area;
- Rare flora and fauna: protection of any rare flora and fauna in accordance with the Wildlife Conservation Act 1950;
- Remnant vegetation: identification and protection of any regionally significant vegetation;
- Erosion: prevention of erosion due to vegetation clearing and increased run-off;
- Dieback: identification of the dieback status of the area, and development of dieback management measures to ensure containment or maintenance as a dieback free area;
- Vegetation clearing: minimisation of clearing of remnant native vegetation occurring within the road reserve; and
- Water Supply: management of demand for water during construction from Neerigen Brook so that environmental needs are met.

(2) Pollution
- Dust control: dwellings and conservation areas being kept free from unacceptable impacts of dust
- Contaminants from stormwater: collection and disposal systems designed to ensure that reduced or no contaminants reach Neerigen Brook;
- Noise: noise at residential dwellings should comply with statutory requirements both during construction and during operation;
- Water quality in Neerigen Brook: during construction turbidity of Neerigen Brook requires management;
- Hydrology of Neerigen Brook: hydrological regime of Neerigen Brook should be maintained at pre-construction levels; and
- Environmental values of Neerigen Brook: environmental values to be maintained or enhanced.

In addition to the key topics, a number of additional aspects of impact to heritage features and the social environment are discussed, although they may fall outside the scope of the definition of environment under the Environmental Protection Act 1986. These topics relate to heritage values, visual amenity and social impacts arising from construction activities and are provided as extra information on project management for members of the public as opposed to environmental topics requiring assessment by the EPA.

5.2 POTENTIAL IMPACTS ON THE BIOPHYSICAL ENVIRONMENT

5.2.1 Bungendore Park

The road design will result in roadworks affecting the Albany Highway edge of the Park. The extent of the ingress into the park will depend upon batter slopes required for road construction. Current plans using a batter slope of 1.5:1 indicate a requirement for a maximum of 25 m ingress along the northern edge of Bungendore Park. However, a batter slope of 3:1 is proposed, and is to be investigated as a component of the Detailed Design stage of the project.

Bungendore Park is adjacent to Albany Highway between SLK 30.30 to 30.64, therefore having a total length of 340 m of the park edge to be effected by roadworks. Actual acquisition of land for road pavement is up to 7 m along the park edge, giving a total area of no more than 2380 m^2 required for acquisition.

In addition to the area for road pavement construction, a requirement exists in this location for cut batters. The total area of impact on Bungendore Park is based upon the scenario of a batter slope of 3:1 being implemented, and includes the 2380 m^2 for roadworks. The total extent of batters ranges between 10 - 70 m along the park boundary. The total area of impact will therefore be approximately 1.4 ha. This represents 0.28 % of the total area of Bungendore Park.

The vegetation along the Albany Highway edge of Bungendore Park is Marri *Eucalyptus calophylla* woodland, which is well represented throughout the study area.

The impact of the project on Bungendore Park will include clearing of vegetation and alteration of landform due to the necessity to cut at this location to obtain necessary grades and batter slopes. The area of cut through the Bungendore Park boundary will occur through sandy gravel, described as fine to medium grained sand, and medium to course grained gravel with clay traces throughout (Soil & Rock Engineering, This area of cut is underlain by gravels and cemented laterites at between 0.3 - 1.5 m, and laterite is believed to be extensive within the cut sections. Although the 1.5:1 batter would impinge less on the park area, the steeper lateritic profile would prove difficult to revegetate and would therefore have a higher level of visual intrusion than the more gentle slope.

A population of King Skinks (*Egernia kingii*) is known to be located within the area which will require reworking for road construction. A community of 15 - 20 King Skinks are to be relocated to an area of suitable habitat between 200 - 300 m further into the Park. The relocation will be overseen by the Bungendore Park Management Committee and the WA Museum, and will involve a volunteer component. The required fauna licence to undertake the activity has been approved by CALM. MRWA are funding a grant for the relocation programme.

The proposed duplication does not compromise the System 6 recommendations made for the M80 Darling Range location.

5.2.2 Rare Flora And Fauna

Declared Rare Flora (DRF) and Priority Flora Species are those flora species protected under the Wildlife Conservation Act, 1950. Priority species are maintained on a "Reserve List" and assigned to one of four categories. Bungendore Park contains two species of orchids that are listed as Declared Rare Flora (DRF).

These orchids are the Dwarf Bee Orchid (*Diuris micrantha*) which is located within swampy areas populated with native sedges. This habitat is not located within the area of Bungendore Park required for roadworks. The Star Orchid (*Thelymitra stellata*) is generally found on lateritic loams and so is unlikely to be found on the sandy gravel soils on the northern boundary of the Park. A DRF survey will be undertaken in spring to ensure than no DRF or Priority Flora are located within the impact area.

The roadside vegetation and the impact area of Bungendore Park are not suitable habitats for the Southern Brown Bandicoot, which is the only known Schedule fauna species from the study area. The fauna as a whole cannot be considered as unique or restricted in distribution. Most species are common and widespread throughout the region.

5.2.3 Regionally Significant Vegetation

The study area falls within the Jarrah - Marri forest on laterite plateau, which is typical for the Darling System (Beard, 1979). The intact native vegetation from larger vegetation stands adjacent to the Albany Highway alignment is in good condition with the exception of the 5 m strip directly adjacent to the road pavement. Weed infestation is much greater next to the road due to less native plant cover which facilitates weed establishment.

The project area is surrounded by residential properties with large tracts of cleared land used for horticultural and agricultural practices. The occurrence of weed species in this land is much more prevalent than in the remaining stands of native trees.

The existing road reserve vegetation is at best a representative remnant of the original cover, however it has been severely degraded over most of its area due to invasion of weed species and human interference such as clearing.

The strip of vegetation which is proposed to be cleared on either side of Albany Highway is well represented in the adjoining vegetation and throughout the conservation estate. In the locality, the Jarrah - Marri woodland is conserved in Bungendore Park, and is effectively protected within water supply reserves over the catchments for the Wungong Dam and the Churchman Brook Reservoir.

5.2.4 Vegetation Clearing

Between Triton Crescent (SLK 27.46) and Bedfordale Hill Road (SLK 28.66), road construction will occur within the existing road reserve, except for two small areas required for batters. The road reserve contains a remnant Marri overstorey. On average, a total of 10 m either side of the existing pavement could be impacted by the duplication. A total area of 1.2 ha of sparse Marri woodland would be impacted in this section.

Between Bedfordale Hill Road (SLK 28.66) and the Bungendore Park boundary (SLK 30.64) the area of impact is predominantly cleared land. Clearing of native vegetation is limited within this sector.

As discussed in Section 6.2.1, a maximum of 1.4 ha of Marri woodland on the Bungendore Park boundary would require clearing.

Albany Highway in the sector between Nelson Street (SLK 30.80) and Springfield Road (SLK 33.64) is bounded by cleared land and orchards, with occasional stretches of Marri overstorey within the existing road reserve. The impact on a 140 m strip of Marri trees (between SLK 31.88 and SLK 32.02) will be minimised by the use of a retaining wall instead of full batters. An additional area of approximately 0.3 ha between SLK 32.82 and SLK 33.02 consisting of sparse Marri woodland will require clearing on the southern side of the existing Albany Highway alignment.

The remaining sector is that between Springfield Road (SLK 33.66) and the Road Train Assembly Area (SLK 35.18). Between SLK 33.66 and SLK 34.06 a 15 m strip of Marri woodland will be impacted by the proposal (a maximum of 0.6 ha).

The last area of native vegetation that will require clearing occurs between SLK 34.58 and SLK 35.08. This area is a mixed Jarrah and Marri woodland occurring within the existing road reserve. A total area of approximately 1 hectare will be impacted by this proposal.

A total of approximately 4.55 hectares of native remnant vegetation will require clearing as a result of this project. As discussed in Section 6.2.3 the vegetation is typical of that found in the Darling Scarp region.

5.2.5 Dieback

The dieback status of the project area is unconfirmed, however due to the level of disturbance, and the susceptibility of the vegetation, dieback infection is likely to be present. The site has been treated as "not effectively quarantined" for management purposes to minimise the risk of dieback being introduced from external areas.

The dieback status of the area will be determined prior to construction, and a management plan developed according to the results. The management strategy will be based upon ensuring that no soil movement will occur between infected and non-infected sites within the project area.

5.2.6 Neerigen Brook

Due to the close proximity of Neerigen Brook to the existing road alignment, the duplication project will impinge upon the drainage line in some locations. Further, in the vicinity of Bedfordale Hill Road, the extent of the roadworks impinges upon the Brook alignment. Consequently, it will be necessary to deviate the Brook from its current alignment to allow the duplication to proceed within the engineering design criteria. The impacts of this requirement are manageable, based upon engineering design and construction strategies to ensure that the long-term water quality and the aesthetic landscape are not detrimentally impacted.

The duplication project will require the deviation of Neerigen Brook in two locations:

- south of Bedfordale Hill Road to where the Brook crosses beneath Albany Highway; and
- a portion of the Brook to the north of Admiral Road.

The deviation of Neerigen Brook in the Bedfordale Hill locality will require the creation of a new channel up to 10 m west of its existing alignment. A total length of up to 250 m will be affected. The deviation north of Admiral Road will affect approximately 80 m of the Brook, resulting in a movement of up to 5 m east of its existing alignment.

Direct impacts of the required deviation will occur in reference to water quality during the construction phase of the brook realignment. This will predominantly be in terms of a temporary increase in the sediment load carried by the brook. The hydraulic characteristics of the brook, in terms of flow rates and velocities will need to be accounted for in the design of the channel bed for the realignment.

5.2.7 Erosion Potential

Batter slopes for areas of cut and fill have been determined through geotechnical investigations to ascertain construction materials and stability factors for the design process. Gradients of batters are recommended to be between 1.5:1 and 1.75:1.

The potential for scouring and slip failures on cut slopes from surface drainage is possible, and has previously occurred in the study area. Potential for erosion and slip failure is reduced through the geotechnical investigations determining the suitability of the site materials for batters. In combination with the drainage system and rehabilitation measures erosion potential for the project will be minimised.

5.3 POTENTIAL POLLUTION IMPACT FROM THE PROPOSAL

5.3.1 Dust

The impact of dust generation in residential areas is primarily a social impact, causing nuisance in the form of dust settling on cars, laundry and outdoor furniture. In high volumes, dust may also have implications for human health; particularly in reference to respiratory complaints and eye irritations. Dust may also impact vegetation adjacent to works areas, where it settles on leaves and hinders biological function.

Dust will be generated during the construction phase of the project due to ground disturbance from earthworking. The potential for dust generation from the site will continue until the rehabilitation is successfully implemented.

5.3.2 Drainage

Under the existing situation for drainage, the overland flow and road drainage flow enter Neerigen Brook along its whole length. There are no provisions to prevent fluid or solid spills from entering the Brook.

Two options for the management of drainage are contained within this CER. The first is the preferred option which involves the separation of overland flow from road drainage flow. The second option arose during the public consultation programme and is based upon maintaining the current drainage characteristics of the project area.

Separation of Overland Flow and Road Runoff
In order to minimise the possibility of pollutants reaching the brook from the road surface, the preferred drainage system is separated into two components; overland flow and road drainage flow. The rationale is to maintain the current flow of water from the catchment to Neerigen Brook, but to minimise the risk of having road runoff contaminated by either transport spillage or the conglomeration of oils and other substances which amass on the road surface during the dry summer months enter the water flow.

Overland flow from the Neerigen Brook catchment yields good quality water which is used by local residents for domestic use. Separation of road drainage allows the opportunity for containing any possible spill within the main piping system and therefore prevent it from entering Neerigen Brook itself. The control mechanism will be a locking gate at the exit pipe at the last manhole. This system will provide greater protection than any small basins or ponds.

The catchment of the road surface from the Road Train Assembly Area to the intersection at Bedfordale Hill Road is 0.12 km^2, in comparison to the overland flow catchment area of 6 km^2, with water volumes entering Neerigen Brook of 0.7 m^3/sec from a total catchment runoff volume of 6.4 m^3/sec. The removal of this volume of water directly from the total volume of the Brook during rainfall events will not significantly alter the hydrological characteristics of Neerigen Brook.

The discharge point of piped road runoff joins with Neerigen Brook at the location where the brook becomes a designated drainage reserve. The flow rate and volume of water at this point will prevent the settling and sedimentation of minor pollutants at the discharge point. Sufficient dilution is expected to occur to prevent contaminant levels below the discharge point being higher than those that currently occur.

This option is consistent with the DEP Guidelines for the CER requiring that stormwater collection and disposal systems should be designed to ensure that minimal or no contaminants reach Neerigen Brook.

The separation of overland flow from road surface runoff is the option preferred by MRWA for this project.

No Alteration to Drainage System
By not providing separation of overland flow from road runoff, pollutants from the road surface can enter the Brook and will therefore occur in water drawn from the Brook by local residents.

There would be no possibility of containing any spills that occurred on the roadway; a situation which would cause serious disruption to residents unable to draw from the Brook in this eventuality. This option is inconsistent with the DEP Guideline stating the stormwater collection and disposal systems should be designed to ensure that reduced or not contaminants reach Neerigen Brook.

