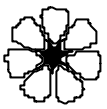
APPENDIX A

ERMP/DRAFT EIS GUIDELINES



Northern Territory Government

Western Australian Environmental Protection Authority/
Northern Territory Department of Lands, Planning & Environment

Joint Environmental Assessment

ORD RIVER IRRIGATION AREA STAGE 2 (M2 CHANNEL SUPPLY AREA), KUNUNURRA

GUIDELINES FOR AN ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME (ERMP)/ ENVIRONMENTAL IMPACT STATEMENT (EIS)

(WA EPA Assessment Number 1240)

July 1999

Foreword

The Western Australian (WA) and Northern Territory (NT) Governments have agreed that the proposal to expand the Ord River Irrigation Scheme and develop the M2 Channel Supply Area should be jointly assessed using the WA environmental impact assessment process. It has also been agreed that the assessment should be as an Environmental Review and Management Programme (ERMP) (WA) and Environment Impact Statement (EIS) (NT).

Environment impact assessment is aimed at protecting the environmental by ensuring that development is environmentally sound and well managed. It also recognises that people want to have a say before the Governments make a decision.

Wesfarmers/ Marubeni and the Water Corporation of Western Australia, as co-proponents, have been required to prepare a joint ERMP and EIS to assist the WA Environmental Protection Authority (WA EPA) and NT Government in assessing the environmental impacts of the project. An environmental impact assessment is a document which describes to the WA and NT Governments, and the community what the proponents wants to do, what the environmental impacts will be and how the proponents intend to manage the project.

The WA Department of Environmental Protection (DEP), on behalf of the WA EPA, and the NT Department of Lands, Planning and Environment (DLPE), have jointly prepared guidelines for the ERMP/EIA. These guidelines identify environmental factors they expect the proponent to address in the ERMP/EIA.

Public comment was invited on the guidelines from 20 April 1999 to 14 May 1999. Comments received were taken into account in the final preparation of these guidelines.

Contents

These guidelines are provided for the preparation of the proponent's environmental review document. The specific environmental factors to be addressed are identified in Part A. The generic guidelines for the format of an environmental review document are provided in Part B.

The environmental review document must address all elements of Part 'A' and Part 'B' of these guidelines prior to approval being given to commence the public review.

Part A: Specific Guidelines for the preparation of the Environmental Review and Management Programme (ERMP)/ Environmental Impact Statement (EIS)

1. Introduction

Background

On 19 April 1995, the Premier of WA and the Chief Minister of the NT signed a Memorandum of Understanding regarding the expansion of the Ord River Irrigation Scheme.

The first part of the expansion of the scheme is the development of the M2 Channel Supply Area, which is located on the Weaber, Keep and Knox Creek Plains that straddle the WA/ NT border north of Kununurra (Attachment 3).

The proponents for the development of the M2 Channel Supply Area are Wesfarmers/ Marubeni and the Water Corporation of Western Australia as co-proponents, with the Wesfarmers/Marubeni joint venture responsible for development associated with the agricultural land and the Water Corporation responsible for water-related infrastructure.

The proposal

The proposal to develop the M2 Channel Supply Area involves the following major elements:

- development of approximately 36,000ha for farms and infrastructure, including ownership and operation by Wesfarmers/ Marubeni of approximately 27,000 ha of this land for sugarcane farms;
- development of a sugar mill by Wesfarmers/ Marubeni with a capacity of approximately 400,000 tpa of raw sugar and 160,000 tpa of molasses;
- development of raw sugar and molasses storage and handling facilities at Wyndham Port by Wesfarmers/ Marubeni;
- allocation of up to 15% of the net irrigable area for sale to independent farmers on an unconditional basis with respect to the types of crops that may be grown; and
- construction of approximately 400 km of water supply channels and drains, as well as almost 150 km of flood protection levees.

2. Assessment Context

The Ord Irrigation Area commenced agricultural land development in the 1960's. This proposal represents a second stage of irrigated land development, with water supplied from the existing Ord River Dam.

There has been substantial change in the context within which Stage 1 and Stage 2 need to be considered. For instance, the Stage 1 development preceded the WA *Environmental Protection Act 1986* the and the related growth in community environmental awareness and statutory assessment. In addition, heritage legislation, water legislation reform, national and international biological diversity agreements and greenhouse gas protocols, and the national agreement on ecologically sustainable development have all been major additions to the broad context within

which this Stage 2 proposal must be examined. This context is not only important for proponents and relevant environmental agencies, but also for the community and the WA, NT and Commonwealth Governments.

A proposal of this scale also needs to be placed within a local and regional context, particularly for such factors as vegetation systems, land systems, water regimes, climate, and fauna. Consideration needs to be given to the adequacy of protection of environmental values within and adjoining the project area from the consequences of development.

The environmental impact assessment process requires the proponent of a proposed development to identify the environmental issues, to describe the environmental aspects of the development area and to outline how they intend to address environmental issues. Consideration also needs to be given to the proposed development area in a regional context. The determination of whether a particular proposed response is adequate is the role of the environmental assessor, through the assessment process, and the role of the associated Government in its decision-making. In order for those responses or solutions to be considered, there must be transparency by the proponent to show how those actions were chosen and the likely success of the selected response. The criteria used to define and select a particular response to an identified issue needs to be specified in the environmental documentation.

The WA EPA has decided that the assessment of this proposal will be undertaken in two stages. The first will look at the key environmental issues, of which the magnitude of the proposed clearing and its effect on biological diversity and significant social values are the major issues. The manner by which these and the other factors listed in these guidelines will be managed will form the second stage of the assessment. This approach means that there will be two assessment reports produced by the WA EPA.

To assist the proponent, community, the WA, NT and Commonwealth Governments, the WA EPA has outlined in these guidelines how it intends to approach the assessment of the implications for biological diversity.

The term 'environment' under the Northern Territory *Environmental Assessment Act 1982* means all aspects of the surroundings of man including the physical, biological, economic, cultural and social aspects. The term is more narrowly defined under the WA *Environmental Protection Act 1986.*

In view of this difference, some issues identified within these guidelines are beyond the scope of the WA EPA to consider in its assessment of the proposal and advice to the WA Minister for the Environment.

In preparing an ERMP/EIS, the proponent should bear in mind the following aims of the ERMP/EIS and public review process:

- to provide a source of information from which interested individuals and groups may gain an understanding of the proposal, the need for the proposal, the alternatives, the environment which it would affect, the impacts that may occur and the measures to be taken to minimise these impacts;
- to provide a forum for public consultation and informed comment on the proposal; and
- to provide a framework in which decision-makers may consider the environmental aspects of the proposal in parallel with economic, technical and other factors.

The proponent should ensure that the ERMP/EIS demonstrates compliance with the goals, objectives and guiding principles of Ecologically Sustainable Development as set out in the

National Strategy for Ecologically Sustainable Development and the principles set out in the National Strategy for the Conservation of Australia's Biological Diversity. The ERMP/EIS should describe the land in terms of its cultural, ecological, economic and social values.

As set out in the following guidelines, the scope of this assessment shall encompass those issues and alternatives directly related to the development of the Ord River Irrigation Area Stage 2 (M2 Channel Supply Area) project.

Social Impacts

A separate study of the social, cultural and economic impact of developments related to this project on Miriuwung and Gajerrong people is being conducted by the Aboriginal Representative Bodies with the support of Wesfarmers/ Water Corporation in parallel to the ERMP/EIS.

To ensure that there is the opportunity for consideration by the public and assessors (WA EPA and NT DLPE) in a timely manner, information from this study and other reports should be referred to in the ERMP/EIS. Additional relevant information should be published prior to the assessors reporting to their respective Ministers.

A number of studies were commissioned by the Department of Resources Development (DRD) to consider social implications of a number of development scenarios for Ord Stage 2. These studies were carried out prior to the selection of Wesfarmers/ Marubeni and Water Corporation as the preferred developer for the M2 project area.

The ERMP/EIS is expected to update and revise information consistent with the specific development proposal.

Studies that contain social information that may be relevant to this assessment, include the:

- Kununurra-Wyndham Area Development Strategy (KWADS),
- Naralup Population Study;
- Beckwith Social Impact Assessments; and
- study by AACM International Pty Ltd titled 'Aboriginal Consultations - Ord River Irrigation Scheme Stage 2 (September 1997)'

(i) Kununurra-Wyndham Area Development Strategy (KWADS),

The KWADS study is being undertaken by the WA Ministry for Planning (MfP) in association with the Shire of Wyndham-East Kimberley and NT DLPE. The purpose of this study is to provide assistance to community, private enterprise and Government agencies to guide and control land use, protect and manage environmental and heritage values, recommend on settlement expansion, promote tourism/ development nodes, assess the need for further industrial land and coordinate transport and infrastructure provision.

This draft plan is expected to be released by the MfP for public review in the third quarter of 1999.

(ii) Naralup Populations Study

DRD commissioned this study in 1996 to examine the population impacts of developing Stage 2 of the irrigation project and identifies population categories generated by the development, tourism and other industry.

(iii) Beckwith Social Impact Assessments

Potential social impacts were examined by Dr Beckwith in 1997 as part of studies by Sinclair Knight Merz related to the Ord Stage 2 development. This study identified current community circumstances and the needs of the existing resident population and establishes what benefits and increased demands on social infrastructure may occur if the population were to substantially increase as a result of Stage 2.

(iv) Aboriginal Consultations - Ord River Irrigation Scheme Stage 2 (AACM)

DRD commissioned this study in 1997 to address Aboriginal aspects of social issues relating to the proposed development of the second phase of the Ord River Irrigation Area. The report complements the earlier social impact assessment conducted by Dr Beckwith.

The Naralup, Beckwith and AACM studies are available from DRD.

Water Allocation Plan

It is also important to note that the WA EPA will be providing advice to the WA Government on the Water and Rivers Commission Draft Interim Water Allocation Plan for the Ord River. This draft interim plan cannot be assessed by the WA EPA as it does not represent a proposal under the WA *Environmental Protection Act*. However, the WA EPA will provide advice in a report pursuant to S16(e) of the WA *Environmental Protection Act*.

The purpose of the interim plan is to:

- define bulk water allocations based on the available hydrological data and the estimates of demand for current and potential water uses;
- describe the system by which licences will be issued under current legislative arrangements; and
- describe the investigations required to allow allocations to be refined, and the process by which any review of allocations will be undertaken; and

The objectives of the interim plan are to:

- make an interim provision of water to the Lower Ord River system and its associated environment;
- determine the remaining water that may be available for diversion for consumptive uses;
- document interim allocation decisions as to how much water should be assigned to the Stage 1 and Stage 2 developments; and
- ensure those existing commitment and longer term demands for hydro-power generation can be accommodated within the interim allocations and that a feasible reservoir operating strategy can be developed that meets all commitments.

This draft interim plan has been released for public comment for a period of eight weeks, closing 20 August 1999.

3. Environmental factors relevant to this proposal

At this stage, the WA EPA believes the relevant environmental factors, objectives and work required is as detailed in the table below:

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**WA EPA objective**	**Work required for the environmental review**
BIOPHYSICAL			
Biodiversity	Ecosystems	To maintain biological diversity meaning the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.	Baseline studies to identify existing genetic diversity, species diversity and ecosystem diversity of the development area and in a relevant regional context to ensure that the project will not affect the diversity of and representativeness of biodiversity in the East Kimberley/ Western Northern Territory. Detail measures proposed to ensure: • avoidance of loss of biological diversity; • maintenance of ecological linkages between different ecosystems and habitat types; and. • protection or rehabilitation of representative ecosystems within and adjacent to the proposed irrigation scheme which have been identified as being of significant local and regional conservation value. Identify and define areas which are "comparable" to the project (including buffer areas) in terms of biodiversity and ecological function at the ecosystem, species and genetic levels. Assess the environmental significance of alterations to the species assemblages in terms of changes to ecosystem/ ecological function pre and post disturbance.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**WA EPA objective**	**Work required for the environmental review**
Terrestrial flora	Vegetation communities	Maintain the species diversity, geographic distribution and productivity of vegetation communities.	Baseline studies to identify existing flora species and vegetation communities (including riparian) present in the proposal area and representation outside project area. Detail measures proposed: • to ensure protection or rehabilitation of representative vegetation communities within the local and regional context which have been identified as being of significant local and regional conservation value; • to ensure introduced crops and weeds are managed so that there are no adverse impacts on the adjacent terrestrial environment; • to address quarantine for disease; • for coordination of long term management of the proposed irrigation scheme to ensure no long term adverse impact on the conservation values of the adjacent terrestrial environment arise from the development; and • to establish buffer zones, protected areas and conservation zones to ensure the maintenance of dependant species.