5.3.3 Noise

MRWA have established noise assessment methodology and noise level criteria for new roads and road upgrading. The MRWA practice on noise assessment and mitigation is utilised in the absence of other policies in this regard.

The Bedfordale Hill project is categorised as an upgrading project. The objectives of a traffic noise impact assessment for the project are to:

- establish existing levels of noise along the project;
- determine the future noise impact of traffic using the road; and
- identify noise control options to achieve Noise Level Objectives.

Noise level objectives are specified upper limits of traffic noise which should not be exceeded, and apply outside residential buildings. In general, the objective for existing roadways is to limit any noise level increase to 3 dB(A). That is, any increase due to road modification is considered acceptable if the increase is limited to 3 dB(A). The Acoustic Assessment for the Bedfordale Hill project was performed by Herring Storer Acoustics (1996).

The finding of the noise assessment is that three residential locations may be adversely impacted by noise level increase. The expansion will not change the acoustic environment for any other residences. The cause of the noise level increase is road realignment that results in the traffic being closer to some residential locations.

5.4 HERITAGE AND SOCIAL TOPICS

5.4.1 Aboriginal Heritage

None of the three sites currently registered with the Aboriginal Affairs Department lies within the impact area of the proposed road duplication. Additional ethnographic and archaeological survey work will be undertaken prior to construction to ensure that no unregistered sites will be impacted by this proposal.

5.4.2 European Heritage

Of all the sites mentioned, Paradise Cottage is of the greatest importance as it lies within the reserve, very close to the existing route of Albany Highway (Figure 5). All due care must be taken to ensure that no damage is sustained by this site.

Willow Heights has been identified as being within the area required for acquisition for the duplication project. The remaining sites are outside the direct impact area of the roadworks.

Willow Heights has been purchased by MRWA and consultants have been appointed to consider options available for relocating the building to another site. This process is being undertaken in association with the City of Armadale.

There are significant stands of exotic plants that may be of Cultural Heritage value, although no specific listings were found with the Heritage Council of Western Australia or the City of Armadale Draft Municipal Heritage Inventory for this area. Although there are no specifically protected trees, the vegetation contributes to the visual amenity of the current road alignment. The proposed alignment will require the removal of four Norfolk Island Pines, to satisfy safety requirements for the design speed of the duplication.

5.4.3 Visual Amenity

The roadworks will impact on the visual amenity of Albany Highway through the Bedfordale Hill section, as the widened roadway will result in removal of trees that line the current alignment. The existing native and exotic vegetation has created visual enclosure along certain parts of the road corridor. The new design will result in visual enclosure being removed from the majority of the road corridor, and the opening up of more extensive viewsheds than currently exist.

The mix of native vegetation, exotic gardens, and orchards along the alignment provides a diverse viewscape for drivers passing through the area. Due to design requirements for roads with travel speeds of 80 -90 km/hour, large plants must be setback 6 -7 m from the roadway. This standard will result in a broader, wider character to the new road.

The duplication will also require steeper cutting to embankments along parts of the road corridor, that will expose more rock and soil in the short term, prior to vegetation becoming established.

The proposed duplication impinges directly upon physical and aesthetic issues, so it is important for the landscape design to address the issues sensitively and creatively. This is addressed in rehabilitation and landscape prescriptions discussed in Section 6.0.

5.4.4 Construction Impacts

Land Use and Acquisition
The Albany Highway Bedfordale Hill Section Duplication will not alter or restrict existing landuse in the project area. The project has been designed to occur within the existing road reserve wherever possible, however there is a total of 36 lots from which roadside areas of up to between 2 m and 30 m are required. Eight additional lots in government ownership are impacted by up to 4 m and 33 m; this includes land owned by MRWA, the State Planning Commission, and Crown Land in the form of Bungendore Park.

Liaison and acquisition of required portions of land is being carried out by Sinclair Knight Merz in association with Land Acquisition officers of MRWA, according to standard MRWA procedures.

The duplication of the Albany Highway road reserve will require alteration to lot boundaries and resurveying and vesting of the newly created road reserve.

Access Severance
In reference to median openings, the City of Armadale have resolved that there will be no left turn from Albany Highway northbound into Bedfordale Hill Road (except for emergency vehicles), left turn only from Bedfordale Hill Road into Albany Highway northbound, and right turn only from Albany Highway southbound into Bedfordale Hill Road. U-turns on Albany Highway from southbound to northbound will be possible.

The duplication of Albany Highway will result in the severance of direct access to and from Nelson Street, which services 12 special rural lots. Nelson Street is to become a cul-de-sac with no access to or from Albany Highway. Severance is required due to the sight line distance not meeting minimum requirements and therefore creating a hazardous intersection. An emergency exit will be provided using a barrier arrangement allowing for one way emergency evacuation onto Albany Highway.

Access severance is necessary to ensure safety aspects of road usage.

Traffic
The construction process will cause traffic delays due to the high use rate of the existing road, and the limited opportunities to divert traffic from the roadworks. Construction will be carried out under constant traffic, and time delays for road users are an inevitable impact of this proposal during the construction phase.

Services Relocation
The duplication project will require relocation of services which occur within the area required for road construction. Relocation requirements exist for water, power and telephone services. No gas services will be impacted by the proposal. Services to residents will be disrupted during the time that the infrastructure is disconnected and reconnected.

6.0 ENVIRONMENTAL MANAGEMENT PROGRAMME

6.1 AIM

The aim of this section is to document the methods by which the identified project impacts can be minimised. Environmental Management should begin with environmentally, culturally and aesthetically sensitive road planning and design. It should continue through implementation, starting with on-site protection of vegetation and fauna using environmentally sensitive construction methods. After completion of the new works any disturbed areas remaining should be revegetated. The success of the Environmental Management Programme (EMP) should be monitored over a period of years with additional works being undertaken as required to ensure that the intent of the EMP is met.

The EMP contains detail on rehabilitation and landscaping practices to be implemented for this project. A landscape concept has been prepared (Hames Sharley, 1996) and specifications are to be developed for this concept to ensure effective rehabilitation within the impact area. The EMP also documents strategies for management of social impacts that may fall outside the scope of issues that can be assessed by the EPA.

The recommendations for management of the road construction project are separated into three distinct phases, these being:

- Pre-construction Phase
- Construction Phase
- Post-construction Phase

Commitments are made within the EMP that will be audited by the DEP following assessment of the project. These and additional commitments concerning implementation are discussed further in Section 7.0.

6.2 PRE-CONSTRUCTION PHASE

6.2.1 Bungendore Park

Bungendore Park is an 'A' Class reserve and a System 6 area, with known DRF occurring within the park boundary. Consequently, the proponent will undertake a Declared Rare Flora search in the impact area prior to construction commencing.

Gradients of batters for the Park area affected by earthworks will be determined during the detailed design stage. Rehabilitation of the batters will occur according to the rehabilitation and landscaping guidelines within this EMP.

Commitment

A survey for Declared Rare and Priority Flora will occur in the impact area within the boundaries of Bungendore Park during Spring 1996. Any requirements to remove Declared Rare and Priority Flora will be subject to approval by CALM.

6.2.2 Dieback

Due to the high level of historical disturbance, the area may be contaminated with dieback. In order to determine the presence and location of dieback within native remnant vegetation a Dieback Survey will be undertaken prior to construction commencing.

A Dieback Management Plan will be prepared for the whole site based on the results of the dieback survey.

All road works should take place in the dry months only, to minimise the potential for introduction or spread of dieback.

Commitment

Prior to construction, analysis for the presence of dieback within areas of remnant native vegetation will be carried out.

The results of the dieback survey will form the basis of a Dieback Hygiene Management Plan to prevent the spread of dieback within the project area. The survey and management plan will be carried out to the satisfaction of CALM.

6.2.3 Vegetation Clearance

A limit-of-works should be shown on the plans with co-ordinates or distances from the reserve boundary. It should generally correspond to the limit of site disturbance caused by earthworks. The superintendent should ensure that this line is not transgressed, by pegging the works area prior to construction activities commencing.

Areas with intact exotic or native vegetation should not be disturbed if outside the limit-of-works. Large trees close to the limit of works should be identified and fenced with temporary fencing to protect them from accidental damage. Fines and/or replacements should be made for damaged trees. Special attention must be given to the areas of tree ferns and exotic conifers that line the reserve to prevent them from sustaining any damage.

Following detailed design, the possibility of pruning trees rather than removing them is to remain an option where driver safety will not be impaired by the tree remaining.

Commitment

The clearing of vegetation is to be minimised by ensuring that the maximum extent of roadworks impact is demarcated on construction drawings. The works area is to be pegged prior to construction commencing to ensure that the limit-of-works is adhered to.

6.2.4 Noise Amelioration

The acoustic assessment found that three residential locations would experience excessive noise based on MRWA assessment criteria. Noise control measures are to be considered for the nominated locations primarily to ascertain whether barriers can be utilised along the road verge.

The use of noise walls in front of the three affected properties will be investigated as a component of the detailed design stage. The height and construction materials for a noise wall fronting the affected properties will be undertaken in conjunction with Sinclair Knight Merz and the MRWA Noise Assessment section.

Noise amelioration will be implemented to ensure that compliance with MRWA criteria occurs.

Commitment

A Noise Management Strategy for the three affected residences will be developed, based upon investigation of suitable materials and specifications for noise walls. Additional monitoring will be carried out as required, and amelioration techniques implemented to satisfy MRWA criteria for noise levels from MRWA criteria.

6.2.5 Neerigen Brook Deviation

Prior to construction, the engineering design for the Neerigen Brook deviation is to document channel design parameters. The channel design is to be based upon existing width and depth characteristics. Construction impact methods and rehabilitation are discussed in the Sections 7.3 and 7.4 respectively.

Commitment

Confirmation of hydrological characteristics of Neerigen Brook, in order to design the sections requiring realignment in accordance with existing channel parameters will be carried out.

6.2.6 Other Topics

Project Induction

An induction to the area should be conducted by MRWA before any work takes place. This induction should include all information pertaining to the job, as well as any information regarding the topics described in Section 5.0.

Land Acquisition

The planning design phase for the Albany Highway duplication resulted in recommendations to MRWA as to what land will be required for the construction of the project. The process of land acquisition is to be carried out by MRWA, in accordance with the provisions of the Public Works Act 1930.

The process is to include:

- discussion with land owners during the planning stage to define the possible impacts on their properties, and to provide information on how the acquisition process will proceed. Consideration should be given to the extent to which severance affects existing land use.
- an experienced land acquisition officer from MRWA Land and Properties Branch be available to meet owners/occupiers to further explain the acquisition and compensation process.
- compensation for or purchase of land required to be based on market value as assessed by qualified land valuers. This includes a MRWA valuation and a private valuation (paid for by MRWA) to reach an agreed sum on the land value.

Aboriginal Heritage Sites

Prior to construction commencing, a complete archaeological and ethnographic survey of the impact area will be carried out. Any Aboriginal heritage sites found to be within the impact area during the detailed design stage are to be the subject of an application to disturb the site in accordance with Section 18 of the Aboriginal Heritage Act 1972.

Cultural Heritage Sites

The City of Armadale Municipal Heritage Inventory is incorporated into Section 5.8 of Town Planning Scheme Number 2 (TPS No 2). The clauses of this section on Heritage Provisions, Conservation of Buildings and Places of Heritage Significance need to be adhered to during the project.

In reference to the Willow Heights property, the current owner will be relocating from the property, which has been purchased by MRWA. The house is currently being examined by MRWA in association with the City of Armadale for potential relocation to another site.

6.3 CONSTRUCTION PHASE

6.3.1 Erosion

Siltation Control
Erosion control is required on new batters to manage drainage on newly constructed slopes. Drainage is to be provided along the top of embankments to intercept surface runoff, and to protect toes of embankments to prevent scouring. Drainage pipes along the top of batters are to connect with the culverts system managing overland flow.

Fill embankments will require adequate compaction and subsequent topsoiling and seeding to promote revegetation . Where runoff cannot be diverted and may potentially cause washouts rock fill or walls is to be put in place to prevent scouring of the toe of the batters.

Due to the close proximity of roadworks to the Neerigen Brook, the construction process must prevent loading of the creekline with eroded sand and silt from the works area. The following procedures should be followed for erosion and siltation control:

- sandbags should be used at all culverts and in any table drain with a slope greater than 5 %, or 1 in 20.
- recently constructed batter slopes should be stabilised with biodegradable Jute matting to prevent erosion.
- should significant rainfall events occur during construction, straw bales to create sedimentation ponds, are to be on hand for placement where appropriate at culvert and drain outlets to prevent sediment loaded runoff entering Neerigen Brook.

Batters and Retaining Walls
Batters should be no steeper than 1.5:1. Where this is not possible due to land limitations, retaining walls or stone pitching should be used. Where it is necessary to reduce excess clearing of remnant vegetation or to save an existing mature tree, the batters may be steepened to 1:1. Spray mulching or application of biodegradable jute matting to steeper batters is recommended.