	Declared Rare and Priority Flora	Protect Declared Rare and Priority Flora, consistent with the provisions of the WA Wildlife Conservation Act 1950 and other relevant State, Northern Territory and Commonwealth legislation.	Baseline studies to identify existing Declared Rare or Priority Flora (or equivalent under NT or Commonwealth legislation (including species listed on the schedules of the Commonwealth's *Endangered Species Protection Act 1992*) present in area of proposed development. Identify threats and potential threats to Declared Rare and Priority Flora (or equivalent under NT or Commonwealth legislation). Detail measures proposed to ensure protection or rehabilitation of any Declared Rare or Priority Flora (or equivalent under NT or Commonwealth legislation).

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**WA EPA objective**	**Work required for the environmental review**
Estuarine flora	Estuarine flora	Maintain the ecological function, abundance, species diversity and geographic distribution of estuarine and marine flora	Baseline studies to identify existing estuarine or marine vegetation assemblages of the Keep River and Sandy Creek. Detail measures proposed to ensure protection of marine flora downstream and in tidal reaches of Keep River and Sandy Creek from increased water flow, sediment load, pesticides and other chemical runoff.
Terrestrial fauna	Terrestrial fauna	Maintain the abundance, species diversity and geographical distribution of terrestrial fauna.	Baseline studies to identify existing occurrence of fauna and usage of the proposed development area by terrestrial fauna. Detail measures proposed to: • ensure protection or rehabilitation of fauna habitat, including that downstream of the proposed development; and • establish buffer zones, protected areas and conservation zones to ensure the existence of dependant species.

	Specially protected (threatened) fauna	Protect Specially Protected (Threatened) Fauna, consistent with the provisions of the WA Wildlife Conservation Act 1950 and other relevant State, Northern Territory and Commonwealth legislation.	Baseline studies to identify existing usage of area of proposed development by Specially Protected (Threatened) or Threatened Fauna and Priority Fauna species (or equivalent under NT or Commonwealth legislation). This should include species protected by international agreements such as CAMBA, JAMBA and Ramsar and species listed on the schedules of the Commonwealth's *Endangered Species Protection Act 1992*.
		Protect Threatened Fauna and Priority Fauna species and their habitats, consistent with the provisions of the WA Wildlife Conservation Act 1950 and other relevant State, Northern Territory and Commonwealth legislation.	Detail measures proposed to ensure protection or rehabilitation of any Specially protected (threatened) or priority fauna species or habitat (or equivalent under NT or Commonwealth legislation). This should include species protected by international agreements such as CAMBA, JAMBA and Ramsar.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**WA EPA objective**	**Work required for the environmental review**
	Subterranean fauna	Maintain the abundance, species diversity and geographical distribution of subterranean fauna	Baseline studies to identify existing usage of area of proposed development by subterranean fauna, including information on habitat use, ecological requirements, occurrence and tolerance of subterranean species to changes in water quality and level. Detail measures proposed to ensure protection or rehabilitation of any subterranean fauna habitat.
Aquatic fauna	Aquatic fauna	Maintain the ecological function, abundance, species diversity and geographic distribution of aquatic fauna.	Baseline studies to identify existing usage by aquatic fauna of rivers, streams and wetlands, including those downstream of proposed development. Detail measures to ensure aquatic fauna are not adversely affected by proposed development.
Wetlands	Wetlands	To protect the environmental values and maintain or enhance key ecological functions of the wetlands	Baseline studies to identify existing environmental values of permanent and seasonal wetlands within the project area and a description of their relative environmental and conservation significance. Identify wetlands within or in the vicinity of the project area that are listed as Wetlands of International Importance under the Ramsar Convention. Detail measures proposed to ensure protection, maintenance or enhancement of key environmental values of affected wetlands.
	Watercourses	Maintain the integrity, functions and environmental values of watercourses.	Baseline studies to identify existing environmental values of Keep River, Knox, Sandy and Border Creeks. Detail measures proposed to ensure protection and enhancement of environmental values of affected watercourses, including changes resulting from modifications to surface runoff and diversion of flows by the proposal.

	Groundwater quantity	Maintain groundwater so that existing and potential uses, including ecosystem maintenance are protected	Baseline studies to identify existing groundwater levels in the project area and existing components of the environment dependant on groundwater. Detail measures proposed to ensure protection of existing and potential uses, including ecosystem maintenance, from changes in groundwater levels.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**WA EPA objective**	**Work required for the environmental review**
	Surface water quantity	Maintain surface water so that existing and potential uses, including ecosystem maintenance are protected	Baseline studies to determine surface water quantity and streamflows. Detail measures proposed to ensure no adverse downstream impacts arise from development.
	Mosquitoes and disease vectors	Mosquito numbers on-site should not adversely affect the health, welfare and amenity of future residents; and Ensure the breeding of mosquitoes is controlled to the satisfaction of the relevant public health agencies without adversely affecting other flora and fauna	Baseline studies to identify existing mosquito and other disease vectors present within or in the vicinity of the project area. Detail measures proposed to ensure disease vectors and pest, such as mosquitoes, are adequately monitored and managed. Where required provide details of drainage systems designed for the prevention of mosquito breeding. Note: the Kimberley region is within the receptive zone for malaria and Australian encephalitis is endemic.
Land	Hydrology	Establish stable, sustainable landform consistent with surroundings.	Baseline studies to document existing hydrological regimes across the project area, particularly in relation to watercourses, other landscape features and on the Weaber, Keep and Knox Plains. Detail measures proposed to: • avoid possible impacts from erosion, flooding and other changes resulting from modifications to surface runoff and groundwater behaviour; • ensure adjacent vegetation communities are unaffected by changes in natural sheet water flows or from altered surface water hydrology associated with diversion of water by the proposal; and • assess and respond to long term risks/trends in salinity and groundwater levels.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**WA EPA objective**	**Work required for the environmental review**
POLLUTION MANAGEMENT			
Air	Particulates and dust	Ensure that the dust levels generated by the proposal do not adversely impact welfare and amenity of surrounding land users or cause health problems by meeting statutory requirements and acceptable standards.	Detail measures proposed to ensure impact from construction and operational activities comply with particulates and dust statutory requirements and guidelines.
	Chemical spray drift	Ensure that spray drift generated by chemicals used for the proposal does not adversely impact health, welfare and amenity of surrounding land users and the environment by meeting statutory requirements and acceptable standards.	Detail measures proposed to ensure impact from agricultural and other activities comply with statutory requirements and acceptable standards for chemical spray drift.
	Greenhouse gases	To minimise greenhouse gas emissions for the project and reduce emissions per unit product as low as reasonably practicable; and To mitigate greenhouse gases emissions in accordance with the Framework Convention on Climate Change 1992, and in accordance with established Commonwealth and State policies.	Baseline studies to estimate the existing greenhouse benefits related to the existing vegetation and land management practices within the project area. Detail measures proposed to ensure that greenhouse gas emissions meet acceptable standards and relevant State, NT and Commonwealth policy and legislation.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**WA EPA objective**	**Work required for the environmental review**
Water	Groundwater quality	Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected.	Baseline studies to identify existing groundwater quality in the superficial and related deep aquifers within and in the vicinity of the project area. Detail measures proposed to: • ensure existing and potential groundwater uses, including ecosystem maintenance are protected; and • ensure that potential for pollution (as a result of the application of herbicides, pesticides and fertilisers) and salinity is managed so that there are no adverse impacts on groundwater quality.
	Surface water quality	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected.	Baseline studies to identify existing surface water quality in watercourses and other surface flows in the project area. Assessment of the potential presence and potential impacts from acid sulphate soils. Detail measures proposed to: • ensure the quality of surface water is maintained so that existing and potential uses, including ecosystem maintenance are protected; and • ensure that potential for pollution (as a result of increased sediment loads, herbicides, pesticides and fertilisers) and salinity is managed so that there are no adverse impacts on surface water quality.
SOCIAL SURROUNDINGS			
Recreation	Recreation	Maintain or enhance recreational usage of the project area, consistent with plans developed by planning agencies.	Baseline studies to identify existing recreational uses within and in the vicinity of the project area. Detail measures to maintain recreational values within the project area, especially the Keep River.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**WA EPA objective**	**Work required for the environmental review**
Culture and heritage	Aboriginal heritage and culture	Ensure the proposal complies with the requirements of relevant State, Northern Territory and Commonwealth legislation; and Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Describe the archaeological and heritage values of the project area and their relationship to other relevant areas. Describe the cultural and traditional relationship of Miriuwung and Gajerrong people with the environment of the project area. Describe the Native Title rights and interests of Aboriginal people in relation to the project area as they are affected by the proposal. Detail measures proposed to: • ensure the proposal complies with the *Aboriginal Heritage Act* and other relevant State, NT and Commonwealth legislation including the *Australian Heritage Commission Act 1975*; • ensure that changes to the biological and physical environment do not adversely affect cultural and traditional associations and the use of the area; • address rights and interests of Aboriginal people that may be affected by changes to the biological and physical environment; and • ensure appropriate consultation with traditional owners and the community.
Social	Social surrounds	To maintain and protect the aesthetic, cultural, economic and social surroundings, where those surroundings affect or are affected by physical or biological change.	Describe the existing and anticipated demographics in the project area and in other areas affected by the proposal (eg Kununurra and Wyndham). Describe community infrastructure requirements resulting from the proposal, including in Kununurra and Wyndham. Describe the existing wilderness and aesthetic values of the project area. Detail measures to maintain and protect wilderness and aesthetic values.

OTHER			
Cumulative impact			Describe relationships between this proposal and other land uses (eg Ord Stage 1). Detail measures proposed to ensure that cumulative environmental impacts are avoided and/or managed.

These factors should be addressed within the environmental review document for the public to consider and make comment to the WA EPA. The WA EPA expects to address these factors in its report to the Minister for the Environment. The factor of biological diversity is discussed in more detail in Section 4 of these guidelines.

The WA EPA expects the proponent to take due care in ensuring any other relevant environmental factors which may be of interest to the public are addressed.

4. The environmental factor of biological diversity

The Ord River Stage 2 M2 proposal involves substantial development of up to 50,000 ha of land on the Weaber Plain, Knox River Plain and Keep River Plain, located within the Kimberley region of WA and the adjoining portion of the NT. There will be large-scale clearing of land within pastoral lease, for irrigated agriculture and related infrastructure, new water-related management requirements, as well as issues associated with the introduction of agricultural crops and chemicals. These developments will require a significant change in the environment in both the short-term and longer-term.

Environmental impact assessment of the proposal will require the consideration of these short and long-term issues and their individual and cumulative consequences. For instance, the loss of up to 50,000 ha of vegetation through clearing is one of the fundamental environmental issues, both from the point of view of the extent of clearing as well as the threats to biological diversity in doing so.

This consideration relates to the environmental factor of biological diversity, which must be addressed through the proposal approval process. In WA this will require approvals in at least three areas: environmental approval under the WA *Environmental Protection Act* 1986, water provision under the WA *Rights in Water and Irrigation Act* 1911, and government approval through a new State Agreement Act. The latter two cannot proceed until environmental approval has been obtained.

The WA EPA has given consideration to how it will assess this key environmental factor of biological diversity.

In 1996 the Commonwealth Government, with all State and Territory Governments, signed the National Strategy for the Conservation of Australia's Biological Diversity. Conservation of biological diversity is a foundation of ecologically sustainable development. In this regard, one of the objectives of the National Strategy for Ecologically Sustainable Development is to protect biological diversity at the ecosystem, species and genetic levels and to maintain essential ecological processes and life-support systems.