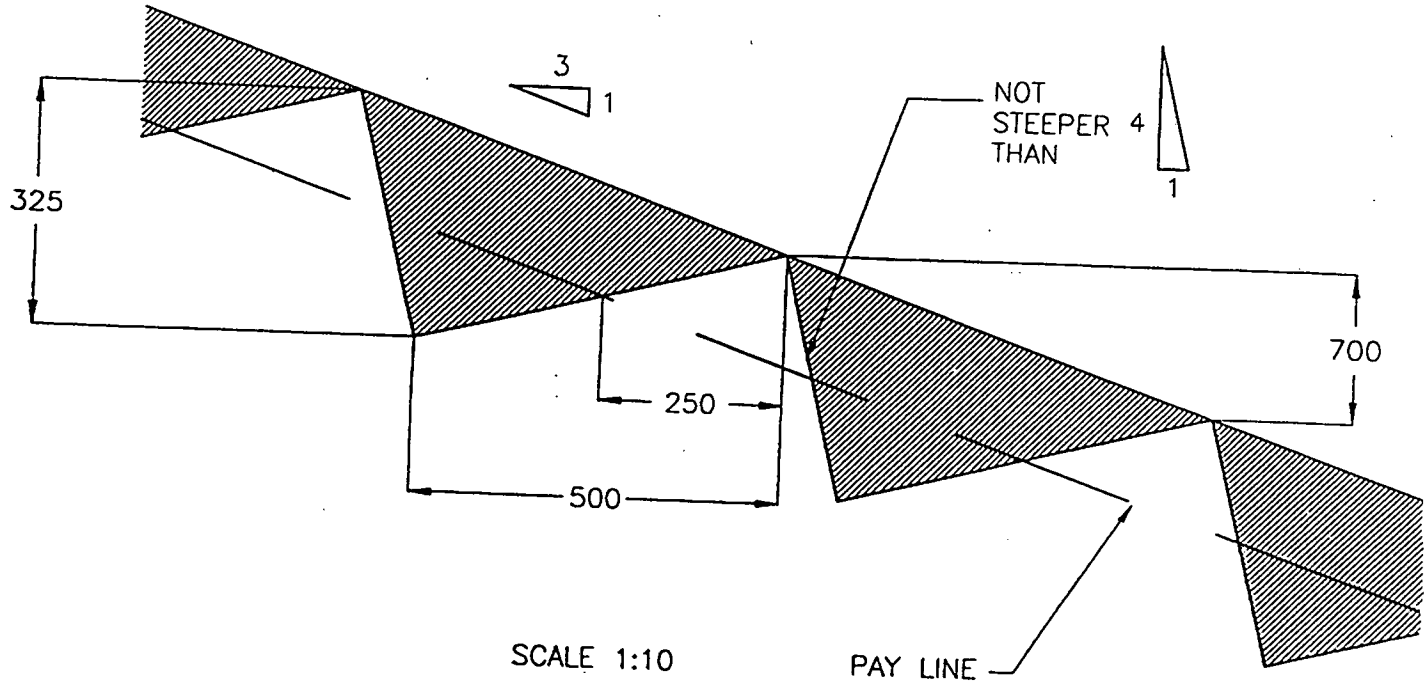
Four retaining walls occur throughout the new road corridor. These are to be built from natural stone used along the valley. Stone is to be laid to a random bond, with raked joints so mortar will not be visible. Walls are to be on a slight batter with weep/drainage holes located at 5000 mm centres through the last course above ground level.

Where batters are to be 1:1.5 the use of 'step cutting' of batters is to be undertaken to allow platforms for collection of soil and vegetable material, which can be planted or seeded according to the Landscape Design drawings. Step cutting is to be implemented during the road construction process. The steps are to be inset by approximately 0.5 m and to be at right angles to the overall gradient of the batter slope. The vertical face of the steps is to have a gradient no greater than 1:4. An example of the design of stepped batters is shown in Figure 8.

Commitment

Erosion control measures will be implemented to prevent an increase in sediment and nutrient load occurring in Neerigen Brook. This will include intereceptor drains at tops of batters, the use of stabilising jute matting on new batters, use of straw bales as sediment filters during rainfall events, and implementation of the rehabilitation strategy as soon as practicable following completion of earthworks.

Figure 8: General dimensions of stepped cut batters



Source: MRWA Landscape Design Drawing No 93410012

6.3.2 Dieback

Pending the results of the Dieback Survey, the entire Bedfordale Hill project area should be treated as potentially dieback infected. The area can be classified as "Not Effectively Quarantined". A dieback hygiene programme will be implemented to reduce the risk of any transport of infection. All earthmoving equipment and vehicles entering and leaving the construction area should be washed down before entering or leaving the work site in accordance with the CALM Dieback Hygiene Manual (CALM, 1992).

Potential exists for introduction of dieback into the project area. Consequently, dieback control procedures are to be strictly adhered to during construction. The CALM Dieback Hygiene Manual (CALM, 1992) Section 3 for "Clean Down" should be implemented for vehicles entering the site with source materials. All vehicles leaving the site should be washed down with scheme or saline water. In dry conditions, vehicles can be brushed down rather that washed down if no soil is adhering to them. Wash-down facilities should be provided on site at a location approved by the superintendent.

Additional strategies to be included in the dieback procedures include:

- selection of material source sites which are known to be free of dieback;
- cleaning down of machinery prior to delivery to the site, to ensure all soil and root material is removed, using a brush and/or compressed air in dry soil conditions, or washdown with fungicide treated water in wet soil conditions;
- construction activities to occur during summer to minimise risk of spreading of dieback;
- education of construction and operations staff in procedures of dieback hygiene.

Commitment

Implementation of the Dieback Hygiene Management Plan as developed during the Pre-Construction Phase.

6.3.3 Vegetation Clearing

Management of Cleared Vegetation
Vegetation is only to be cleared in areas directly required for roadworks, and is to be stockpiled as close as possible to the site of clearance. Initially, the vegetation is to be pushed into a windrow by use of front end rakes, which minimise disturbance to the soil profile. Vegetation is to be retained in windrows until required for processing for rehabilitation.

Any felled vegetation with a diameter greater than 100 mm at the base should be left on site as erosion protection, or as a fauna haven where the location is adjacent to remnant native vegetation. Other vegetation should be chipped or mulched and spread to a depth of 50-70 mm over any site that requires rehabilitation and rototilled into the existing soil.

Chipped and mulched vegetation is to be re-applied to approximately the same area as it was collected from. Where an excess of material occurs in a given area it is to only be used in areas of the same vegetation association, as defined by vegetation mapping included as Figures 4 - 7.

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

Topsoil Management
Topsoil management recommendations have been adapted from draft guidelines produced by MRWA (1995).

The topsoil in areas of remnant vegetation will contain a seed source for rehabilitation. The topsoil and the overlying litter layer are to be stockpiled for rehabilitation. The extent of weed infestation in remnant vegetation in the study area is generally low enough for the material to be used for this purpose. Topsoil from areas mapped as exotic conifer plantation, orchards or cleared land will not contain a useful seed source and is not to be stockpiled for use in the rehabilitation programme.

Topsoil is to be removed following clearing of vegetation to a depth of 5 to 10 cm. The topsoil is to be retained for a minimum amount of time in order to maximise the viability of the seed store within the material. For the Bedfordale Hill project, the topsoil is to be re-applied no later than the end of each construction stage (*i.e.* May 31). Topsoil is to be respread dry to a maximum depth of 5 cm.

Topsoil cleared from the works site should be stockpiled in windrows (no higher than 1.5 m) on site and respread over approximately the same area as it was collected from after completion of works. In the event of rain, the topsoil stockpiles are to be spread and dried as soon as possible, to prevent the seed in the centre of the stockpile from germinating and rotting.

In areas where topsoil is significantly infected with weeds (in particular *Watsonia* species), the soil is to be removed, and disposed of in a pit not located within an area of native vegetation, or is to be buried under a minimum cover of 30 cm of weed free soil. Due to the potential for dieback infestation, no topsoil is to be removed from the project area for use elsewhere. It is however suitable for re-application in its area of origin.

Commitment

Vegetation and topsoil management strategies will be implemented through the construction phase as a component of the landscape and rehabilitation programme described within this document.

6.3.4 Dust Control

Dust should be controlled through repeated spraying of earthworks with potable water only. In dry conditions watering shall be conducted at least four times per day, while construction activities are proceeding.

There is also potential for dust generation between completion of sections of roadworks and initiating rehabilitation. If complaints are received from residents, then a paper mulch should be sprayed on problem areas to stabilise the surface until permanent stabilisation can be achieved.

Commitment

Control of dust generated through roadworks will be controlled by regular spraying with potable water.

6.3.5 Contaminants from Stormwater

Additional techniques will be required within the overland flow drainage system to manage sediment and nutrient movement, and erosion control. The main factor in the use of these techniques is to ensure that the water quality of Neerigen Brook is not adversely impacted by the project. The strategies are to apply to culvert outlets and road drainage pipe outlets, as described in Section 3.2.

Settling Basins

To reduce the effects of erosion, siltation and turbidity, settling basins are to be constructed in the road verge adjacent to culvert outlets, and at the discharge points of the road drainage system. The aim of these basins is to reduce the velocity of the runoff from the discharge point by pooling the water and restricting the flow rate. Although discharge velocities do not exceed 2.6 m/sec and will therefore have a comparatively low erosion potential, the transport of silt sized particles remains a problem.

The pipe outlets will discharge over a concrete apron to disperse the water over an increased area following the concentration within the pipe system. The settling basins consist of a depression of approximately 20 cm depth below the outflow level of the apron, with a width of approximately one metre. The basins will extend the length of the concrete apron. This system will encourage sedimentation, with only clear water moving into the riffle zone.

The settling basins will experience a build-up of sediment which will require manual removal as part of general road maintenance procedures.

Riffle Zones

These are to be placed on the downhill end of the settling basins. As the water flowing from the basins may still be moving quite quickly, riffle zones are used to slow the water velocity entering Neerigen Brook and to trap any further silt. These zones are recommended to be as wide as the corresponding settling basin, and proportional at a rate of approximately 1:2. The riffle zones are to be constructed of rocks between 5 cm and 15 cm in diameter, or equivalent gabion mattress units.

During the construction phase it will be necessary to provide interim sedimentation trapping to guard against rain events. Sediment loads will be heavy during earthworks and construction due to ground disturbance and so this contingency is necessary until roadworks are completed and the rehabilitation stage has been initiated. The use of strawbales is recommended, to be positioned at the far edge of the riffle zone, for the length of each respective zone.

Riffle zones will experience a build up of sediment which will encourage revegetation. This is to be encouraged, as it will improve visual amenity, create further sediment trapping niches and reduce water flow velocities.

Commitment

A drainage strategy will be adopted that will minimise the potential for contaminants, sediment and nutrients from entering Neerigen Brook. The drainage strategy will be resolved to the satisfaction of the DEP and the City of Armadale.

6.3.6 Noise Control

Due to the proximity of residents to the works area, construction is to be restricted to a maximum of 10 hours per day between the hours of 7 am and 6 pm; with a maximum of 60 hours per week.

Commitment

During the construction phase, works will occur between the hours of 7:00 am and 6:00 pm to a maximum of 60 hours per week.

6.3.7 Water Quality in Neerigen Brook

Management techniques to prevent the siltation of downstream areas are required to maintain water quality in areas where water may be drawn for domestic consumption. It is also necessary to prevent erosion of realigned channel banks where they are adjacent to batters of the duplicated roadway.

The new channel alignment for the brook is to be wholly excavated prior to water diversion occurring. Also prior to water diversion, sediment filtering mechanisms are to be placed at the downstream end of the re-aligned channel. The use of straw bales is recommended for this purpose. The filter will remove finer particles of sediment that will be mobilised by the initial movement of water through the newly excavated channel. The diversion should occur during summer when the base flow will be lowest, to minimise the potential for initial erosion of the channel bed.

The realigned channel bed is to be lined with rocks of between 5 cm and 15 cm diameter, or appropriately sized gabion mattress units. This will prevent stream bed erosion and encourage sedimentation within the channel alignment.

Settling basins and riffle zones as described in Section 6.3.11 are also to be implemented at the point where Neerigen Brook is channelled beneath Albany Highway. This location will require additional filtering of sediment following the opening of the realigned channel which is expected to have a high initial sediment load.

The southern bank of the Admiral Road deviation will require reinforcement, as will the outer bends of the section of the Brook which crosses beneath Albany Highway. Gabion walls are recommended for reinforcement of channel banks. Gabion walls consist of wire mesh cells filled with a mix of earth and rocks, the mixture varied according to the application. The cells can be varied to form structures with vertical, battered or steeped fronts as required. In addition, front faces of the cell can be filled with soil to allow planting, or can be seeded thereby assisting the revegetation phase. The final locations, and the length of area to be treated will be a function of the eventual stream morphology as determined by the engineering specifications for the Neerigen Brook deviation.

6.3.8 Other Topics

Traffic Management

As the opportunity for traffic diversion from the works area is limited, management of traffic is important. MRWA will advertise the dates and times in which the works will be undertaken in the West Australian and local community newspapers. The advertisement will indicate the extent of the works, the requirement for speed restrictions, and indicate a contact officer to respond to enquiries.