The National Strategy for the Conservation of Australia's Biological Diversity adopted the following principles as a basis for the Strategy's objectives and actions. These should be used as a guide for implementation:

1. Biological diversity is best conserved in-situ.
2. Although all levels of government have clear responsibility, the cooperation of conservation groups, resource users, indigenous peoples, and the community in general is critical to the conservation of biological diversity.
3. It is vital to anticipate, prevent and attack at source the causes of significant reduction or loss of biological diversity.
4. Processes for and decisions about the allocation and use of Australia's resources should be efficient, equitable and transparent.
5. Lack of full knowledge should not be an excuse for postponing action to conserve biological diversity.
6. The conservation of Australia's biological diversity is affected by international activities and requires actions extending beyond Australia's national jurisdiction.
7. Australians operating beyond our national jurisdiction should respect the principles of conservation and ecologically sustainable use of biological diversity and act in accordance with any relevant national or international laws.
8. Central to the conservation of Australia's biological diversity is the establishment of a comprehensive, representative and adequate system of ecologically viable protected areas integrated with the sympathetic management of all other areas, including agricultural and other resource production systems.
9. The close, traditional association of Australia's indigenous peoples with components of biological diversity should be recognised, as should the desirability of sharing equitably benefits arising from the innovative use of traditional knowledge of biological diversity.

In its consideration of the consequences of the proposal on biological diversity, the WA EPA will focus on these principles and the related objectives and actions in the National Strategy. The WA EPA would expect that the WA, NT and Commonwealth Governments will take account of these principles prior to making any decisions in relation to the proposal, and the WA EPA will ensure that the proponent has addressed these principles in the ERMP. In addition, it is clear to the WA EPA that, in view of the scale of the proposal, the proponent alone may not be able to protect biological diversity and that it will require the participation of the WA and NT Governments as well.

The WA EPA's consideration of biological diversity will include the following basic elements:

- a comparison of a number of development scenarios to evaluate protection of biodiversity at the species and ecosystem levels;
- no known species of plant or animal is caused to become extinct as a consequence of the development and the risks to threatened species are considered to be acceptable;
- no association or community of indigenous plants ceases to exist as a result of the project;
- there is comprehensive, adequate and secure representation of scarce or endangered habitats within the project area and/or in areas which are biologically comparable to the project area within WA and the NT, protected in secure reserves;

- the project area itself includes a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity is secure and protected; and
- the on-site and off-site impacts of the project are identified and the proponent demonstrates that these impacts can be managed.

In relation to land clearing, the WA EPA notes that Objective 7.1 of the National Strategy commits State, Territory and Commonwealth Governments by the year 2000 to, among other things:

> " *(l) arresting and reversing the decline of remnant native vegetation; and*
>
> *(m) avoiding or limiting any further broad-scale clearance of native vegetation, consistent with ecologically sustainable management and bioregional planning, to those instances in which regional biological diversity objectives are not compromised."* (Commonwealth of Australia 1996, p.42)

5. Availability of the environmental review

5.1 Copies for distribution free of charge

Supplied to DEP:

- Library/Information Centre 9
- WA EPA members 6
- Officers of the DEP (Perth) 8

Distributed by the proponent to:

Government Departments:

- Aboriginal Affairs Department 1
- Agriculture Western Australia 2
- Department of Conservation and Land Management 2
- Department of Land Administration 1
- Department of Minerals and Energy 1
- Department of Resources Development 2
- Environment Australia 10
- Fisheries Western Australia 2
- Kimberley Development Commission 2
- Main Roads Western Australia 1
- Northern Territory Department of Lands Planning and Environment 10

  [and 2 copies on CD rom in ADOBE format (*.pdf)]
- Water and Rivers Commission 2
- Western Australian Museum 2

Local government authorities:

- Shire of Wyndham/ East Kimberley 2

Libraries:

- J S Battye Library 3
- The Environment Centre (WA)..... 2
- The Environment Centre (NT)..... 3
- Shire of Wyndham/ East Kimberley Library .....2 (each at least)

Other:

- Aboriginal Legal Service 2
- Conservation Council of WA..... 1
- Kimberley Land Council..... 2
- Northern Land Council 2
- Waringarri Aboriginal Corporation 1

5.2 Available for public viewing

- J S Battye Library (WA)
- Shire of Wyndham/ East Kimberley Libraries
- Department of Environmental Protection Library
- NT Department of Lands Planning and Environment
- Department Lands Planning and Environment in Katherine
- NT State Library
- NT Parks and Wildlife Commission at Timber Creek
- Waringarri (Kununurra)
- Joorook Ngari (Wyndham)

Part B: Generic Guidelines for the preparation of an environmental review document

1. Overview

All environmental reviews have the objective of protecting the environment. Environmental impact assessment is deliberately a public process in order to obtain broad ranging advice. The review requires the proponent to describe:

- the proposal;
- receiving environment;
- potential impacts of the proposal on factors of the environment; and
- proposed management strategies to ensure those environmental factors are appropriately protected.

Throughout the assessment process it is the objective of the WA EPA to help the proponent to improve the proposal so the environment is protected. The DEP will co-ordinate, on behalf of the WA EPA, relevant government agencies and the public in providing advice about environmental matters during the assessment of the environmental review for this proposal.

The primary purpose of the environmental review is to provide information on the proposal within the local and regional framework to the WA EPA, with the aim of emphasising how the proposal may impact the relevant environmental factors and how those impacts may be mitigated and managed.

The language used in the body of the environmental review should be kept simple and concise, considering the audience includes non-technical people, and any extensive, technical detail should either be referenced or appended to the environmental review. It should be noted that the environmental review will form the legal basis of the Minister for the Environment's approval of the proposal and therefore the environmental review should include a description of all the main and ancillary components of the proposal, including options where relevant.

Information used to reach conclusions should be properly referenced, including personal communications. Such information should not be misleading or presented in a way that could be construed to mislead readers. Assessments of the significance of an impact should be soundly based rather than unsubstantiated opinion, and each assessment should lead to a discussion of the management of the environmental factor.

For the purposes of assessment, the project officer should be supplied with an electronic copy of the document for use on Macintosh, Microsoft Word Version 6, and any scanned figures. Where possible, figures should be reproducible in a black and white format.

2. Objectives of the environmental review

The objectives of the environmental review are to:

- place this proposal in the context of the local and regional environment;
- adequately describe all components of the proposal, so that the Minister for the Environment can consider approval of a well-defined project;

- provide the basis of the proponent's environmental management program, which shows that the environmental impacts resulting from the proposal, including cumulative impact, can be acceptably managed; and
- communicate clearly with the public (including government agencies), using written material, video or other means, so that the WA EPA can obtain informed public comment to assist in providing advice to government.

3. Environmental management

The WA EPA expects the proponent to have in place an environmental management system appropriate to the scale and impacts of the proposal including provisions for performance review and a commitment to continuous improvement. The system may be integrated with quality and health and safety systems and should include the following elements:

- environmental policy and commitment;
- planning of environmental requirements;
- implementation and operation of environmental requirements;
- measurement and evaluation of environmental performance; and
- review and improvement of environmental outcomes.

A description of the proposed environmental management system should be included in the environmental review documentation. If appropriate, the documentation can be incorporated into a formal environmental management system (such as AS/NZS ISO 14001). Public accountability should be incorporated into the approach on environmental management.

The environmental management program (EMP) is the key document of an environmental management system that should be adequately defined in an environmental review document. The EMP should provide plans to manage the relevant environmental factors, define the performance objectives, describe the resources to be used, outline the operational procedures and outline the monitoring and reporting procedures which would demonstrate the achievement of the objectives.

4. Format of the environmental review document

The environmental review should be provided to the DEP officer for comment. At this stage the document should have all figures produced in the final format and colours.

Following approval to release the review for public comment, the final document should also be provided to the DEP in an electronic format.

The proponent is requested to supply the project officer with an electronic copy of the environmental review document for use on Macintosh, Microsoft Word Version 6, and any scanned figures. Where possible, figures should be reproducible in a black and white format.

5. Contents of the environmental review document

The contents of the environmental review should include an executive summary, introduction and at least the following:

5.1 The proposal

A comprehensive description of the proposal including its location (address and certificate of title details where relevant) is required.

Justification and alternatives

- justification and objectives for the proposed development;
- the legal framework, including existing zoning and environmental approvals, and decision making authorities and involved agencies; and
- consideration of alternative options (including a 'no development' option).

Key characteristics

The Minister's statement will bind the proponent to implementing the proposal in accordance with any technical specifications and key characteristics[1] in the environmental review document. It is important therefore, that the level of technical detail in the environmental review, while sufficient for environmental assessment, does not bind the proponent in areas where the project is likely to change in ways that have no environmental significance.

Include a description of the components of the proposal, including the nature and extent of works proposed. This information must be summarised in the form of a table as follows:

[1] Changes to the key characteristics of the proposal following final approval, would require assessment of the change and can be treated as non-substantial and approved by the Minister, if the environmental impacts are not significant. If the change is significant, it would require assessment under section 38 or section 46. Changes to other aspects of the proposal are generally inconsequential and can be implemented without further assessment. It is prudent to consult with the Department of Environmental Protection about changes to the proposal.

Table 1: Key characteristics (example only)

Element	Description
Life of project (mine production)	< 5yrs (continual operation)
Size of ore body	682 000 tonnes (upper limit)
Area of disturbance (including access)	100 hectares
List of major components • pit • waste dump • infrastructure (water supply, roads, etc)	Refer plans, specifications, charts section immediately below for details of map requirements
Ore mining rate • maximum	 • 200 000 tonnes per year
Solid waste materials • maximum	 • 800,000 tonnes per year
Water supply • source • maximum hourly requirement • maximum annual requirement	 • XYZ borefield, ABC aquifer • 180 cubic metres • 1 000 000 cubic metres
Fuel storage capacity and quantity used	Litres; litres per year
Heavy mineral concentrate transport • truck movements (maximum)	 • 75 return truck loads per week

Plans, Specifications, Charts

Adequately dimensioned plans showing clearly the location and elements of the proposal which are significant from the point of view of environmental protection, should be included. The location and dimensions (for progressive stages of development, if relevant) of plant, amenities buildings, accessways, stockpile areas, dredge areas, waste product disposal and treatment areas, all dams and water storage areas, mining areas, storage areas including fuel storage, landscaped areas etc.

Only those elements of plans, specifications and charts that are significant from the point of view of environmental protection are of relevance here.

Figures that should always be included are:

- a map showing the proposal in the local context - an overlay of the proposal on a base map of the main environmental constraints;
- a map showing the proposal in the regional context; and, if appropriate
- a process chart / mass balance diagram showing inputs, outputs and waste streams.

The plan/s should include contours, a north arrow, a scale bar, a legend, grid co-ordinates, the source of the data, and a title. If the data is overlaid on an aerial photo then the date of the aerial photo should be shown.

Other logistics

- timing and staging of project; and
- ownership and liability for waste during transport, disposal operations and long-term disposal (where appropriate to the proposal).

5.2 Environmental factors

The environmental review should focus on the relevant environmental factors for the proposal, and these should be agreed in consultation with the WA EPA and DEP and relevant public and government agencies. Preliminary environmental factors identified for the proposal are shown in Part A of these guidelines.

Further environmental factors may be identified during the preparation of the environmental review, therefore on-going consultation with the WA EPA, DEP and other relevant agencies is recommended. The DEP can advise the proponent on the recommended WA EPA objective for any new environmental factors raised. Minor matters which can be readily managed as part of normal operations for the existing operations or similar projects may be briefly described.

Items that should be discussed under each environmental factor are:

- a clear definition of the area of assessment for this factor;
- the WA EPA objective for this factor;
- a description of what is being affected - why this factor is relevant to the proposal;
- a description of how this factor is being affected by the proposal - the predicted extent of impact;
- a description of where this factor fits into the broader environmental / ecological context (only if relevant - this may not be applicable to all factors);
- a straightforward description or explanation of any relevant standards / regulations / policy;
- environmental evaluation - does the proposal meet the WA EPA's objective as defined above;
- if not, environmental management proposed to ensure the WA EPA's objective is met; and
- predicted outcome.