Aboriginal Heritage Sites
The discovery of any archaeological or ethnographic material during construction activities requires that all work cease in the locality of that site, and the Aboriginal Affairs Department be notified. Work is to be suspended until permission to proceed is received from the Aboriginal Affairs Department.

Services Relocation
The timing of works is to be co-ordinated where possible with works required for services relocation (Western Power and Telstra), in order to minimise site disturbance and inconvenience to residents and road users. Provision is to be made for water supply to residents during the period when pipe cuts have been made and new connections are completed and operational.

Chemical Spillage
Spillage of oil, fuel, grease or any other toxic substance during construction should be immediately removed from the site and disposed of in accordance with the required procedures for transport of such goods documented in the Explosive and Dangerous Goods Act 1961 Regulations.

The works contractor will be responsible for the development of a contingency plan for the clean-up of fuel spills as a condition of being awarded the construction contract.

Hardstand Areas
At the completion of construction, all hardstand areas shall have the asphaltic surfaces removed and properly disposed of, and all sub-base should be deep-ripped. The entire disturbed area is to be deep ripped to a minimum depth of 500 mm at 500 mm spacing.

Weed Control
Prior to completion of works where rehabilitation cannot be achieved in the same season, a weed eradication program should be implemented over areas prone to infection of weeds.

Applications of herbicide, should be applied according to the manufacturers specifications. The optimum timing for application is during the latter months of winter to early Spring, (August to September). Application of herbicides during this period should prevent flowering and seeding of the majority of weeds occurring in the project area. Grass selective herbicides can be used over rehabilitated areas, however, other herbicides cannot be applied around native plant seedlings or planted tubestock, except by careful hand application.

Commitment

Weed control will be incorporated into the rehabilitation programme within Section 6.0, in order to prevent the infestation of weeds to areas disturbed by roadworks.

6.4 POST-CONSTRUCTION PHASE

6.4.1 Landscape Design Guidelines

The objective of the landscape and environmental management plan is the maintenance and rehabilitation of all disturbed areas. Revegetation must take place only in those areas which have been disturbed by roadworks or where vegetation is non existent. All disturbed areas should be seeded or planted according to the Landscape Design Drawings. Micro-relief should be provided in all rehabilitated areas to maximise water permeability, maintain soil friability and maximise seed lodgement. Micro-relief should be provided via ripping and the retention of vegetative and soils debris produced during clearing.

The Landscape works should be implemented as soon as possible after completion of the roadworks, according to the Landscape Plan prepared for the project by Hames Sharley (1996). The major recommendations of the Landscape Design Concept are summarised below.

The philosophy of the landscape design concept is to retain as much variety of landscape as had previously existed. It is also to provide roadside planting that reflects the natural vegetation of the area and planting that reflects the cultural aspect of the road corridor, including a form of planting that relates to the entrance onto the Swan Coastal Plain at Armadale.

The basic design approach has three main aspects:

- *Ecological*: involves the use of native plant species to create a simplified composition of the natural ecosystem, in combination with other native species that are not endemic but have a proven record in road side rehabilitation.
- *Cultural*: involves the use of exotic plant species that are already part of the valley landscape, and to use them in situations where the road widening has eradicated previous planting.
- *Selective*: planting selected from a palette of non-native species to create a special effect, such as an entry feature, and to signify a road intersection or to highlight an historic landscape.

A specific list of species for revegetation and rehabilitation are included in Appendix E.

6.4.2 Landscaping and Rehabilitation Requirements

Rehabilitation
All areas impacted by construction works are to be rehabilitated. This is to occur by spreading of stockpiled vegetation over destabilised ground to minimise wind erosion of surface sediments, and to provide seed, moisture traps and fauna micro-habitats. The rehabilitation programme is to include landscaping and revegetation to reduce the visual impact of the widened road.

Supplementary reseeding and planting using local species is to occur in the winter following construction if natural regeneration has not occurred, according to the landscape design concept and the requirements of the completion criteria.

Weed Control
Ongoing road reserve maintenance and rehabilitation may require the application of herbicides to control weed species. This is to occur in newly landscaped and adjacent areas with a grass selective herbicide over three years in order to fulfil completion criteria.

Irrigation
In general, the project will not require artificial irrigation, except for designated areas where exotic planting is installed. Irrigation will be required for the first three years to achieve establishment of these plantings, after which time the irrigation can be disconnected.

Areas designated for irrigation are:

- portions of the central median relating to culturally significant areas;
- intersections with exotic species; and
- entry statement species.

Maintenance of the irrigation system is to come under the landscape maintenance contract.

Mulching
Mulching to be used during implementation of the landscape works is to consist of weed free native vegetation cleared from the road corridor. Existing vegetation is to be chipped on site and respread. Logs or large branches taken from site as part of the clearing process are to be replaced on site for fauna and flora habitats at the direction of the construction superintendent.

Seeding
The seed stock for the project is to be obtained from the road corridor and adjacent bush areas, prior to works commencing. Broadcast seeding is to be used to result in a more natural arrangement of species. However, large trunked species are to be separated from the main seed mix and seeded according to setback requirements for the road design criteria.

All leguminous seed is to be steeped in just boiled water overnight and broadcast on the following day.

Seed beds are to be ripped to a depth of 400 mm to ensure good root preparation. Final soil preparation is to involve a light harrowing to loosen the soil surface. The seed bed is to be left 'dimpled' with small hollows and high points just prior to seeding.

Planting
Planting is not to commence until the soil is moist to a depth of 300 mm; or after the commencement of winter rains. Locations, quantities and species are to be planted according to the defined areas on the landscape design drawings.

The following requirements are to be met for the planting programme:

- a hole to be excavated for each plant, sufficient to accommodate the root system;
- the plant to be removed from its container without damaging the top growth or root system;
- plant to be placed in the hole so that the root system is not coiled or turned upward and so that the top of the rootball finishes 12 mm below surrounding soil level;
- excavated soil to have clods, rocks and detritus greater than 50 mm removed, and then to be backfilled around the plant to eliminate air pockets and to create a saucer shaped depression around the seedling; and
- a 1 x 10 g Langley Tree tablet to be placed with each plant according to manufacturers directions.

Each plant is to be thoroughly watered following planting. All tube stock seedlings are to be supplied with a rabbit-proof guard to maximise the establishment of planted vegetation.

Commitment

Landscaping and rehabilitation works will be carried out in accordance with the specifications documented.

6.4.3 Completion Criteria

General
The objective of the completion criteria is that the landscape and rehabilitation specifications result in a sustainable area of vegetation that integrates with the surrounding landscape. The landscape guidelines are designed to ensure that the Landscape Management Zone Objective of visual intrusion being minimised as far as practical within five years from the initial alteration is attained.

The revegetation is to be monitored to ascertain whether satisfactory germination and development of revegetated areas has occurred. A particular criterion is the extent to which invasion of weed species has occurred. Unsatisfactory progress in condition of desired vegetation, or excessive extent of weed species is to result in remedial action being implemented.

Slope Stabilisation
Road batters are to be monitored for three years following the implementation of the landscape design. Monthly monitoring is to occur during winter due to the erosion potential at this time.

Success of Seeding
Seeding areas are to be assessed in June 1997, February 1998, June 1998 and February 1999. The following procedure is to be implemented to determine the success of seeded areas:

(i) isolate square metre quadrants at random locations;

(ii) document the number of germinated seeds; and

(iii) document the species diversity of seeds germinated.

The documentation of five seedlings per quadrant can be interpreted as successful rehabilitation.

Species per Square Metre
A criteria of three species per square metre represents a successful rehabilitation in reference to achieving species diversity.

Extent of Weed Invasion
Criteria set for achieving successful control of weed species are:

(i) no weed species shall be within 300 mm of recently germinated seedlings within the second month after seeding; and

(ii) no weed species are to obtain a height above recently germinated seedlings within the first month after seeding and then again four months later.

Aesthetic Appearance of Roadway
The aesthetic appearance of the road corridor is to be assessed by a series of photographs taken along its lengths immediately after civil works, and in December 1997, June 1998, December 1998, and June 1999.

The predominant colour will gauge the success of the rehabilitation, and therefore the aesthetic appearance of the project. The criteria to be met are:

(a) Following civil works: a red gravel colour.

(b) February 1997: with possible revegetation (green) showing maintained weed growth (brown).

(c) February 1998: colour dominate by 70 % dark / olive green / greys.

(d) December 1998: Criteria of 70 % green growth.

Commitment

Rehabilitation monitoring will occur on all rehabilitation works twice per year for at least the first three years.

6.4.4 Funding

Landscape Works
It is important that adequate funds over and above the initial landscape construction and the regular maintenance funds are available for the Landscape Establishment Program as outlined in the Monitoring Report.

This program ensures the proper establishment of the landscape design, preserves the site assets and ensures that the financial investment made in the site is not wasted.

The following five year funding is recommended:

- Year One* - 10% of landscape implementation budget,
- Year Two - 8% of landscape implementation budget;
- Year Three - 6% of landscape implementation budget;
- Year Four - 4% of landscape implementation budget; and
- Year Five - 2% of landscape implementation budget.

*Year One = One year after implementation of revegetation works.

7.0 PROPONENT COMMITMENTS

7.1 IMPLEMENTATION OF THE ENVIRONMENTAL MANAGEMENT PROGRAMME

7.1.1 Implementation Schedule

MRWA Metropolitan Division is responsible for the construction of the Albany Highway Bedfordale Hill Section Duplication in an environmentally and socially responsible manner. The environmental management procedures detailed in the EMP documented within Section 6.0 are to be complied with throughout the design and construction of the project.

The project is scheduled to be constructed in two stages between December and May 1996/97, and between November 1 and May 31 in 1997/98. The commencement of the project is subject to attainment of all necessary approvals.

Pre-construction management recommendations are to be carried out prior to commencement of site works. Strategies documented for the construction phase are to apply between the dates specified, and apply to both stages of construction. Post-construction requirements are to apply from June 1, 1997 for Stage 1 of construction and be ongoing, and from June 1, 1998 for Stage 2. This is necessary to ensure that landscaping and rehabilitation are implemented as soon as possible after siteworks, to prevent long-term exposure of destabilised surfaces, and to ensure the viability of seed stock in topsoil piles. Monitoring and reporting requirements for the landscaping and rehabilitation aspects of the project may be separated for the two phases.

7.1.2 Landscape Establishment Program

A Landscape Establishment Program with an appropriate budget will be included as part of the original works program and should be over and above the regular maintenance procedures undertaken by the Division. It should include the following:

- a semi-annual works or establishment program for the first five years after construction;
- measures which address the problems and suggested solutions as outlined in the Post Construction Reports; and
- a record of the procedures employed and their success rate.

7.2 MONITORING REQUIREMENTS

7.2.1 Rehabilitation Monitoring

General
Post Construction Monitoring of the works should be carried out by a biological scientist, botanist or landscape architect twice a year for at least three years.

The following procedures should be undertaken:

Site Visit
Semi annual visits to the site preferably in Summer and Winter should take place at approximately the same time each year, *e.g.* in February and July. This will ensure monitoring of site conditions during the extremes of temperature, rainfall *etc.*

Report
A Post Construction Report detailing the current status of the project should be made at the time of the visit, or made from site notes as soon as possible after the visit. The report should do the following:

- Describe the cultural, physical, biological and aesthetic conditions of the site and evaluate them in terms of the completion criteria detailed above;
- Identify specific problem areas, in particular problems associated with management techniques, timing of works, cost and maintenance of works;
- Recommend solutions for the problems.

Photographic Record
A photographic record should be made at the time of the site visit. To facilitate yearly comparisons of the site the following procedures should be followed:

- photo points should be selected locations, where physical impact is most noticeable;
- markers should be set in the ground to identify the exact location of these points.
- photos should be taken at of approximately 1600 mm above ground level.
- photos should be labelled with the appropriate chainage and orientation and date;
- plant species visible in the photo should also be recorded.

The photographic record should be included in the report.

7.3 AUDIT REQUIREMENTS

7.3.1 Auditing of the Environmental Management Programme

The EMP included in Section 6.0 documents completion criteria for landscaping and rehabilitation. In order to determine that the set completion criteria have been satisfied requires a monitoring and audit programme. MRWA utilise Environmental Assessment and Management Plans (EAMP) to implement environmental management recommendations for road projects. An Environmental Assessment and Draft Management Plan currently exists for this project, and this will be amended to be consistent with the outcome of the formal environmental assessment process.

The finalised version of the EAMP will include a commitment and implementation schedule similar to that produced through the environmental assessment process. This schedule will form a component of the contract for the Works Contractor and will be subject to audit through the Landscape and Environment Branch of MRWA.

7.3.2 Audit of the CER

MRWA will undertake auditing of the Conditions of the Minister for the Environment on the Albany Highway Bedfordale Hill Section Duplication project CER assessment. Reporting will occur at the completion of each major phase of the project, or an annual basis where any one phase extends over more than 12 months. The report will be in the format of a typical Progress and Compliance Report and will be submitted to the Audit Branch of the DEP for assessment.