The proponent should provide a summary table of the above information for all environmental factors, under the three categories of biophysical, pollution management and social surroundings:

Table 2: Environmental factors and management (example only)

Environ-mental Factor	WA EPA Objective	Existing environment	Potential impact	Environ-mental management	Predicted outcome
BIOPHYSICAL					
Vegetation community types 3b and 20b	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation community types 3b and 20b	Reserve 34587 contains 45 ha of community type 20b and 34 ha of community type 3b	Proposal avoids all areas of community types 20b and 3b	Surrounding area will be fully rehabilitated following construction	Community types 20b and 3b will remain untouched Area surrounding will be revegetated with seed stock of 20b and 3b community types
POLLUTION MANAGEMENT					
Dust	Ensure that the dust levels generated by the proposal do not adversely impact upon welfare and amenity or cause health problems by meeting statutory requirements and acceptable standards	Light industrial area - three other dust producing industries in close vicinity Nearest residential area is 800 metres	Proposal may generate dust on two days of each working week.	Dust Control Plan will be implemented	Dust can be managed to meet WA EPA's objective
SOCIAL SURROUNDINGS					
Visual amenity	Visual amenity of the area adjacent to the project should not be unduly affected by the proposal	Area already built-up	This proposal will contribute negligibly to the overall visual amenity of the area	Main building will be in 'forest colours' and screening trees will be planted on road	Proposal will blend well with existing visual amenity and the WA EPA's objective can be met

5.3 Environmental management commitments

The implementation of the key characteristics of the proposal and the environmental management commitments made by the proponent become legally enforceable under the conditions of environmental approval issued in the statement by the Minister for the Environment. All the auditable environmental management commitments should be consolidated in the public review document in a list (usually in an Appendix). This list is attached to the Minister's statement and becomes part of the conditions of approval.

The proponent's compliance with the consolidated environmental management commitments will be audited by the DEP, so they must be expressed in a way which enables them to be audited.

A commitment needs to contain most (if not all) of the following elements to be auditable:

- who (eg. the proponent)

- will do what (eg. prepare a plan, take action)
- why (to meet an environmental objective)
- where/how (detail the action and where it applies)
- when (in which phase, eg. before construction starts)
- to what standard (recognised standard or agency to be satisfied)
- on advice from (agency to be consulted).

The proponent may make other 'commitments', which address less significant or non-environmental matters, to show an intention to good general management of the project. Such 'commitments' (or management strategies/policies) would not be included in the consolidated list of environmental management commitments appended to the statement.

Continuous improvement during the implementation of the consolidated commitments may necessitate changes whilst ensuring the environmental objective is still achieved; these can be made in updates to the environmental management plan. Modified and/or additional proponent commitments arising from the fulfilment of environmental conditions will be audited by the DEP and should follow the accepted format.

Once the proposal is approved under a statement of conditions, any proposed modifications or additional commitments should be referred to the WA EPA for consideration of the environmental impacts. Such changes to the consolidated list of commitments would normally be dealt with through the audit process; however, if significant impacts are involved, the proposed changes may constitute a change to the proposal which would require assessment.

Examples of the preferred format for typical commitments are shown in the following table:

Table 3: Summary of proponent's commitments (example only)

Who/What **Commitment**	**When plan prepared** **Timing**	**Why** **Objective**	**How/Where** **Action**	**Whose advice** **expert consulted**	**Evidence Standard** **Compliance criteria**
1. The Proponent will develop and implement a rehabilitation plan	before construction commences	to protect the abundance, species diversity, geographic distribution and productivity of the vegetation community types 3b and 20b (fig 3.1, EMP)	by limiting construction to 10 ha of Reserve 34587 and rehabilitating the area	on advice of CALM.	similarity rating of rehab'd area consistent with vegetation community types 3b and 20b.
2. The Proponent will prepare and implement a dust control plan	before the start of construction	to minimise dust generation and impact on nearby land owners	by measures such as watering roads and monitoring wind direction	preparation of the plan on advice of DEP.	1000mg/m3 (WA EPA Dust Control Criteria)

Commitments should preferably be written in tabular format, preferably with some specification of ways in which the commitment can be measured, or how compliance can be demonstrated.

Draft commitments, whether in textual or tabular format, which are not in a format that can be audited will not be accepted by DEP assessment officers for public review documentation. Proponents will be assisted to revise inadequate commitments.

5.4 Public consultation

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

5.5 Other information

Additional detail and description of the proposal, if provided, should go in a separate section.

Attachment 1

The first page of the proponent's environmental review document must be the following invitation to make a submission, with the parts in square brackets amended to apply to each specific proposal. Its purpose is to explain what submissions are used for and to detail why and how to make a submission.

Invitation to make a submission

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

[the proponent] proposes [the rezoning of land and the development of a Marina Complex in the City of Bunbury]. In accordance with the WA *Environmental Protection Act*, a [PER] has been prepared which describes this proposal and its likely effects on the environment. The [PER] is available for a public review period of [8] weeks from [**date**] closing on [**date**].

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

Why write a submission?

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

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

Why not join a group?

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

Developing a submission

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

When making comments on specific elements of the [PER]:

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

Points to keep in mind

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

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

Remember to include:

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

The closing date for submissions is: [**date**]

Submissions should be addressed to:

The Environmental Protection Authority
Westralia Square
141 St George's Terrace
PERTH WA 6000

Attention: Juliet Cole

Attachment 2

Advertising the environmental review

The proponent is responsible for advertising the release and arranging the availability of the environmental review document in accordance with the following guidelines:

Format and content

The format and content of the advertisement should be approved by the DEP before appearing in the media. For joint State-Commonwealth assessments, the Commonwealth also has to approve the advertisement. The advertisement should be consistent with the attached example.

Note that the DEP officer's name should appear in the advertisement.

Size

The size of the advertisement should be two newspaper columns (about 10 cm) wide by about 14 cm long. Dimensions less than these would be difficult to read.

Location

The approved advertisement should, for CER's, appear in the news section of the main local newspaper and, for PER's and ERMP's, appear in the news section of the main daily paper's ("The West Australian") Saturday edition, and in the news section of the main local paper at the commencement of the public review period and again two weeks prior to the closure of the public review period.

Timing

Within the guidelines already given, it is the proponent's prerogative to set the time of release, although the DEP should be informed. The advertisement should not go out before the report is actually available, or the review period may need to be extended.

Example of the newspaper advertisement

SCM CHEMICALS LTD

Consultative Environmental Review

EXTENSION TO DALYELLUP RESIDUE DISPOSAL PROGRAM

(Public Review Period: [**date**] to [**date**])

SCM Chemicals Ltd is planning to extend the company's existing residue disposal program at Dalyellup, south of Bunbury, from March 1992 to March 1993.

A Consultative Environmental Review (CER) has been prepared by the company to examine the environmental effects associated with the proposed development, in accordance with Western Australian Government procedures. The CER describes the proposal, examines the likely environmental effects and the proposed environmental management procedures.

SCM has prepared a project summary which is available free of charge from the company's office on Old Coast Road, Australind.

Copies of the CER may be purchased for $5 from:

SCM Chemicals Ltd
Old Coast Road
AUSTRALIND WA 6230
Telephone: (08) 9467 2356

Copies of the complete Consultative Environmental Review will be available for examination at:

- Environmental Protection Authority
  Library Information Centre
  8th Floor, Westralia Square
  38 Mounts Bay Road
  PERTH WA 6000
- Environmental Protection Authority
  65 Wittenoom Street
  BUNBURY WA 6230
- City of Bunbury public libraries
- Shire of Capel libraries
- Shire of Harvey library (Australind)
- Shire of Dardanup (Eaton)

Submissions on this proposal are invited by [**closing date**]. Please address your submission to:

Chairman
Environmental Protection Authority
8th Floor, Westralia Square
141 St Georges Terrace
PERTH WA 6000
Attention: [**Juliet Cole**]

If you have any questions on how to make a submission, please ring the project officer, [**Project Officer name**], on (08) 9222 7xxx.

APPENDIX B
GLOSSARY

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GLOSSARY

Accessions	Water infiltration from the ground surface to underlying aquifers.
Adsorption	The concentration or sorption of one substance on the surface of another.
Aeolian	Descriptive of soil deposited by wind.
Aquifer	A permeable rock formation that stores and transmits sufficient groundwater to yield significant quantities of water to wells, bores or springs.
Arboreal	Of living in, or connected with trees.
Avian	Of, or relating to birds.
Avifauna	Birds of a region or country collectively.
Bagasse	The fibreous residue left after the extraction of juice from sugarcane.
Biogeographic region	A territory defined by a combination of biological, social and geographic criteria rather than by geopolitical considerations; generally, a system of related, interconnected ecosystems.
Biological diversity	The variety of life forms: the different plants, animals and microorganisms, the genes they contain, and the ecosystems they form.
Calcareous	Composed of, or containing calcium compounds, particularly calcium carbonate.
Calcrete	Friable to hard calcareous material of secondary accumulation found near or on the surface, and composed largely of crusts of soluble calcium salts intermixed with gravel, sand, salt and clay.
Carbon dioxide equivalent carbon	The amount of carbon that would need to be fully combusted to produce carbon dioxide with an equivalent global warming potential.
Colloid	A mixture of ultramicroscopic (i.e. clay) particles in water.
Conservation	The protection, maintenance, management, sustainable use, restoration and enhancement of the natural environment.
Cucurbits	Gourds (e.g. melons and pumpkins).
Cuesta	A gentle slope, especially one ending in a steep drop.
Enzootic	Regularly affecting animals in a particular district or at a particular season.
Evapotranspiration	The return of water vapour to the atmosphere by evaporation from land and water surfaces and by the transpiration of vegetation.
Feral species	A domesticated species that has become wild.
Fluvial	Of, or found in, a river or rivers.
Gilgai	The microrelief of soils produced by expansion and contraction with changes in moisture, found in soils that contain large amounts of clay. It is characterised by a markedly undulating surface with mounds and depressions.
Global warming	The increase in temperature of the earth's atmosphere caused by the greenhouse effect.
Global warming potential	The potential for a gas to contribute to global warming. Usually expressed as a factor of carbon dioxide. Factors are published by the Intergovernmental Panel on Climate Change.
Greenhouse gas	Any of the various gases, especially carbon dioxide, that contribute to the greenhouse effect.
Greenhouse sinks	Activities that sequester greenhouse gases from the atmosphere.
Habitat	The place or type of site in which an organism naturally occurs.

Hogback	A steep-sided ridge of a hill.
Hydrogeology	The science dealing with groundwater and with related geological aspects of surface water.
Indicator species	A species whose presence or absence is indicative of a particular habitat, community or set of environmental conditions.
Karstic	Descriptive of uneven limestone topography, characterised by depressions, fissures, etc., created by percolating waters.
Metabolite	A substance produced during, or taking part in, metabolism.
Native vegetation	Any local indigenous plant community containing throughout its growth the complement of native species and habitats normally associated with that vegetation type or having the potential to develop these characteristics.
Organochlorine	A compound containing carbon and chlorine.
Organophosphate	A compound containing carbon and phosphorous.
Palaeochannel	Buried channel of a watercourse from the geological past.
Pediment	A broad flattish rock surface at the foot of a mountain slope.
Riparian	Of or on a riverbank.
Saxicoline	Rock inhabiting.
Smut	A group of Basidiomycete fungi (order Ustilanginales) with sooty spore masses.
Sodicity	A form of land degredation involving sodic soils (clay particles with attached sodium ions), resulting in poor water infiltration, surface crusting, erosion and water logging.
Solodic	Soils with strong differences in texture with increasing depth; acid surface layers and strongly alkaline deeper layers.
Species	A group or organisms capable of interbreeding freely with each other but not with members of other species.
Stygofauna	Fauna (usually invertebrae) that live exclusively in subterranean habitats.
Synclinal	Rock formation having the characteristics of a trough.
Tailwater	Irrigation water that leaves the end of the furrow.
Taxon (pl. taxa)	The named classification unit to which individuals or sets of species are assigned, such as species, genus and order.
Threatened	A species or community that is vulnerable or endangered.
Transgenic	Having genetic material introduced from another species of animal or plant.
Trash	The refuse of stripped leaves and tops produced during the harvesting of sugarcane.
Vector	Any organism that conveys a disease-producing organism from one host to another, either within or on the surface of its body.
Volatilisation	Vaporization, evaporation.
Wilderness	Land that, together with its plant and animal communities, is in a state that has not been substantially modified by, and is remote from, the influences of European settlement or is capable of being restored to such a state, and is of sufficient size to make its maintenance in such a state feasible.

APPENDIX C
ABBREVIATIONS

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ABBREVIATIONS

Measurements

Technical units of measurement in this report are based on the International System of Units (SI) wherever possible. These technical units may be broadly grouped as prefixes and measurements. A prefix applies to the unit of measurement that immediately follows it—for example, milligram is abbreviated as mg. Superscripts ^{2} and ^{3} following a linear unit indicate area and volume respectively—for example, m^2 (square metres) and m^3 (cubic metres). Different units are combined by a full stop (.) to differentiate units of the same exponential sign, and a solidus (/) to indicate 'per'. For example, kilometres per hour is abbreviated as km/h, while megalitres per day per square kilometre is ML/d.km^2.

Prefixes

G	giga	1,000,000,000
M	mega	1,000,000
k	kilo	1,000
m	milli	0.001
µ	micro	0.000001
n	nano	0.000000001

Units of Measurement

a	year (annum)
BP	before present
cm	centimetre(s)
EC_e	electrical conductivity of saturation extract
g	grams(s)
GL	gigalitre(s)
GL/a	gigalitre(s) per year
g/m^3	grams(s) per cubic metre
g/Nm^3	gram(s) per normal cubic metre(s) (gas volume at 0°C and 1 atmosphere)
ha	hectare(s)
ha/a	hectare(s) per year
kg	kilogram(s)
kg/h	kilogram(s) per hour
kg/ha	kilogram(s) per hectare
kg/m^3	kilogram(s) per cubic metre
km	kilometre(s)
km^2	square kilometre(s)
km/h	kilometre(s) per hour

L	litre(s)
lb	pound(s)
L/s	litre(s) per second
m	metre(s)
m^3/h	cubic metre(s) per hour
mg/L	milligram(s) per litre
ML	megalitre(s)
ML/a	megalitre(s) per year
ML/d	megalitre(s) per day
ML/ha	megalitre(s) per hectare
mm	millimetre(s)
mm/a	millimetre(s) per year
mm/d	millimetre(s) per day
mm/h	millimetre(s) per hour
m^3/s	cubic metre(s) per second
m/s	metre(s) per second
Mt	megatonne(s)
Mt/a	megatonne(s) per annum
MW	megawatt(s)
NTU	Nephelometric turbidity unit
pH	degree of alkalinity/acidity
p.p.m.	parts per million
s	second(s)
t	tonne(s)
t/a	tonne(s) per year
t/d	tonne(s) per day
t/h	tonne(s) per hour
µg/L	microgram(s) per litre
µSv/cm	microsievert(s) per centimetre
USc/lb	cents (United States of America) per pound weight
$	dollar(s)
°C	degree(s) Celsius
%	per cent

General

AAD	Aboriginal Affairs Department
AAPA	Aboriginal Areas Protection Authority
ACMC	Aboriginal Cultural Material Committee
AGWEST	Agriculture Western Australia

AHA	*Aboriginal Heritage Act 1972*
AHC	Australian Heritage Commission
AHCA	*Australia Heritage Commission Act 1975*
AHD	Australian Height Datum
ALRA	*Aboriginal Land Rights (Northern Territory) Act 1976*
ALS	Aboriginal Legal Service
ANCA	Australian Nature Conservation Agency
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average Recurrence Interval
ASEIA	Aboriginal Socio-Economic Impact Assessment
ASSANTA	*Northern Territory Aboriginal Sacred Sites Act 1989*
ATSIHPA	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
BOD	Biological oxygen demand
CALM	Department of Conservation and Land Management
CAMBA	China–Australia Migratory Birds Agreement
CDEP	Community Development Employment Projects
CHMP	Cultural Heritage Management Plan
COAG	Council of Australian Governments
Co-proponents	Wesfarmers Sugar Company Pty Ltd, Marubeni Corporation and the Water Corporation of Western Australia
CRES	Centre for Resource and Environmental Studies
DAP	Diammonium phosphate
DEP	Department of Environmental Protection
DOLA	Department of Land Administration
DPIF	Department of Primary Industry and Fisheries
DRD	Department of Resources Development
EIS	Environmental Impact Statement
EKAMS	East Kimberley Aboriginal Medical Service
EMP	Environmental Management Plan
EPA	Environmental Protection Authority (Western Australia)
ERMP	Environmental Review and Management Programme
ESD	Ecologically Sustainable Development
ESP	Exchangeable sodium percentage
Fisheries	Fisheries Western Australia
FOB	Free on Board
HAC	Heritage Advisory Council
HCA	*Heritage Conservation Act 1991*
HCB	Heritage Conservation Branch

HCWA	Heritage Council of Western Australia
HWAA	*Heritage of Western Australia Act 1990*
ILUA	Indigenous Land Use Agreement
IUCN	International Union for Conservation of Nature and Natural Resources
JAMBA	Japan–Australia Migratory Birds Agreement
KDC	Kimberley Development Commission
KLC	Kimberley Land Council
KWADS	Kununurra–Wyndham Area Development Strategy
Marubeni	Marubeni Corporation
MfP	Ministry for Planning
NLC	Northern Land Council
NNTTA	National Native Title Tribunal
NRA	National Registration Authority for Agriculture and Veterinary Chemicals
NSCABD	National Strategy for the Conservation of Australia's Biological Diversity
NTA	*Native Title Act 1993*
NY No. 11	No. 11 raw sugar futures contract traded on the New York Coffee, Sugar and Cocoa Exchange
ODC	Ord Development Council
OIC	Ord Irrigation Co-operative Ltd
ORIA	Ord River Irrigation Area
PBC	Prescribed Body Corporate
pers. comm.	personal communication
Project	Ord Sugar Project
Project Area	Land that would be developed for farms and infrastructure and associated land that would be managed for conservation
Proponents	Wesfarmers Sugar Company Pty Ltd, Marubeni Corporation and the Water Corporation of Western Australia
Ramsar Convention	Convention on Wetlands of International Importance especially on Water Fowl Habitat, 1975
SCADA	Supervisory, Control and Data Acquisition
TDS	Total dissolved solids
ULV	Ultra-low-volume
WARMS	Western Australian Rangeland Monitoring System
Water Corporation	Water Corporation of Western Australia
Wesfarmers	Wesfarmers Sugar Company Pty Ltd

Vegetation Associations

Grasslands and Sedgelands

G1 Dense Grassland mosaic dominated by *Heteropogon contortus, Iseilema fragile, Chrysopogon fallax* or *Sorghum timorense;* Soil Unit 1.

G2 Dense Grassland of *Themeda triandra, Dichanthium sericeum* var. *polystachyum, Sorghum timorense* and *Chrysopogon fallax*; Soil Unit 3c.

G3 Open Grassland of *Themeda triandra* over *Eriachne* sp.; Soil Unit 1.

G4 Open annual grassland of *Sorghum timorense* over dense *Chrysopogon fallax;* Soil Unit 5c.

G5 Open Grassland of *Imperata cylindrica* over *Xerochloa imberbis* and *Sporobolus virginicus*; Soil Unit 7a.

G6 Mixed Sedgeland and Grassland of *Eriachne sulcata, Eleocharis dulcis* and *Eleocharis* sp. B (Kimberley Flora) with emergent *Corymbia confertiflora;* Soil Unit 5c/4d.

Grasslands with Emergent Trees

GT1 Tall Grassland of *Sorghum timorense, Aristida latifolia* and *Heteropogon contortus* with emergent *Eucalyptus microtheca;* Soil Unit 1.

GT2 Dense grassland of *Iseilema vaginiflorum, Aristida latifolia, Sorghum timorense, Themeda triandra* with emergent *Eucalyptus microtheca, Excoecaria parvifolia, Atalaya hemiglauca* and *Bauhinia cunninghamii;* Soil Unit 1.

GT3 Grassland of *Panicum decompositum, Heteropogon contortus, Themeda triandra* and *Iseilema vaginiflorum* with emergent scattered *Eucalyptus microtheca* and *Corymbia bella* in Soil Unit 1; the raised eastern bank above Milligan Lagoon. Open Sedgeland dominated by *Eleocharis dulcis* and *Schoenoplectus praelongatus* with emergent *Excoecaria parvifolia* and *Barringtonia acutangula* on the edge of Milligan Lagoon.

GT4 Grassland dominated by *Themeda triandra* and *Aristida latifolia* with emergent trees of *Eucalyptus microtheca;* Soil Unit 5a.

GT5 Grassland dominated by *Iseilema vaginiflorum* with emergent *Eucalyptus microtheca* and emergent to dense *Excoecaria parvifolia;* Soil Unit 5b.

GT6 Grassland of *Cymbopogon procerus* and *Themeda triandra* with emergent *Bauhinia cunninghamii* and *Acacia ditricha;* Soil Unit 4a.

GT7 Grassland of *Bothriochloa bladhii, Themeda triandra* and *Ophiuros exaltatus* with emergent *Eucalyptus microtheca, Acacia ditricha* and *Bauhinia cunninghamii;* Soil Unit 7a.

GT8 Grassland of *Themeda triandra, Iseilema vaginiflorum* and *Aristida latifolia* with scattered *Bauhinia cunninghamii, Acacia ditricha* and *Corymbia bella;* Soil Unit 1.

GT9 Open tussock and annual grassland of *Eulalia aurea, Panicum decompositum* and *Sorghum timorense* with emergent *Corymbia belle* and *Parkinsonia aculeata* at a Swamp; Soil Unit 1.

GT10 Open Hummock grassland dominated by *Plectrachne bynoei* with Open Shrubland of *Calytrix exstipulata* and scattered low trees of *Buchanania obovata, Owenia vernicosa* and *Eucalyptus confertiflora;* Soil Unit 6.

GT11 Open annual grassland and herbfield of *Neptunia monosperma* with emergent trees of *Atalaya salicifolia* and *Excoecaria parvifolia;* Soil Unit 9c.

GT12 Open Grassland of *Sehima nervosum* and *Themeda triandra* with scattered trees of *Bauhinia cunninghamii, Adansonia gregorii, Corymbia foelscheana* and *Eucalyptus microtheca*; Soil Unit 2b.

GT13 Moderately dense tussock and annual grassland of *Chrysopogon fallax, Themeda triandra* and *Iseilema fragile* with emergent low trees *of Corymbia bella, Excoecaria parvifolia* and *Bauhinia cunninghamii*; Soil Unit 5c.

GT14 Open grassland and herbland of mixed species with emergent *Eucalyptus microtheca, Corymbia bella* and *Adansonia gregorii*; Soil Unit 11 at the base of a rock outcrop.

Woodlands

Woodlands of *Eucalyptus microtheca, Atalaya hemiglauca, Bauhinia cunninghamii and Excoecaria parvifolia*

Em1 Dense Woodland of *Eucalyptus microtheca* over a grassland of *Iseilema vaginiflorum* and *Aristida latifolia*; Soil Unit 1.

Em2 Woodland of *Eucalyptus microtheca* over open *Bauhinia cunninghamii* and *Atalaya hemiglauca* over a grassland of *Chrysopogon fallax, Iseilema vaginiflorum* and *Brachyachne convergens;* Soil Unit 1g.

Em3 Woodland of *Eucalyptus microtheca* over a grassland of *Themeda triandra* and *Chrysopogon fallax*; Soil Unit 4b.

Em4 Woodland of *Eucalyptus microtheca* and *Excoecaria parvifolia* over sedge-grassland of *Aristida latifolia, Panicum decompositum, Chrysopogon fallax, Panicum laevinode Sorghum timorense* and *Iseilema fragile*; Soil Unit 5a.

Em5 Woodland of *Eucalyptus microtheca* and *Bauhinia cunninghamii* over a closed tussock grassland of *Themeda triandra* and *Ophiuros exaltatus*; Soil Unit 7b.