A summary of the required actions in each of the project phases is included in Table 2. This table will form the basis of an audit schedule for use by the DEP

7.4 SUMMARY OF PROPONENT COMMITMENTS

This section summarises the commitments made by MRWA throughout this CER document. The commitments are discussed according to the phase in which they are to occur and are sequentially numbered for the life of the project.

The commitments have been separated into those which will be audited by the DEP through the progress and compliance reporting procedure, and those which will be contained within the MRWA internal audit process.

7.4.1 Commitments for Audit by the DEP

All Phases

(1) MRWA are committed to effective environmental management practices, and will implement the mitigation and management strategies documented within the EMP contained within this CER.

(2) Alterations to the EMP proposed herein will occur according to comment received from public submissions received on this CER. The EMP as detailed in Section 6.0 will be implemented to the satisfaction of the DEP.

Pre-Construction Phase

(3) A survey for Declared Rare and Priority Flora will occur in the impact area within the boundaries of Bungendore Park during Spring 1996. Any requirements to remove Declared Rare and Priority Flora will be subject to approval by CALM.

(4) Prior to construction, analysis for the presence of dieback within areas of remnant native vegetation will be carried out.

(5) The results of the dieback survey will form the basis of a Dieback Hygiene Management Plan to prevent the spread of dieback within the project area. The survey and management plan will be carried out to the satisfaction of CALM.

(6) The clearing of vegetation is to be minimised by ensuring that the maximum extent of roadworks impact is demarcated on construction drawings. The works area is to be pegged prior to construction commencing to ensure that the limit-of-works is adhered to.

(7) A Noise Management Strategy for the three affected residences will be developed, based upon investigation of suitable materials and specifications for noise walls. Additional monitoring will be carried out as required, and amelioration techniques implemented to satisfy MRWA criteria for noise levels from MRWA criteria.

(8) Confirmation of hydrological characteristics of Neerigen Brook, in order to design the sections requiring realignment in accordance with existing channel parameters will be carried out.

Construction Phase

(9) Erosion control measures will be implemented to prevent an increase in sediment and nutrient load occurring in Neerigen Brook. This will include intereceptor drains at tops of batters, the

use of stabilising jute matting on new batters, use of straw bales as sediment filters during rainfall events, and implementation of the rehabilitation strategy as soon as practicable following completion of earthworks.

(10) Implementation of the Dieback Hygiene Management Plan as developed for Commitment 5.

(11) Vegetation and topsoil management strategies will be implemented through the construction phase as a component of the landscape and rehabilitation programme as per Section 6.0.

(12) Control of dust generated through roadworks will be controlled by regular spraying with potable water.

(13) A drainage strategy will be adopted that will minimise the potential for contaminants, sediment and nutrients from entering Neerigen Brook. The drainage strategy will be resolved to the satisfaction of the DEP and the City of Armadale.

(14) During the construction phase, works will occur between the hours of 7:00 am and 6:00 pm to a maximum of 60 hours per week.

(15) Weed control will be incorporated into the rehabilitation programme within Section 6.0, in order to prevent the infestation of weeds to areas disturbed by roadworks.

Post Construction

(16) Landscaping and rehabilitation works will be carried out in accordance with the specifications documented in the EMP included as Section 6.0 of this CER.

(17) Rehabilitation monitoring will occur on all rehabilitation works twice per year for at least the first three years.

(18) Audit of the CER. A Progress and Compliance Report will be prepared for each major phase of the project, or on an annual basis, to the satisfaction of the DEP.

7.4.2 Commitments for Audit by MRWA

Pre-Construction Phase

(i) Surveys to determine the presence of any Aboriginal Archaeological or Ethnographic sites not registered with the AAD will be undertaken. Clearances to disturb any sites located within the impact area will be sought according to the provisions of the Aboriginal Heritage Act 1972.

(ii) The Willow Heights property within the impact area is listed on the City of Armadale Heritage Inventory. MRWA will liaise with the City of Armadale to develop a management strategy acceptable to the local authority for removal or relocation of the building.

(iii) Landowners will be compensated for the loss of land required for road reserve purposes under the Public Works Act 1902.

Construction Phase

(iv) Services relocation will be scheduled so as to cause as little disruption to residents as possible. Advice of timing of disruptions will occur by directly informing affected parties. This is to occur in conjunction with Telstra, Western Power and the Water Corporation.

(v) Should any Aboriginal Archaeological or Ethnographic sites be uncovered during construction works, activities will cease in the near vicinity and consultation will be undertaken with the Aboriginal Affairs Department.

Post-Construction

(vi) MRWA will initiate an internal audit process of the management commitments within the EMP documented in Section 6.0. These commitments will be included in the amended EAMP, and included as an auditable schedule within the Works Contract for the construction of the duplication.

Table 2 - Schedule of Proponent Commitments

PHASE	ISSUE	OBJECTIVE	NUMBER	COMMITMENT	TO SATISFY	PERFORMANCE INDICATORS
All Phases	EMP	Implementation of effective Environmental Management Programme as per the CER	1	Implement the EMP contained within the CER.	DEP	As per results of auditing procedures
	EMP	Amend the EMP as per public comment	2	To amend the EMP as per comment received from public submissions of the CER. EMP to be incorporated into the Environmental Assessment and Management Plan required by MRWA processes.	DEP	N/A
Pre-Construction	DRF	Survey for occurrence of DRF in Bungendore Park impact area	3	To undertake a DRF survey and obtain any necessary approvals.	CALM	DRF survey completed and approved prior to construction
	Dieback Management	Determine occurrence of dieback within the study area	4	Dieback Survey.	CALM	Dieback survey completed prior to construction
	Dieback Management	Prepare a management strategy for dieback affected areas	5	Dieback Hygiene Management Plan prepared in accordance with CALM practice and policy.	DEP / CALM	Dieback Hygiene Management Plan completed and approved prior to construction
	Vegetation Clearance	Ensure that no unnecessary clearing of roadside vegetation occurs	6	To demarcate a limit-of-works on construction plans, and to peg this limit on site prior to construction commencing.	DEP	Compliance assessed through MRWA internal audit
	Noise Monitoring	Appropriate noise control measures for affected residences	7	Noise Monitoring and Management Strategy to satisfy MRWA noise level criteria.	DEP	Noise levels following completion of project within MRWA criteria
	Neerigen Brook Deviation	Confirmation of hydrological characteristics	8	To confirm channel characteristics of deviated section of Neerigen Brook.	DEP	Channel characteristics documented
Construction	Erosion Conrol	Protect Neerigen Brook from an increased sediment load	9	Erosion / siltation control measures to be implemented as per EMP.	DEP	Compliance assessed through MRWA internal audit
	Dieback Management	To prevent the spread of dieback in the project area	10	Implementation of Dieback Hygiene Management Plan as per Commitment 5.	DEP	Compliance with Dieback Hygiene Management Plan as assessed through MRWA internal audit process
	Maximise effectiveness of rehabilitation strategy	Vegetation and Topsoil Management	11	Implementation of measures documented within the EMP.	DEP	Completion Criteria for rehabilitation satisfied within 5 years of site disruption.
	Dust Control	Minimise nuisance to residents	12	Spraying of earthworks.	DEP	No complaints of dust generation received from local residents
	Drainage	Maintain environmental values of Neerigen Brook	13	Implement a drainage strategy to management sediment and nutrient movement as per EMP.	DEP	Compliance assessed through MRWA internal audit
	Noise Control	Minimise nuisance to residents	14	Construction to occur between 7 am and 6 pm to a maximum of 60 hours per week.	DEP / City of Armadale	No noise complaints occurring outside specified construction hours
	Maximise effectiveness of rehabilitation strategy	Weed Control	15	To carry out weed eradication programme during rehabilitation works, to satisfy documented Completion Criteria.	DEP	Completion Criteria satisfied within 5 years of site disruption.
Post-construction	Landscaping and Rehabilitation	To landscape and rehabilitate all areas disturbed during roadworks	16	To implement landscape and rehabilitation guidelines to meet Completion Criteria documented within the EMP.	DEP	Completion Criteria satisfied within 5 years of site disruption.
	Landscaping and Rehabilitation	To monitor progress of rehabilitation in reference to documented Completion Criteria	17	To undertake monitoring of rehabilitation works twice per year for at least three years.	DEP / MRWA Landscape & Environment Branch	Monitoring report contents documenting extent to which Completion Criteria have been achieved
	Audit of CER	Preparation of PCRs on CER conditions and commitments	18	To prepare PCRs at major phases of the project, or on an annual basis.	DEP	Acceptance of PCRs by DEP.

8.0 SUMMARY AND CONCLUSIONS

The proposed Albany Highway Bedfordale Hill Section Duplication discussed in this CER arises from the requirement for upgrading of this section of road in a context of an increasing volume of traffic and an existing high accident risk. The option of constructing a four lane divided highway has been selected as the preferred response to the requirement for roadworks, as it will satisfy projected traffic volumes, meets road design guidelines, and improves safety and transport efficiency. The specific alignment selected as the preferred option is considered to balance the environmental objectives of:

- minimisation of intrusion into Bungendore Park;
- avoiding where possible significant vegetation and buildings adjacent to the existing road;
- minimisation of impact on Neerigen Brook; and
- minimising requirements for land acquisition.

The project planning has occurred with regard to the social and biophysical environment of the study area. Possible environmental impacts were identified during the initial phases of project planning and this input has been included in development of the current proposal. The investigation of potential impacts has occurred simultaneously with engineering design, allowing for the development of a comprehensive environmental management plan for this project.

Public consultation and community involvement has been a feature of the development of this proposal. This has included newsletter delivery, public information days, formation of a Consultative Liaison Group, and direct liaison with residents adjacent to Albany Highway. The community is well informed about this proposal, and submissions and comment from members of the public and other interest groups has been utilised in the design process.

The main impacts of the project have been identified as:

- intrusion into Bungendore Park;
- requirements for clearing of exotic and native vegetation;
- impact on water quality in Neerigen Brook;
- noise; and
- impact on cultural heritage and visual amenity.

Intrusion into Bungendore Park will occur due to requirements for cut to achieve road grades, and a requirement for earthworks. The project will not compromise System 6 values, objectives of the Darling Regional Park or biophysical characteristics in the area of impact. The Bungendore Park Management Committee has been involved in development of this proposal, which reflects the comments and concerns of this group.

Clearing of vegetation is an unavoidable impact of road development. This proposal has aimed to minimise clearing and is located within land identified for road requirements wherever possible. The native vegetation that will require clearing is typical of and well represented within the region.

Maintenance of water quality in Neerigen Brook has been carefully considered during the development of this proposal. The system of collecting road runoff to prevent it from entering the Brook upstream of the drainage reserve is the preferred option for drainage management. This strategy will ensure that contaminants from the road surface do not enter the water supply where it is a major water source for local residents. Construction and drainage management measures have been developed to prevent erosion and sedimentation within Neerigen Brook.

Noise levels are predicted to exceed the specified MRWA criteria for three residences within the study area. Noise mitigation measures will be implemented in these locations to ensure that road generated noise does not form a nuisance for the residents.

The project requires removal of Willow Heights, a building with local heritage value. It is anticipated that the building will be relocated to a position identified in conjunction with the City of Armadale. The road project will also cause alteration to the visual amenity of the alignment. However, the landscape plans developed for the project account for the existing character of the project area which is accounted for in the planting and rehabilitation programme. The rehabilitation strategy will ensure that revegetation of the alignment occurs, and that the visual impact of the project will be redressed within five years of project completion.

The impacts identified by the project team and through the guidelines produced by the EPA have all been addressed within the EMP incorporated within Section 6.0 of this CER. The EMP has been specifically designed to mitigate the predicted impacts of the proposal. The proponent has undertaken a number of comprehensive management commitments to ensure that the impact of the proposal is minimised.

In conclusion, the planning and consultation for this project has been extensive, and a detail environmental management strategy developed to mitigate impacts. With implementation of the project as documented within this CER there should be no long term negative impact on the site, nor its inhabitants.

STUDY TEAM

The Albany Highway - Bedfordale Hill Section Duplication Consultative Environmental Review was planned, co-ordinated and executed by;

ecologia Environmental Consultants
165 Walcott Street
Mt Lawley, WA, 6050

Project Staff

G.W. Connell	BSc. (Hons) (Zool)	Project Manager
T.M. Gepp	BA. (Hons) (Geog)	Environmental Planner, Project Quality Manager
M. Maier	BSc. (Hons) (Zool)	Senior Botanist
M. Wells	Dip Draft.	Drafting

In addition;

1. Armadale City Council provided valuable data on the Draft Municipal Heritage Inventory.

2. Sinclair Knight Merz provided information on engineering design and public consultation for the Albany Highway - Bedfordale Hill Section Duplication Consultative Environmental Review.

REFERENCES

Atkins, K. (1995). *Declared Rare and Priority Flora List*. Unpublished flora listing prepared by the Department of Conservation and Land Management, Perth.

Beard, J.S. (1979) Vegetation Survey of Western Australia: The Vegetation of the Pinjarra Area. Map and Explanatory Memoir, 1: 250, 000 series. Vegmap Publications, Perth.

Beard, J.S. & Webb, M.J. (1974) Great Sandy Desert. *Explan. Notes to Sheet 2, 1:1000000 Series, Vegetation Survey of W.A.* UWA Press.

Cogger, H.G. (1992) Reptiles and Amphibians of Australia. Reed Books, New South Wales.

Department of Conservation and Environment (1983) Conservation Reserves for Western Australia as recommended by the Environmental Protection Authority - 1983: The Darling System - System 6 Part II: Recommentdations for Specific Localities. Department of Conservation and Environment, Western Australia.

Department of Conservation and Land Management (1992) Dieback Hygiene Manual

Department of Planning and Urban Development (1993a) The Natural Resources of the Darling Ranges. Darling Range Regional Park Supplementary Report No. 2. Department of Planning and Urban Development, Western Australia.

Department of Planning and Urban Development (1993b) Darling Range Regional Park and Landscape Study: A Proposal for a Darling Range Regional Park. Department of Planning and Urban Development, Western Australia.

Department of Planning and Urban Development (1993c) Visual Resource Assessment of the Darling Range Sub-Region. Darling Range Regional Park Supplementary Report No. 3. Department of Planning and Urban Development, Western Australia.

ecologia Environmental Consultants (1996) Albany Highway Bedfordale Hill Section Duplication Environmental Assessment and Draft Management Plan. Main Roads Western Australia, March 1996.

GB Hill & Partners (1994) Albany Highway Planning Study for Duplication Options at Bedfordale Hill. Main Roads Western Australia, November 1994.

Hames Sharley (1996) Albany Highway Bedfordale Hill Landscape Design Concept Main Roads Western Australia, February 1996.

Havel, J.J. (1975) Site Vegetation Mapping in the Northern Jarrah Forest (Darling Range): I. Definition of site-vegetation types. II. Location and mapping of site-vegetation types. *Bull. For. Dept. West. Aust.* No's 86 & 87.

Herring Storer Acoustics (1996) Road Duplication Bedfordale Hill - Albany Highway Acoustic Assessment. Main Roads Western Australia, February 1996.

Hoffman, N. & Brown, A. (1992) Orchids of South-West Australia. University of Western Australia Press.

L Millar & Associates (1995) Albany Highway, Bedfordale Hill Justification of Proposed Works. Main Roads Western Ausralia, May 1995.

Main Roads Western Australia (1992) Environmental Management Manual. Main Roads Western Australia, May 1992.

Main Roads Western Australia (1995) Topsoil Management in *Conservation and Regeneration Draft Best Practice Manual: pp23 - 25.*

Sinclair Knight Merz (1995a) Albany Highway Bedfordale Hill Section Planning Review Report. Main Roads Western Australia.

Sinclair Knight Merz (1995b) Albany Highway Bedfordale Hill Section Concept Plan Report on Submissions. Main Roads Western Australia, November 1995.

Sinclair Knight Merz (1996a) Albany Highway Bedfordale Hill Section Preliminary Design Report. Main Roads Western Australia.

Sinclair Knight Merz (1996b) Albany Highway Bedfordale Hill Section Preliminary Design Report on Submissions - Draft. Main Roads Western Australia, February 1996.

Sinclair Knight Merz (1996c) Albany Highway Bedfordale Hill Section Master Plan. Main Roads Western Australia, April 1996.

Soil & Rock Engineering (1996a) Albany Highway Bedfordale Hill Section Geotechnical Investigation Evaluation Report. Main Roads Western Australia, February 1996.

Soil & Rock Engineering (1996b) Albany Highway Bedfordale Hill Section Geotechnical Investigation Factual Report. Main Roads Western Australia, February 1996.

Speck, N.H. (1958) The Vegetation of the Darling-Irwin Botanical Districts. PhD Thesis, University of Western Australia.

APPENDIX A

EPA Guidelines for Preparation of the CER

EXPANSION AND WIDENING OF ALBANY HIGHWAY TO FORM A FOUR LANE DUAL CARRIAGEWAY FROM TRITON CRESENT TO THE ROAD TRAIN ASSEMBLY AREA AT BEDFORDALE (1018).

GUIDELINES FOR THE ENVIRONMENTAL IMPACT ASSESSMENT DOCUMENT

(CONSULTATIVE ENVIRONMENTAL REVIEW)

Overview

All environmental reviews have the objective of protecting the environment, and environmental impact assessment is deliberately a public process in order to obtain broad ranging advice. The review requires the proponent to describe the proposal, receiving environment, potential environmental impacts and the management of the issues arising from the environmental impacts, so that the environment is protected to an acceptable level.

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

Objectives of the CER

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

The contents of the CER should reflect these objectives.

Contents of the CER

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

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

The textual content of the CER should include:

- introduction to the proponent, the project and location;
- the legal framework, decision making authorities and involved agencies;

- description of the components of the proposal (road, borrow pits and associated earthworks) and identification of the potential environmental impacts;
- description of the receiving environment which may be affected;
- discussion of the key environmental topics (shown in the next section), including an assessment of their significance in comparison to relevant objectives, policies or standards;
- discussion of the objectives for management of the issues, including commitments to appropriate action; and
- a summary of the environmental management programme, including the key commitments, monitoring work and the auditing of the programme.

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

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

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

Key environmental topics

The key topics can be determined from a consideration, called scoping, of the potential impacts of the proposal on the environment. The receiving environment includes social surroundings.

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

The key topics identified at this stage and the assessment objectives include:

Biophysical

Environmental topic	EPA objective
System 6 Area M80	The proposal should be consistent with Environmental Protection Authority Recommendations for M80.
Rare flora and fauna	Rare flora and fauna (if any) should be protected in accordance with the requirements of the Wildlife Conservation Act.
Remnant vegetation	Regionally significant vegetation should be identified and protected.

Erosion	Erosion due to vegetation clearing and increased run off should be identified and preventative measures installed
Dieback	Identification of the dieback status in the area should occur with appropriate measures employed to ensure either containment, or maintenance as a dieback free area.
Vegetation Clearing	Clearing of vegetation should be reduced as far as possible.
Water Supply	Manage demand for water during construction from Nerrigin Brook so that environmental needs are meet.

Pollution

Dust Control	Residential dwellings and conservation areas should be free from unacceptable impacts of dust
Contaminants from stormwater	Stormwater collection and disposal systems should be designed to ensure that reduced or no contaminants reach Nerrigen Brook.
Noise	Noise at residential dwellings should comply with statutory requirements both during construction and during operation.
Water quality in Neerigen Brook	During construction turbidity of Neerigen Brook should be managed.
Hydrology of Neerigen Brook	Hydrological regime of Neerigen Brook should be maintained at pre construction levels.
Environmental Values of Neerigen Brook	Those areas of Neerigen Brook affected by the proposal should have environmental values maintained or enhanced.

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

Public consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent in preparing the CER. It should describe the activities undertaken, the dates, the groups/individuals involved and the objectives of the activities. Cross reference should be made with the description of environmental management of the issues which should clearly indicate how community concerns have been addressed. Those concerns which are dealt with outside the EPA process can be noted and referenced.

Environmental management commitments

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

The commitments should have the form of: the proponent (**who**) will prepare a plan or take action (**what**) to meet an objective, to the timing for its achievement (**when**), and to which

agencies will be consulted or to **whose requirements**, if not the DEP, the action/plan will be prepared.

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

Issue	Objectives	NO	Commitment	When	By Whom	To whose satisfaction
CER	Implement effective CER	1.	Develop and implement an effective CER	Pre-construction and on-going	MRD	DEP, CALM etc.

Quality Assurance

For QA purposes, these draft guidelines reflect the outcome of the Strategy meeting held on 10 May 1996 and endorsed at the managers meeting on 15 May 1996. They have also been checked against the Decision to Assess or Not Assess Form 2.

The draft guidelines were circulated with a 10 working day turn around time to the following parties, and the final guidelines been modified to reflect advice received:

Agriculture Western Australia

Department of Conservation and Land Management

Department of Transport

Main Roads Western Australia

National Parks and Nature Conservation Authority

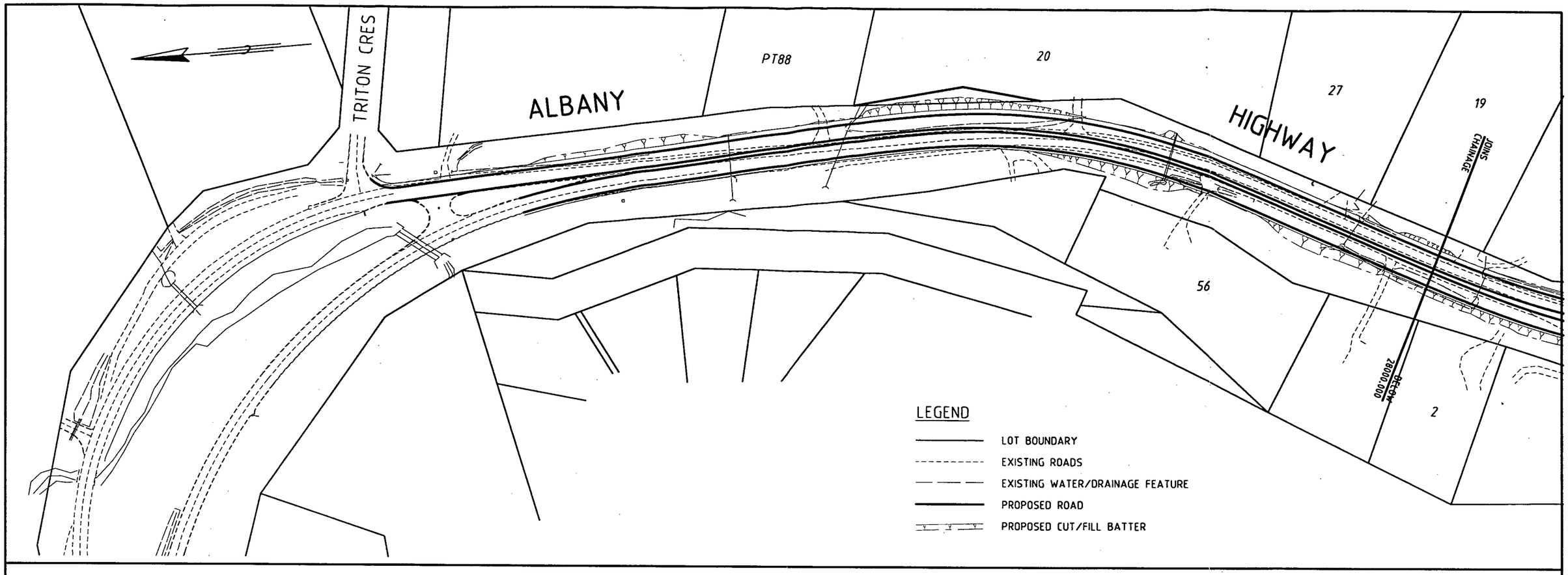
Pollution Prevention Division, Department of Environmental Protection

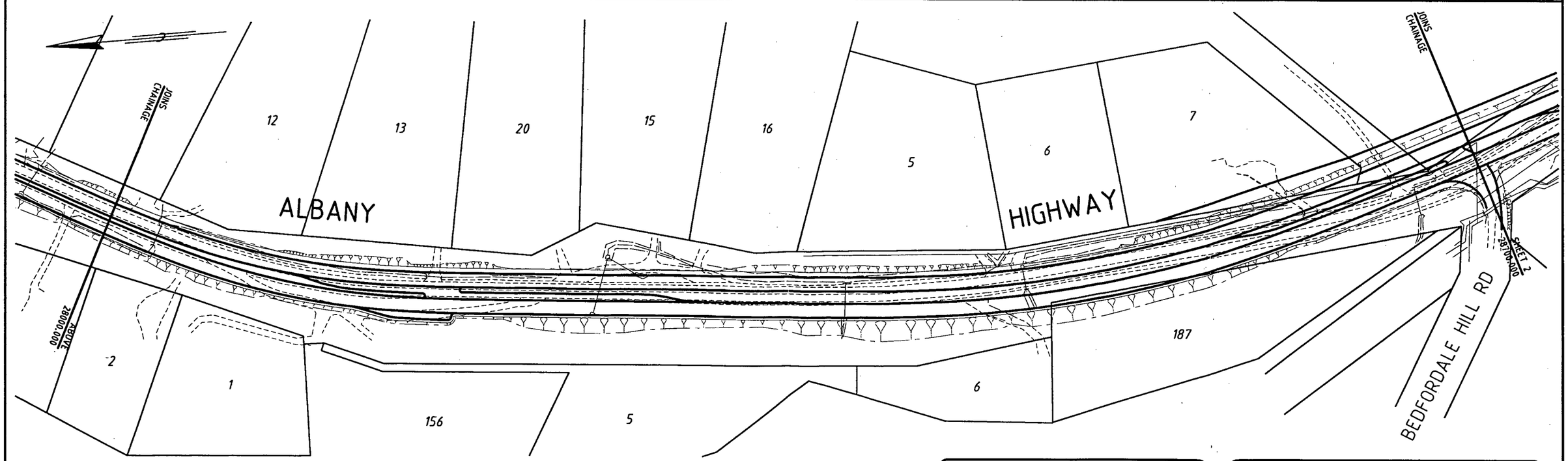
Shire of Armadale

Water Corporation

APPENDIX B

Plans of Road Alignment and Land Acquisition Requirements for the Albany Highway Bedfordale Hill Section Duplication