Em6 Open Woodland of *Eucalyptus microtheca, Bauhinia cunninghamii, Excoecaria parvifolia* and *Atalaya hemiglauca* over an open shrubland of *Bauhinia oblongata* subsp. *volucris* open grassland of *Astrebla squarrosa, Aristida latifolia* and *Panicum decompositum*; Soil Unit 1 and 1c.

Em7 Open Woodland of *Eucalyptus microtheca* and *Acacia ditricha* over a tall grassland dominated by *Oryza australiense, Sorghum timorense* over *Panicum decompositum;* Soil Unit 1.

Em8 **Low** Open Woodland of *Eucalyptus microtheca* and *Excoecaria parvifolia* over a dense grassland dominated *of Ophiuros exaltatus, Sorghum timorense, Oryza australiensis* and *Iseilema fragile*; Soil Unit 5b.

Em9 Open Woodland of *Eucalyptus microtheca* over open tussock and annual grassland of *Panicum laevinode, Ophiuros exaltatus, Cyperus conics* and *Neptunia monosperma;* Soil Unit 5a.

Woodlands of *Eucalyptus microtheca* and *Melaleuca spp.*

EM1 Open Woodland of *Eucalyptus microtheca* over Shrubland of *Melaleuca nervosa* and *Grevillea striata* over a low open grassland of *Themeda triandra, Eriachne obtusa* and *Aristida hygrometrica;* Soil Unit 1.

EM2 Woodland of *Eucalyptus microtheca* over a low woodland of *Excoecaria parvifolia, Melaleuca viridiflora* and *Terminalia oblongata* subsp. *volucris*; Soil Unit 11.

EM3 Woodland of *Eucalyptus microtheca, Melaleuca argentea* and *Lophostemon grandiflorus* subsp. *riparius* over Dense Low Woodland of *Bauhinia cunninghamii;* Soil Unit7a.

Woodlands of *Eucalyptus microtheca* and Shrubland of *Terminalia oblongata* subsp. *volucis*

ET1 Woodland of *Eucalyptus pruinosa, Eucalyptus microtheca* over Open Shrubland of *Terminalia oblongata* subsp. *volucris, Bauhinia cunninghamii* and *Carissa lanceolata* over a grassland dominated by *Themeda triandra, Sehima nervosum, Chrysopogon pallidus* and *Eriachne glauca* var. *glauca;* Soil Unit 5e.

ET2 Woodland of *Eucalyptus microtheca* over *Bauhinia cunninghamii* and *Terminalia oblongata* var. *volucris* over dense grassland of *Themeda triandra* and *Sehima nervosum*; Soil Unit 3c.

ET3 Woodland of *Eucalyptus microtheca* and *Corymbia greeniana* over *Bauhinia cunninghamii, Terminalia oblongata* subsp. *volucris* and *Hakea arborescens* over scattered tussocks of *Aristida latifolia, Sorghum timorense* and *Iseilema vaginiflorum*; Soil Unit 5a.

ET4 Low open woodland of *Eucalyptus microtheca, Bauhinia cunninghamii,* over a Shrubland of *Terminalia oblongata* subsp. *volucris* over dense grassland dominated by *Themeda triandra, Aristida latifolia, Sehima nervosum, Chrysopogon fallax* and *Ophiuros exaltatus*; Soil Unit 4d.

ET5 Open Low Woodland of *Excoecaria parvifolia, Bauhinia cunninghamii* over a Shrubland of *Terminalia oblongata* subsp. *volucris* and *Eucalyptus microtheca* over an Open Tussock Grassland of *Chrysopogon fallax, Panicum decompositum, Astrebla elymoides* and *Iseilema fragile*; Soil Unit 5b and 5bt.

ET6 Open Low Woodland of *Excoecaria parvifolia, Bauhinia cunninghamii* and *Eucalyptus microtheca* over a Shrubland of *Terminalia oblongata* subsp. *volucris* and a grassland of *Panicum decompositum, Iseilema vaginiflorum* and *Sorghum timorense*; Soil Unit 1.

Woodlands of *Eucalyptus miniata*

Min1 Woodland of *Eucalyptus miniata, Eucalyptus tetrodonta* and *Terminalia platyphylla* over a shrubland of *Acacia difficilis* over an open grassland of *Aristida* sp.; the Cockatoo Land System.

Min2 *Eucalyptus miniata* low forest over open *Grevillea agrifolia* over *Plectrachne caroliniana* or *Triodia burbidgeana* and *Sorghum* sp. open grassland on a moderate slope of the Cockatoo Land System.

Woodland of *Eucalyptus papuana*

Ep1 Woodland of *Eucalyptus papuana* over a Shrubland of *Flueggia virosa* var. *melanthesoides* over Grassland of *Heteropogon contortus;* Soil Unit 7.

Woodland of *Eucalyptus tetradonta*

Et1 Woodland of *Eucalyptus tetrodonta, Corymbia greeniana* and *Terminalia canescens* over a shrubland of *Acacia* affin. *aulacocarpa;* Cockatoo Soil Unit.

Woodlands of *Corymbia bella*

Cb1 Open woodland of *Eucalyptus microtheca, Corymbia bella*, *Corymbia greeniana, Excoecaria parvifolia* and *Bauhina cunninghamii* over a grassland of *Sehima nervosum* and *Heteropogon contortus;* Soil Units 7a and 7a/b.

Cb2 Woodland of *Eucalyptus microtheca, Corymbia greeniana, Corymbia confertiflora, Corymbia bella* and *Adansonia gregorii* over an open shrubland of *Bauhinia cunninghamii* and a grassland of *Sehima nervosum* and *Themeda triandra*; Soil 7f .

Cb3 Woodland of *Eucalyptus mictrotheca, Corymbia bella, Bauhinia cunninghamii* and *Excoecaria parvifolia* over a grassland dominated by *Ophiuros exaltatus,. Chrysopogon fallax, Dichanthium sericeum* var. *polystachion;* Soil Unit 5e.

Cb4 Woodland of *Bauhinia cunninghamii, Eucalyptus bigalerita, Terminalia grandiflora* and *Corymbia bella* over an open tussock and annual grassland of *Heteropogon contortus* and *Chrysopogon fallax*; Soil Unit 8b.

Cb5 Woodland of *Corymbia bella, Eucalyptus pruinosa* and *Melaleuca minutifolia* woodland over dense grassland of *Themeda triandra*; Soil Units 2a and 2a/3a.

Cb6 Open Woodland of *Terminalia platyphylla, Corymbia bella over an open woodland of Bauhinia cunninghamii* and *Terminalia oblongata* subsp. *volucris* and scattered *Acacia ditricha* over a dense annual and tussock grassland of *Themeda triandra, Heteropogon contortus, Aristida latifolia* , *Ophiuros exaltatus* and *Sorghum timorense;* Soil Units 4a, 4b and 4c.

Cb7 Open Woodland of *Corymbia bella, Corymbia polycarpa*, and *Melaleuca viridiflora* over a dense grassland of *Themeda triandra*; Soil Unit 7a.

Cb8 Open Woodland of *Corymbia bella* and *Acacia ditricha* over a Grassland of *Themeda triandra, Ophiuros exaltatus, Chrysopogon fallax* and *Cymbopogon contortus*; Soil Unit 1and 5a.

Cb9 Open Woodland of *Corymbia bella, Planchonia careya, Atalaya salicifolia* and *Acacia ditricha* over tussock grassland of *Themeda triandra*, *Ophiuros exaltatus* and *Eulalaia aurea*; Soil Unit 8.

Cb10 Very Open Woodland of *Corymbia bella* over tussock and annual grassland of *Themeda triandra , Ophiuros exaltatus* and *Sorghum stipoideum;* Soil Unit 9c.

Woodlands of *Corymbia confertiflora*

Cc1 Open Woodland of *Corymbia confertiflora, Planchonia careya* and *Terminalia latipes* var. *latipes* over moderately dense *Bauhinia cunninghamii* and a very open tussock grassland of *Heteropogon contortus, Themeda triandra* and *Sorghum plumosum*; Soil Unit 2b.

Cc2 Woodand of *Corymbia bella, Acacia ditricha, Corymbia confertiflora, Planchonia careya* and *Bauhinia cunninghamii* over an open grassland of *Themeda triandra, Heteropogon contortus* and *Sehima nervosum*; Soil Unit 4d.

Cc3 Woodland of *Corymbia confertiflora, Corymbia greeniana* and *Planchonia careya* over scattered mallees of *Corymbia foelscheana* over a grassland of *Heteropogon contortus* and *Sehima nervosum*; Soil 2a.

Cc4 Woodland of *Corymbia confertiflora, Eucalyptus microtheca* and *Eucalyptus tectifera* over a Grassland dominated by *Aristida holathera* var. *holathera, Themeda triandra, Sorghum plumosum* var. *plumosum;* Soil Unit 8a.

Woodlands of *Corymbia tectifica*

Ct1 Woodland of *Eucalyptus tectifica* over open tussock grassland of *Heteropogon contortus, Themeda triandra* and *Chrysopogon fallax , Themeda triandra*; Soil Unit 2a and 2c.

Ct2 Low Woodland of *Eucalyptus tectifica* over dense tussock and annual grassland of *Themeda triandra, Panicum decompositum* and *Sorghum timorense*; Soil Unit 4a.

Woodlands of *Corymbia* sp., *Brachychiton diversifolius* and *Gyrocarpus americanus*

CBG Woodland of *Corymbia* spp. *Brachychiton diversifolius, Bauhinia cunninghamii* with scattered taller *Gyrocarpus americanus* subsp. *pachyphyllus* over an open grassland of *Themeda triandra*; Soil Unit 6e.

Woodland of Bauhinia cunninghamii

Bc1 Low Woodland of *Bauhinia cunninghamii* over tussock and annual grassland of *Iseilema* sp. *Panicum decompositum, Sehima nervosum, Aristida latifolia, Cyperus bifax, Sehima nervosum, Chrysopogon fallax* and *Sorghum timorense;* Soil Unit1.

Bc2 Low Shrubland of *Bauhinia cunninghamii* and *Atalaya hemiglauca* over grassland of *Chrysopogon fallax* with lianes of *Rhynchosia fallax;* Soil Unit1.

Bc3 Low Woodland of *Bauhinia cunninghamii* occasionally with scattered *Acacia ditricha* over grassland of *Themeda triandra* and *Chrysopogon fallax;* Soil Unit1.

Woodlands of *Excoecaria parvifolia*

Ex1 Woodland of *Excoecaria parvifolia* with scattered *Corymbia bella* and *Bauhinia cunninghamii* over mixed grass species; Soil Unit 1.

Ex2 Woodland of *Excoecaria parvifolia* over an open to dense grassland dominated by *Ophiuros exaltatus, Iseleima fragile or Heteropogon contortus.* Typically this occurs along minor drainage lines within the Grasslands of the Keep River and is an extension of the grassland community G1.

Ex3 Woodland of *Excoecaria parvifolia* with scattered *Eucalyptus microtheca* over a Low Grassland dominated by *Sehima nervosum* and *Cyperus viscidulus;* Soil unit 1e.

Ex4 Woodland of *Melaleuca nervosa, Excoecaria parvifolia* and *Cathormion umbellatum* over scattered *Strychnos lucida* shrubs and mid-dense **Passiflora foetida* var. *hispida* lianes; Soil Unit 7.

Woodlands of *Melaleuca* species

Me1 Woodland of *Eucalyptus* sp., *Corymbia* sp., *Terminalia grandiflora*, *Melaleuca nervosa* and *Acacia difficilis* over and open grassland of *Eriachne obtusa*, *Chrysopogon setifolius* and *Aristida holanthera* var. *holathera*; Soil Type 8e.

Me2 Low Woodland of *Melaleuca viridiflora* and *Eucalyptus tectifera* over open shrubland of *Acacia difficilis* over open *Plectrachne* sp. and *Fimbristylis* sp.; Soil Unit 7a.

Me3 Open shrubland of *Melaleuca acacioides* and *Excoecaria parvifolia* over scattered grassland of *Heteropogon contortus;* Soil Unit 7.

Me4 Woodland of *Melaleuca minutifolia, Melaleuca viridiflora*, *Excoecaria parvifolia*, and *Cochlospermum fraseri* over an open to dense grassland of *Themeda triandra* and *Sorghum timorense*; Soil Units 3a/4a.

Woodland of *Buchanania obovata*

Bo1 Low Woodland of *Buchanania obovata* and *Bauhina cunninghamii* over Open Grassland of *Sehima nervosum* and *Sorghum stipoideum* on a dolomite hill.

Woodlands of *Terminalia canescens*

Tc1 Low Woodland of *Terminalia canescens* over a very open *Heteropogon contortus* grassland on a sandstone hill on the Knox Creek Plain.

APPENDIX D
REFERENCES

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Chapter One

Government of Western Australia and the Government of the Northern Territory. *Terms of Reference for Expressions of Interests in the Development of the Ord River Irrigation Area - Stage 2, 1997*.

International Sugar Organization 1994. *World Sugar Statistics 1955-1994.*

LMC International Ltd 1999. *LMC Commodity Bulletin, Sugar July 1999.*

Chapter Two

Agriculture Western Australia. 1998. *Agriculture in Western Australia.*

Cook, L. A. 1997. *'A report on aerial application for weed insect and disease control currently in use on the Ord River Irrigation Scheme'.* Agriculture Western Australia.

Doupé, R.G., M.A. Lund and S.R. Ranford. 1998. *A short-term assessment of point source pollution in the M1 irrigation supply channel with notes on agricultural discharge into the lower Ord River.*

Government of Western Australia and Government of the Northern Territory. 1996. *Ord River Irrigation Project — A review of its Expansion Potential.* Joint publication.

Waters and Rivers Commission. 1998. *A Preliminary Investigation of Fish Kills and Endosulfan levels in the Dunham and Ord Rivers.* In: *Proceedings of the Environmental Symposium "The Issues facing the Ord today".*

Chapter Three

Bureau of Sugar Experiment Stations 1998. *1997/1998 Annual Report.*

Sherrard, J.H. 1994. *Water Requirements for Irrigated Cropping in the Ord River Irrigation Area.* Western Australian Department of Agriculture.

Chapter Four

Aldrick, J.M. and P.W. Moody. 1977. Report on the *Soils of the Lower Weaber and Keep Plains*, N.T. Animal Industry and Agriculture Branch Department of Northern Territory Darwin, N.T.

Aldrick, J.M., A.J. Clarke, P.W. Moody, M.R.H van Cuylenburg, and B.A. Wren. 1978. *Soils of the Ivanhoe Plain, East Kimberley, Western Australia*. Western Australian Department of Agriculture. Technical Bulletin No. 82.

Baker, D.E. and V.J. Eldershaw. 1993. *Interpreting soil analyses for agricultural land use in Queensland*. Department of Primary Industries and Fisheries.

Department of Industries and Development. 1977. *Report on soils of the lower Weaber and Keep Plains, Northern Territory*. Technical Bulletin No. 19.

Dixon, J. 1996. *Soils of the Weaber Plain East Kimberley, Western Australia Natural Resources Assessment Group March 1996.* Agriculture Western Australia.

George, P.R. 1983. Unpublished, *Soil Salinity and Sodicity in Relation to Land Use*. Ivanhoe Plain Ord River Project Area. Department of Agriculture.

Hubble ,G.D., R.F. Isbell, and K.H Northcote. 1983. *Features of Australian Soils*. In: *Soils an Australian Perspective*. Commonwealth Scientific Industry and Research Organisation. Division of Soils, Melbourne.

Humpheys, B. 1995. *Limestone of the east Kimberley, Western Australia-karst and cave fauna*. Western Australian Museum.

Hunsigi. 1993. Production of Sugarcane Theory and Practice, Advanced Series in Agricultural Sciences 21. Springer-Verlag.

Lavalle , A.M. 1983. *Review of Land and Water Resources of Ord River Irrigation Area Western Australia*. Report prepared for Booker Agriculture International.

Riley, I.T., D.A. McGhie, and J.H. Sherrard. 1993. *Soils of the Ord River Irrigation Area.* Department of Agriculture Western Australia.

Schoknecht, N. and C. Grose. 1996. *Soils of the Knox Creek Plain East Kimberley Western Australia and Northern Territory*. Agriculture, Western Australia. Resource Management Technical Report 153.

Shaw, R. 1988. *Soil Salinity and Sodicity*. In *Understanding Soils and Soil Data*. Ed I.F. Fergus Australian Society of Soil Science Incorporated Queensland Branch. p109-134.

Shaw, R.J. and D.F. Yule. 1978. Assessment of soils for irrigation, Emerald, Queensland, Agriculture Chemistry Branch Technical Report No. 13, Department of Primary Industries, Queensland.

Stace, H.T.C., G.D. Hobble, R. Breuers, K.H Northcook, J.R. Sleeman, M.J. Mulchay and E.G. Hallsworth. 1968. A Handbook of Australian Soils Rellim Technical Publications.

Stewart, G.A. et al. 1970. *Lands of the Ord-Victoria area, Western Australia and Northern Territory*. CSIRO Aust. Land. Research Series. No. 28. Melbourne.

Chapter Five

ANZECC. 1992. *Australian Water Quality Guidelines for Fresh and Marine Waters.* Australian and New Zealand Environment and Conservation Council.

Barrett, J.W., S.M. Peterson, and G.E. Batley. 1991. *The Impact of Pesticides on the Riverine Environment with Specific Reference to Cotton-Growing*. A report by Barrett Purcell and Associates with CSIRO Centre for Advanced Analytical Chemistry.

Chang, H.H. 1998. *Fluvial Processes in River Engineering.* John Wiley & Sons Inc.

Doupé, R.G., M.A. Lund, and S.R. Ranford. 1998. A short-term assessment of point source pollution in the M1 irrigation supply channel with notes on agricultural drainage into the lower Ord River. A report for the Water Corporation of Western Australia.

Environmental Protection Authority of NSW. 1995. *Draft Environmental Guidelines for Irrigation Farming: General Principles - Draft.* Environmental Protection Authority of New South Wales.

Field, D.F. 1988. Baseflow Water Quality Surveys in Rivers of the Northern Territory - Volume 12 The Keep River. Report 11/1988. Power and Water Authority Water Directorate, Water Resources Group.

Gardiner H.G. & Associates. 1998. Issues paper prepared on behalf of Ord Land & Water.

ID&A. 1996. *Hydraulic Geometry of Brisbane Streams: Guidelines for Natural Channel design*. Part 1 - Guidelines. Final Report for Brisbane City Council.

Larson, H. 1999. *Keep River Aquatic Fauna Survey*. Museums and Art Galleries of the Northern Territory Research Report No. 4 February 1999.

Schofield, N., V. Edge, R. Moran. 1998. *Minimising the Impact of Pesticides on the Riverine Environment - Using the Cotton Industry as a Model.* Water January / February 1998.

Sinclair Knight Merz. 1998. *Ord Irrigation Area Stage 1 - Water and Nutrient Balance Study*. Report prepared for the Water Corporation of Western Australia.

Water and Rivers Commission. 1999. *Draft Interim Water Allocation Plan - Ord River Western Australia*. Water and Rivers Commission Report WRAP 15.

Chapter Six

ANZECC. 1992. Australian Water Quality Guidelines for Fresh and Marine Waters.

Chin, D., G. Humphreys, and P. Jolly. 1997. *Sub-surface Hydrology of the Knox Plain (NT Portion)*, Department of Lands, Planning and Environment, Water Resources Division, Darwin.

Humphreys, G., S. Tickell, D. Yin Foo, and P. Jolly. 1995. *Sub-surface Hydrology of the Keep River Plains,* Technical Report No 24/95D, Water Resources Division, Power and Water Authority, Darwin.

Hutson, J.L., and R.J. Wegenet. 1992. *LEACHM - Leaching Estimation and Chemistry Model.* Version 3, New York Sate College of Agriculture and Life Sciences, Cornell University, Ithaca, New York, USA.

Laws, A.T., 1991. *The Hydrogeology of the Ord River Irrigation Area*, in conference proceedings "50 Years of Ord Irrigation - Review and Future Perspectives", Kununurra 1991: Western Australia, Minister for North West, Agriculture, Water Resources, Ord Development Council

Moray, A.J. and G.M. Beere. 1988. *Geology of the Onshore Bonaparte and Ord Basin in Western Australia*, Western Australia Geological Survey, Bulletin 134.

Nixon, R.D. 1997a. *Ord River Irrigation Area Drilling Project, Bore Completion Report on the Knox Creek Plain*, Water and Rivers Commission Hydrogeology Report No 65.

Nixon, R.D. 1997b. *Ord River Irrigation Area Drilling Project, Bore Completion Report on the Weaber Plain*, Water and Rivers Commission Hydrogeology Report 66.

Nixon, R.D. 1997c. *Ord River Irrigation Area Drilling Project, Bore Completion Report on the Ivanhoe Plain*, Water and Rivers Commission Hydrogeology Report 70.

Nixon, R.D. 1997d. *Ord River Irrigation Area Miscellaneous Data Report on the Weaber and Knox Creek Plains*, Water and Rivers Commission Hydrogeology Report 72.

Nixon, R.D. 1997e. *Ord River Irrigation Area Drilling Project, Bore Completion Report on the Cave Spring Gap*, Water and Rivers Commission Hydrogeology Report No 71.

O'Boy, C.A. 1997. *Ord River Irrigation Area Test Pumping*, Water and Rivers Commission Hydrogeology Report No 48/1997.

O'Boy, C.A. 1998. *Ord River Irrigation Area Long-term Test Pumping*, Water and Rivers Commission Hydrogeology Report No 125/1998

Sinclair Knight Merz. 1998. *Ord Irrigation Area Stage 1 - Water and Nutrient Balance Study*. Report prepared for the Water Corporation of Western Australia.

Sweet, I.P., J.R. Mendrum, R.J. Bultitude, and C.M Morgan. 1974. *The Geology of the Southern Victoria River Region*, Northern Territory, Australia, Report 167, Bureau of Mineral Resources.

Whitehead, B.R., and G.M. Fahey. 1985. *Geology of the Keep River National Park*, Report 1, Northern Territory Geological Survey.

Chapter Seven

Agriculture and Resource Management Council of Australia and New Zealand, Australian and New Zealand Environment and Conservation Council of Forestry Ministers 1999. *The National Weeds Strategy: A Strategic Approach to Weed Problems of national Significance.*

Aldrick, J.M., and P.W. Moody. 1977. Report on the soils of the lower Weaber and Keep Plains, NT Animal Industry.

Beard, J.S. 1979. Kimberley. Explanatory notes to Sheet 1, 1:1,000,000 Series Vegetation Survey of Western Australia. UWA Press, Nedlands.

Beard, J.S. 1990. *Plant Life of Western Australia*. Kangaroo Press, Sydney.

Braithwaiter, R.W., J.M. Lonsdale, and J.A. Esterbergs. 1998. *Alien Vegetation and Native Biota in Tropical Australia: The Spread and Impact of Mimose Pigra*. Biol. Cons. 48: 189-210.

Brocklehurst, P., B. Harwood, J. Hill, B. Edmeades, and A. Fischer. 1998. Reconnaissance Land Resource Survey of Auvergene Station and Sections of Spirit Hills Station, Northern Territory (unpublished report).

Burbidge, A.A., N.L. McKenzie and K.F. Kenneally. 1991. *Nature Conservation Reserves in the Kimberley Western Australia*. Surrey Beatty and Sones, Canberra.

Connell Wagner Pty Ltd. 1997. *Draft Environmental Impact Statement and Environmental Management Plan Bradshaw Training Area*. Prepared for the Department of Defence.

Connors, G., B. Oliver, and J. Woinarski. 1996. *Bioregions in the Northern Territory: conservation values, reservation status and information gaps.* Report to AVCA National Reserves System Cooperative Program. ANCA Canberra.

Dames and Moore. 1982. Environmental Review and Management Programme, Argyle Diamond Project. Unpublished report to the Department of Conservation and Environment.