1:2000

0 20m 40 60 80 100

MAIN ROADS
Western Australia

MAIN ROADS WA
ALBANY HIGHWAY
BEDFORDALE HILL SECTION
SHEET 1

LEGEND

- LOT BOUNDARY
- EXISTING ROADS
- EXISTING WATER/DRAINAGE FEATURE
- PROPOSED ROAD
- PROPOSED CUT/FILL BATTER

ALBANY HIGHWAY

JOINS CHAINAGE 29400.000

SHEET 1 JOINS CHAINAGE 28700.000

SHEET 3 JOINS CHAINAGE 30100.000

ABOVE JOINS CHAINAGE 29400.000

10 16 PT9 PT8 1 12 10

PT6 16 17 601 15 14 13 16 17

1:2000

0 20m 40 60 80 100

MAIN ROADS
Western Australia

MAIN ROADS WA
ALBANY HIGHWAY
BEDFORDALE HILL SECTION SHEET 2

100
103
6
12
11
ALBANY
HIGHWAY
JOINS CHAINAGE
SHEET 2 30000.000
JOINS CHAINAGE
BELOW 30800.000
BUNGENDORE PARK

LEGEND

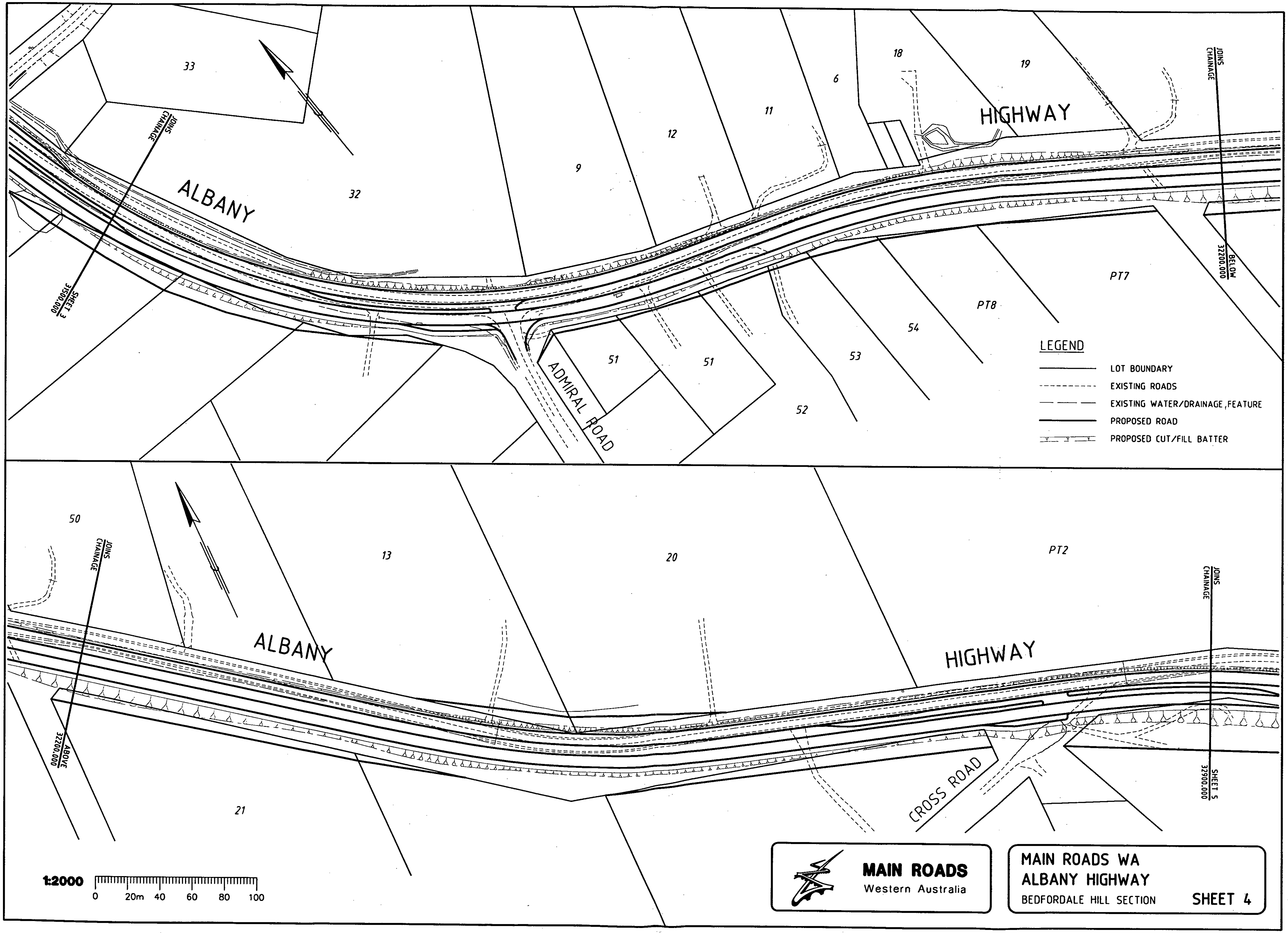
- LOT BOUNDARY
- EXISTING ROADS
- EXISTING WATER/DRAINAGE FEATURE
- PROPOSED ROAD
- PROPOSED CUT/FILL BATTER

500
ALBANY
HIGHWAY
48
WATERWHEEL ROAD
33
JOINS CHAINAGE
39
JOINS CHAINAGE
37
36
35
40
43
NELSON STREET
PT1
38
ABOVE 30800.000
SHEET 1 31500.000

1:2000
0 20m 40 60 80 100

MAIN ROADS
Western Australia

MAIN ROADS WA
ALBANY HIGHWAY
BEDFORDALE HILL SECTION
SHEET 3



33
32
9
12
11
6
18
19
ALBANY
HIGHWAY
JOINS CHAINAGE
SHEET 3
31500.000
JOINS CHAINAGE
BELOW
32200.000
PT7
PT8
54
53
52
51
51
ADMIRAL ROAD
LEGEND
LOT BOUNDARY
EXISTING ROADS
EXISTING WATER/DRAINAGE,FEATURE
PROPOSED ROAD
PROPOSED CUT/FILL BATTER
50
13
20
PT2
21
ALBANY
HIGHWAY
JOINS CHAINAGE
ABOVE
32200.000
JOINS CHAINAGE
SHEET 5
32900.000
CROSS ROAD
1:2000
0
20m
40
60
80
100
MAIN ROADS
Western Australia
MAIN ROADS WA
ALBANY HIGHWAY
BEDFORDALE HILL SECTION
SHEET 4

JOINS CHAINAGE

SHEET 4 32900.000

102

ALBANY

PT CAN LOC 413

HIGHWAY

JOINS CHAINAGE

BELOW 33600.000

LEGEND

- LOT BOUNDARY
- EXISTING ROADS
- EXISTING WATER/DRAINAGE FEATURE
- PROPOSED ROAD
- PROPOSED CUT/FILL BATTER

DMETRIEFF ROAD

PT LOC 465

ALBANY HIGHWAY

JOINS CHAINAGE

ABOVE 33600.000

SHEET 6 34300.000

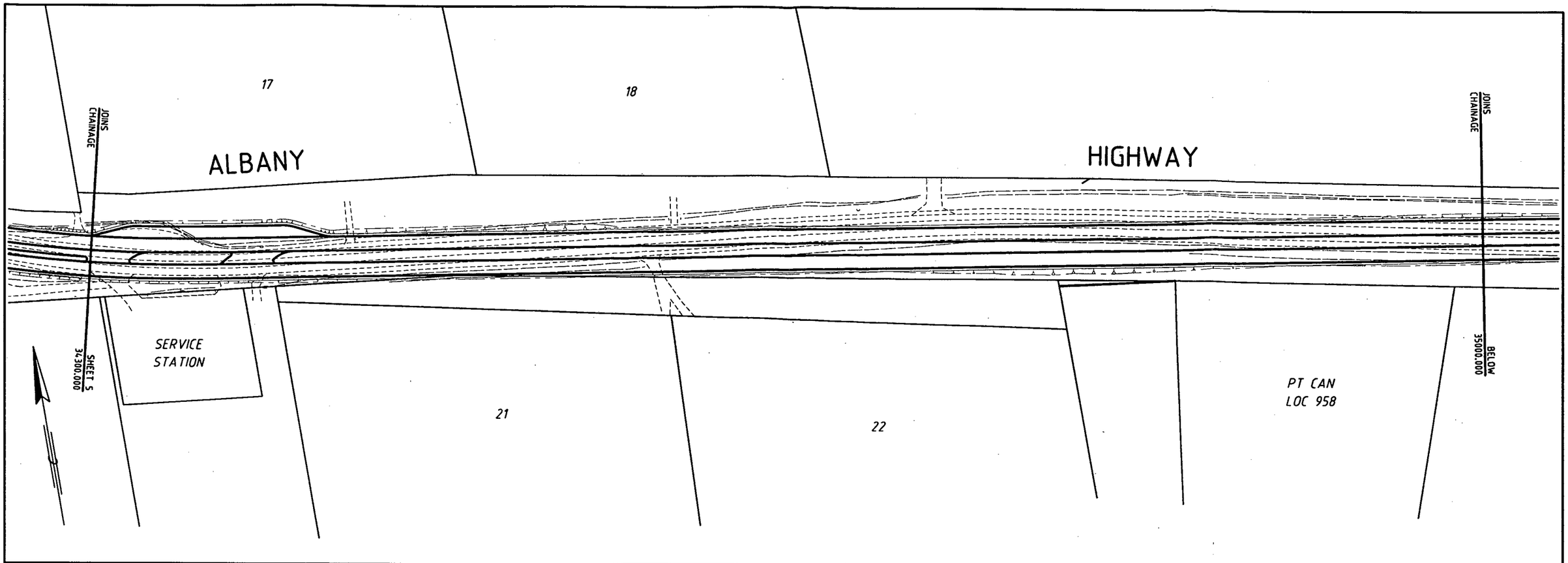
SPRINGFIELD ROAD

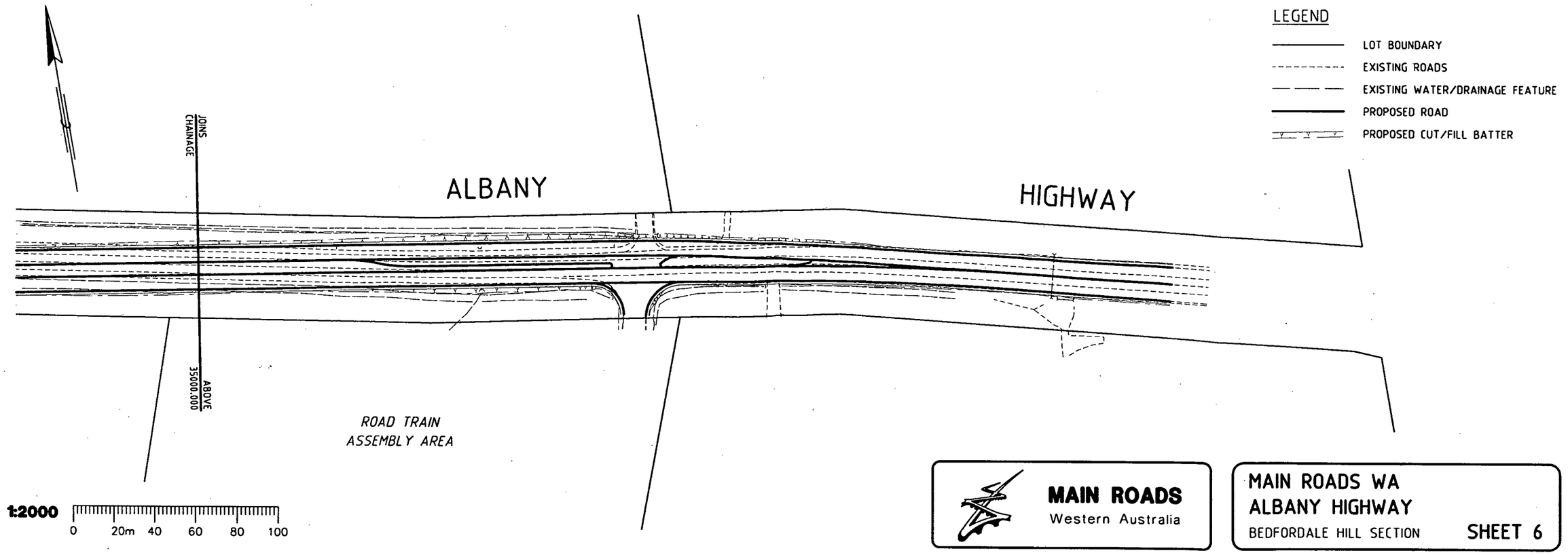
1:2000

0 20m 40 60 80 100

MAIN ROADS
Western Australia

MAIN ROADS WA
ALBANY HIGHWAY
BEDFORDALE HILL SECTION
SHEET 5





MAIN ROADS
Western Australia

MAIN ROADS WA
ALBANY HIGHWAY
BEDFORDALE HILL SECTION
SHEET 6

APPENDIX C

Summary of Public Consultation Programme

C1.0 SUMMARY OF PUBLIC CONSULTATION PROGRAMME

C1.1 INTRODUCTION

A major public consultation programme has been undertaken to understand the community concerns and to address those concerns within the project design wherever possible. The programme has included:

(1) Consultation on the Concept Plan;

(2) Consultation on the Preliminary Design; and

(3) Establishment of a Community Liaison Group.

The approvals process for the project under the Environmental Protection Act 1986 also provides additional opportunity for public input into the development and implementation of the Albany Highway Bedfordale Hill Section project.

Newsletters and submission summaries are included in Appendix E.

C1.2 CONSULTATION PROGRAMME

C1.2.1 Consultation On The Concept Plan

The public consultation programme has been carried out by Sinclair Knight Merz, and has incorporated the delivery of a newsletter to all householders and businesses in the area, explaining the project and requesting input from the community. The newsletter is included in Appendix E.

This phase of consultation included a static display at the Armadale Shopping City from 6 November 1995 to 17 November 1995. An open day on 11 November 1995 was staffed by representatives of Sinclair Knight Merz and MRWA.

A total of 54 submissions were received during this stage by Sinclair Knight Merz. Of these, 42 were generally supportive of the project, giving suggestions and seeking clarification on specific issues including property acquisition; amenity; noise; water quality; and median openings. Twelve submissions were opposed to the project stating various reasons, including the suggestion that trucks go via Jarrahdale as opposed to Bedfordale.

The outcome and recommendations of the report concluded that there was wide community support for the project, with a number of specific issues requiring resolution in the Preliminary Design stage. The issues identified through the first stage of consultation were:

- Land acquisition;
- Landscape;
- Water access and quality;
- Property access; and
- Median break locations.

The results of the consultation process have been summarised in a separate report by Sinclair Knight Merz (1995b).

C1.2.2 Consultation On The Preliminary Design

This phase of the consultation programme replicated the first phase, with preliminary design plans available for public comment. A staffed display was held between 5 February and 17 February 1996, with open days on the 8th, 10th and 15th of February 1996, staffed by representatives of MRWA and Sinclair Knight Merz. A newsletter was delivered (Appendix E) advising householders of the display, which was also advertised in the local newspaper.

A total of 58 responses were received, 55 of which were generally supportive of the project but seeking clarification on specific issues. Three submissions were opposed to the project for various reasons, including the suggestion that trucks should go via Jarrahdale rather than Bedfordale, obviating the need for the duplication project.

The biggest concerns for residents adjacent to the Highway were identified as:

- Driveways to be made good on completion;
- Water supply and quality;
- Median break locations;
- Bedfordale Hill Road banned turns;
- Median U-turns for trucks; and
- Saving existing trees.

For residents away from the Highway, the main concerns were identified as:

- Bedfordale Hill Road banned turns;
- Springfield Road; and
- Arrester Bed.

The results of the consultation process have been summarised in a separate report by Sinclair Knight Merz (1996b).

C1.2.3 Outcomes of Consultation Programme

Recommendations to be accounted for during the detailed design stage of the project were derived from a review of the submissions, together with feedback from open days, and additional telephone conversations. The recommendations are:

(1) Water Supply and Quality: Water supply requirements of residents be investigated and a plan for water supply continuation during construction be developed. A requirement to ensure that construction and Brook relocation strategies and techniques minimise adverse impacts on water quality, including siltation.

(2) Bedfordale Hill banned turns: City of Armadale to be provided with details of opponents to banned turns.

(3) Median break locations and U-turns for trucks: median breaks to be revised for eight locations, with allowances for embayments to allow truck U-turns.

(4) Save existing trees: opportunities to use retaining walls where practical to save trees. Design team to have an objective of retaining as many existing trees as possible.

(5) Springfield Road: design team to add a merging lane for the left turn from Springfield Road to Albany Highway.

(6) Arrester Bed: MRWA review the need for an arrester bed.

(7) Other Detailed Issues: To be accommodated in the design process where possible.

C1.3 COMMUNITY LIAISON GROUP

A Community Liaison Group (CLG) consisting of 10 residents and landowners adjacent to and close by Albany Highway was established for the Master Planning Stage of the project. This group first met on the 7 December 1995, and met every six weeks for the Master Planning stage. The CLG has provided important local experience, expertise and information on traffic, social, environmental, water, drainage and site conditions in the study area. The information gathered from the CLG meetings has been utilised to finalise the Master Plan for the duplication design of the Albany Highway Bedfordale Hill Section.

C1.4 BUNGENDORE PARK

The Bungendore Park Management Committee and the Armadale Wildflower Society (Inc.) have submitted requests for consideration during planning for this project. These are:

- the retention of *Nuytsia floribunda* trees at the Albany Highway entrance to Bungendore Park;
- the provision of a break in the median for access into Bungendore Park, especially for the access of emergency vehicles in the case of bushfire;
- a request that the rehabilitation of the road reserve and medians be carried out using local indigenous species;
- inclusion of an entry statement to Bungendore Park from Albany Highway as a component of the overall landscape treatment; and
- a population of King Skinks *Egernia kingii* is reported within the impact area by the Bungendore Park Management Committee, which wishes to organise a relocation strategy for the population affected by roadworks.

The rehabilitation strategy was developed on the basis of retaining the existing character of the Bedfordale Hill Section of Albany Highway. As this includes numerous exotic vegetation species, these have been included in the landscape design. However, areas containing remnant vegetation, particularly the Bungendore Park boundaries will be revegetated using native vegetation.

A median break has been provided at the entrance to Bungendore Park.

MRWA will provide funding to assist the Bungendore Park Management Committee in developing and implementing a relocation programme for King Skinks *Egernia kingii* within the impact area of the roadworks.

C1.5 ADDITIONAL CONSULTATION

C1.5.1 City of Armadale

Councillors and officers of the City of Armadale have been kept fully briefed on the project, and have had substantial input into decisions on key issues. An issue raised by the City of Armadale following the release of the Master Plan for the project, is the philosophy behind the drainage strategy, and the issue of kerbing.

The concerns of the City of Armadale are as follows:

(1) that the piping of stormwater drainage and its discharge into Neerigen Brook at two points below Bedfordale Hill Road will concentrate pollutants in Neerigen Brook downstream of Albany Highway.

(2) that the piping of stormwater will, due to increased volumes of water and greatly reduced delivery time, create a significant potential for flooding in the Neerigen and Wungong floodplains of Armadale.

(3) that the kerbing of the road without provision of an emergency lane will contribute to the potential for serious collisions on the road which will be unable to leave the carriageway in the event of breakdown, or emergency braking.

The City of Armadale in recognising the need to protect water quality of Neerigen Brook for domestic users, considers that the alternative of providing reticulated scheme water to necessary properties requires investigation. MRWA however has no jurisdiction over the Water Corporation's plans to provide reticulated scheme water to domestic users, and cannot allow funding for this to occur from the MRWA budget.

The drainage strategy documented in Section 3.0 is the preferred option of MRWA. However, both options are further discussed in Section 6.0.

Barrier kerbing was originally proposed for the Bedfordale Hill Section duplication, in keeping with kerbing used for other similar roadways in the Metropolitan area. However, in view of the request of the City of Armadale, MRWA will use semi-mountable kerbing for the entire project, to allow vehicles to leave the road pavement if necessary.

C1.5.2 Miscellaneous Issues

A number of additional issues were raised during the consultation process, and have been incorporated into the project design.

(1) Liaison with the Armadale Primary School highlighted the need to incorporate bus bays into the road design. Consequently bus bays are to be provided at all intersections and at selected U-turn locations for school buses operating along Albany Highway

(2) Liaison with the Volunteer Fire Service has been undertaken to ensure appropriate access to all water supplies and to Bungendore Park is accommodated within the road design.

APPENDIX D

Vegetation List for the Albany Highway Bedfordale Hill Section Duplication Project Area

Appendix D: Vegetation list for the Bedfordale Hill project area.

Species Name	Common Name	Form
Acacia pulchella	Prickly Moses	Shrub
Acacia urophylla	(Wattle)	Shrub
Agonis linearifolia.	(Peppermint)	Shrub
Aira caryophylla	Silvery Hair Grass	Introduced Grass
Allocasuarina fraseriana	Sheoak	Tree
Banksia grandis	Bull Banksia	Tree
Bossiaea ornata	(Pea)	Shrub
Briza maxima	Quaking Grass	Introduced Grass
Clematis pubescens	–	Climber
Dampiera linearis	Common Dampiera	Herb
Dianella revoluta	(Lily)	Herb
Dryandra sessilis	Parrot Bush	Shrub
Dryandra nivea	Couch Honeypot	Shrub
Eucalyptus calophylla	Marri	Tree
Eucalyptus marginata	Jarrah	Tree
Eucalyptus rudis	Flooded Gum	Tree
Hakea amplexicaulis	Prickly Hakea	Shrub
Hakea lissocarpha	Honey Bush	Shrub
Hakea trifurcata	–	Shrub
Hakea undulata	–	Shrub
Hibbertia hypericoides	Guinea Flower	Shrub
Hyalosperma cotula	(Daisy)	Introduced Herb
Kennedia coccinea	Coral Vine	Climber
Lasiopetalum floribundum	–	Shrub
Lepidosperma purpurea	(Sword Sedge)	Sedge
Lepidosperma tenue	(Sword Sedge)	Sedge
Leucopogon capitellatus	–	Shrub
Leucopogon propinquus	–	Shrub
Leucopogon verticillatus	Tassell Shrub	Shrub
Macrozamia riedlei	Zamia	Shrub
Melaleuca sp	Paperbark	Shrub
Mesomelaena tetragona	Semaphore Sedge	Sedge
Opercularia echinocephala	–	Herb
Paspalum dilatatum	Paspalum	Introduced Grass
Pentapeltis peltigera	–	Herb
Pericalymma ellipticum	–	Shrub
Petrophile striata	–	Shrub
Phyllanthus calycinus	–	Shrub
Restionaceae sp	–	Rush-like Herbs
Thysanotus sparteus	–	Herb
Ursinia anthemoides	–	Introduced Herb
Watsonia bulbillifera	Bugle Lily	Introduced Plant
Xanthorrhoea preissii	Blackboy	Shrub
Xanthosia candida	–	Herb

NB: Names in brackets are general names for that genus, or in some cases family, where a specific common name is not available.

APPENDIX E

Suggested Revegetation Flora Species List

SPECIES LIST

Native Species:

Species	Anticipated Height	Species	Anticipated Height
Acacia lateriticola	1-5m	*Melaleuca preissiana*	
Acacia nervosa	450-600mm	*Melaueca radula*	1.5m x 1.5m
Acacia pulchella	2m	*Melaleuca rhaphiophylla*	
Acacia saligna	6-10m	*Melaleua scabra*	600-1000mm
Agonis linearifolia	3m	*Mirbelia spinosa*	500mm
Agrostocrinum scabrum	500mm		
Allocasuaria fraseriaa	8m		
Allocasuaria huegelii	10-15m	*Nuytsia floribunda*	6-10m
Allocasuaria humilis	1m		
Anigozathos manglesii	600mm		
		Patersonia occidentalis	400mm
		Patersoia pygmaea	150mm
Baeckea camphorosmae	500mm	*Petrophile biloba*	1-2m
Banksia grandis	1.5-3m	*Pimelea ciliata*	700mm
Billardiera bicolour		*Pimelea imbricata*	
Billardiera variifolia	1mx1m	*Pimelea rosea*	600-700mm
Bossiaea ericarpa	500-1m x 500-	*Pimelea spectabilis*	800mm
Bossaia ornata	1m	*Pimelea suaveolens*	700mm
Calothamnus quadrifidus	1.5m x 2m	*Schoenus elegans*	
Calothamus rupestris	.5m x .5m	*Sollya heterophylla*	climber
Calothamnus saguinius	1m	*Sphaerolobium medium*	small
Chorizema dicksonii	1m or less	*Stypandra glauca*	1m
Clematis pubescens			
Conospermum huegelii	600mm		
Conostylis aculeata	300mm	*Thysanotus multiflorus*	300mm
Constylis setosa	150mm		
		Verticordia pennigera	
Davesia cordata	1.5m	*Viminaria juncea*	
Davesia decurrens	1m x 2m		
Dianella divaricata	1m		
		Waitzia citrina	500mm
		Xanthorrhoea preisii	

Exotic Species:

Species:	Anticipated Height
Araucaria heterophylla	30m
Brachychiton Acerifolius	10-30m
Choisya ternata	1-1.25m
Cotoneaster conspicuous	450mm
Erythina indica	10m
Gazonia spp	300mm
Grevillea crithmifolia	
Grevillea crithmifolia (prostate form)	
Hymenosparum flavium	
Jiniperus conferta	1m
Latana camara	300-1000mm
Lonicera periclymenum	
Myoporum parviflorum	300mm
Pinus radiata	18-27m
Plumbago capensis	1.5-2.5m
Populus nigra (Italica)	30m
Schinus molle	6m
Tecomaria capensis	2-3m