Department of Conservation and Land Management. 1992. *A survey of wildlife and vegetation of Purnululu National Park*. Research Bulletin No 6, Perth, Western Australia.

Department of Conservation and Land Management. 1998. Lower Ord Ramsar Site Draft Management Plan.

Department of Conservation and Land Management. 1999. Max Database Western Australia Herbarium, Como.

Dixon, J. 1996. *Soils of the Weaber Plain East Kimberley Western Australia*. Agriculture Western Australia. Resource Management Technical Report.

Ecologia Environmental Consultants. 1997a. *Ord River irrigation Area - Stage 2 M2 Development Area Terrestrial Biological Assessment.* Unpublished report for Department of Resources Development, Perth.

Ecologia Environmental Consultants. 1997b. *Ord River Irrigation Area - Stage 2 Riverside Development. Terrestrial Biological Assessment.* Unpublished Report for Western Australian Department of Resources Development.

Ecologia Environmental Consultants. 1999. *Ord River Irrigation Area - Stage 2 M2 Development Area. Terrestrial Biological Assessment Addendum A: Regional Biodiversity and Representation* Commissioned by Wesfarmers Limited, Marubeni Corporation and the Water Corporation of Western Australia.

Forbes, S.J. and K.F. Kenneally. 1986. *A botanical survey of the Bungle Bungle and Osmond Range, south-eastern Kimberley, Western Australia*. Western Australian Naturalist 16: 93-168.

Gardner, C.A. 1923. *Botanical Notes, Kimberley Division of Western Australia*. Western Australian Forests Department Bulletin No. 32.

Gowland, P.N. and N. Sonnemann. 1980. *North East Kimberley Reptile and Amphibia list.* Department of Agriculture, Kununurra

Gowland, P.N., and R.G. Brennan. 1980. *Ord River Irrigation Area Bird list*. Department of Agriculture. Department of Agriculture, Kununurra.

Gowland. 1980. *Ord River Irrigation Area Mammal list*. Department of Agriculture, Kununurra.

Henshall, T.S. and A.S. Mitchell. 1979. *Vegetation survey of the Keep River study area*. NT Botanical Bulletin No. 2 Conservation Commission of the Northern Territory.

Kabay, E.D. and A.A. Burbidge. 1977. *A Biological Survey of the Drysdale River National Park North Kimberley, Western Australia*. Research Bulletin No. 6 Fisheries and Wildlife, Perth.

Kinhill Pty Ltd 1999. *Ord Sugar Project. Biological Surveys of the Proposed Development Area - May and June 1999*. Commissioned by Wesfarmers Limited, Marubeni Corporation and the Water Corporation of Western Australia.

Larson, H. 1999. Keep River Aquatic Fauna Survey Unpublished Report Museum and Art Gallery of the Northern Territory, Darwin.

McKean, J.L. 1986. Birds of the Keep River National Park (Northern Territory) including the Night Parrot *Geopsittacus occidentalis. Aus. Bird Watcher* 11: 114-130

McKenzie, N.L., R.B. Johnston. and P.G. Kendrick, (eds). 1991. Kimberley Rainforests of Australia. Surrey Beatty and Sons, Canberra.

Miles, J.M. and A.A. Burbidge. 1975. *A Biological Survey of the Prince River Reserve North-west Kimberley Western Australia*. Research Bulletin No. 3 Fisheries and Wildlife, Perth

Perry, R.A. 1956. *The plant ecology of the Ord-Victoria area, north-western Australia*. MSc Thesis, University of Adelaide.

Petheram, R.J. and B. Kok. 1991. *Plants of the Kimberley Region of Western Australia*. UWA Press, Nedlands.

Stewart, G.A., R.A. Perry, S.J. Patterson, J.R. Sleeman, and P. Traves. 1970. Lands of the Ord-Victoria Area, Western Australia and Northern Territory. CSIRO Aust. Land. Res. Ser. No. 28 Melbourne.

Thackway, R. and I.D. Cresswell, I.D. 1995. An Interim Biogeographic Regionalisation for Australia. ANCA, Canberra.

Tidemann, S.C., P. Wilson, J. Burgess, S. Kerin, and J. NcCartney. 1987. An ecological survey of part of Spirit Hills station, Northern Territory. Conservation Commission Northern Territory, Darwin.

Wheeler, J.R., B.L. Rye, B.L. Koch, A.J.G. Wilson. 1992. *Flora of the Kimberley Region.* Department of Conservation and Land Management, Perth.

Wilson, B.A., P.S. Brocklehurst, M.J. Clark, K.J.M Dickinson. 1990. Vegetation Survey of the Northern Territory, Australia Conservation Commission of the Northern Territory Australia.

Wilson, B.R. et. al. 1981. *Biological survey of Mitchell Plateau and Admiralty Gulf, Kimberley.* Western Australia. Western Australian Museum.

Wrightman, G.M. 1989. Mangroves of the Northern Territory. Northern Territory Botanical Bulleting No. 7 Conservation commission of the Northern Territory Palmerston Northern Territory.

Chapter Eight

Beard, J.S. 1979. Kimberley Explanatory notes to Sheet 1, 1:1,000,000 Series Vegetation Survey of Western Australia. UWA Press, Nedlands.

Dames and Moore. 1982. *Environmental Review and Management Programme, Argyle Diamond Project.* Unpublished report to the Department of Conservation and Land Management.

Department of Conservation and Land Management. 1992. *A survey of the Wildlife and Vegetation of Purnululu National Park*. Research Bulletin No. 6 Perth WA.

Department of Conservation and Land Management. 1998. Lower Ord Ramsar Site, Draft Management Plan.

Ecologia Environmental Consultants. 1997a. *Ord River irrigation Area - Stage 2 M2 development Area Terrestrial Biological Assessment.* Unpublished report for Western Australian Department of Resources Development.

Ecologia Environmental Consultants. 1997b. *Ord River Irrigation Area - Stage 2 Riverside Development Terrestrial Biological Assessment.* Unpublished report for Western Australian Department of Resources Development.

Gibert, J., D.L Danielopol and J.A. Stanford (eds). 1994. *Groundwater Ecology.* Academic Press, London.

Horner, P. and A. Fisher. 1998. *Ctenotus rimacola sp. nov. (Scincidae), a new species of lizard with two allopatric subspecies from the Ord-Victoria region of northwestern Australia*. Records of the Western Australian Museum 19: 187-200.

Humphreys W.F. in press b. Physico-chemical profile and energy fixation in an anchialine remiped habitat in north-western Australia. J*ournal of the Royal Society of Western Australia*.

Humphreys, W.F. 1995. *Limestone of the east Kimberley, Western Australia - karst and cave fauna*. WA Museum, Perth.

Humphreys, W.F., in press a. *The hypogean fauna of the Cape Range peninsula and Barrow Island, north-west Australia*. Pp •••-••• *in* H. Wilkens, D.C. Culver and W.F. Humphreys (eds). *Ecosystems of the World, vol 30. Subterranean Ecosystems,* Chapter 30. Elsevier, Amsterdam.

Kabay, E.D. and Burbidge, A.A. 1977. *A Biological Survey of the Drysdale River National park North Kimberley, Western Australia*. Research Bulletin No. 6. Fisheries and Wildlife, Perth.

Kinhill Pty Ltd 1999. *Ord Sugar Project - A Fauna Survey of the M2 Development Area - May and June 1999.* Commissioned by Wesfarmers Limited, Marubeni Corporation and the Water Corporation of Western Australia.

Kitchener, D.J. 1978. *Mammals of the Ord River area, Kimberley, Western Australia, Rec*. West. Aust. Mus. 6: 189-219.

Larson, H.K. 1995. *Diversity of Fishes in Ranger and Comparison Billabongs, Kakadu National Park: Final Report*. Report to CSIRO, Canberra.

Larson, H.K. 1996. *Report on the Biological Resources Survey of the Roper River System, Gulf of Carpentaria, Northern territory, Australia: Coastal and Estuarine Fishes.* Report to Mount Isa Mines Holdings, Brisbane.

Larson, H.K. 1999. *Keep River Aquatic Fauna Survey*. Unpublished report for Kinhill Pty Ltd. Museum and Art Gallery of the Northern Territory

McKenzie, N.L. R.B. Johnston, and P.G. Kendrik. (eds). 1991. Kimberley Rainforests of Australia. Surrey Beatty and Sons, Canberra.

Miles, J.M. and A.A. Burbidge. 1975. *A Biological Survey of the Prince Regent River Reserve North-west Kimberley, Western Australia*. Research Bulletin No. 3. Fisheries and Wildlife, Perth.

Northcote, K.H., G.D. Hubble, R.F. Isbell, C.H Thompson and E. Bettenay. 1960-68. *Atlas of Australian Soils*. CSIRO and Melbourne University Press, Melbourne.

Puckey, H. Kerin, D. Sand Cheal. 1999. Flat-headed Frog - *Limnodynastes depressus* Proceedings of a Workshop. Northern Territory Parks and Wildlife Commission.

Schminke, H.K. 1986. Suncarida. Pp 389-404 *in* L. Botosaneanu (ed.). *Stygofauna Mundi.* a *faunistic, distributional, and ecological synthesis of the world fauna inhabiting subterranean waters.* E.J Brill / Dr W. Backhuys, Leiden,

Stewart, G.A., R.A. Perry, S.J. Patterson, J.R. Sleeman, and P. Traves. 1970. *Lands of the Ord-Victoria Area, Western Australia and Northern Territory.* CSIRO Aust. Land Res. Ser. No. 28. Melbourne.

Wheeler, J.R., B.L. Rye, B.L. Koch, and A.J.G. Wilson. 1992. *Flora of the Kimberley Region*. Department of Conservation and Land Management, Perth.

Wilson, B.R. et al. 1981. *Biological survey of Mitchell Plateau and Admiralty Gulf, Kimberley, Western Australia*. Western Australian Museum.

Woinarski, J.C.Z (ed). 1992. *The Wildlife and Vegetation of Purnululu (Bungle Bungle) National Park and Adjacent Area*. Wildlife Research Bulletin No. 6. Department of Conservation and Land Management, Perth.

Chapter Nine

Allen, G.R. 1982. *Inland fishes of Western Australia*, Western Australian Museum, Perth.

ANCA. 1995. Guidelines for preparing the second edition of a Directory of Important Wetlands in Australia. Australian Nature Conservation Agency.

Arthrington, A.H. and L.N. Lloyd. 1989. *Introduced poeciliids in Australia and New Zealand in Meffe, G.K. and Snelson, F.F. Ecology and evolution of livebearing fishes (Poeciliidae).* Prentice Hall, New Jersey.

Benson, L. 1997. Attachment 3 in Sinclair Knight Mertz. 1997. *Ord Irrigation Area - Stage 2 M2 Development Area.* Unpublished report prepared for the Western Australian Department of Resources Development.

Brown, G. and H. Larson. 1999. Annexe to MAGNT Research Report No. 4 Keep River Aquatic Fauna Survey, Keep River Aquatic Insects. Unpublished report for Kinhill Pty Ltd.

Coombes, K. 1996. Population dynamics and ecology of a suite of Atyidae (Crustacea: Decapoda) species in freshwater ecosystems in the Darwin region. Unpublished B.Sc. (Hons.) thesis, Northern Territory University.

Gowland. 1982. *Lake Kununurra Wetland.* Department of Agriculture WA.

Halse S.A., R.J. Shiela and G.B. Pearson. 1996. *Waterbirds and aquatic invertebrates of swamps on the Victoria-Bonaparte mudflat, northern Western Australia*. Journal of Royal Society of Western Australia 217-224.

Hutchins, J.B. 1981. *Freshwater fish fauna of the Mitchell Plateau area, Kimberley, Western Australia* in *Biological Survey of Mitchell Plateau and Admiralty Gulf, Kimberley*, Western Australian Museum, Perth.

IUCN. 1990. *1990 IUCN Red List of Threatened Animals*. IUCN World conservation Monitoring Centre, Cambridge, United Kingdom.

Jackson P.D. 1992. *Australian Threatened Fishes 1992 Supplement.* Australian Society for Fish Biology Newsletter, 22 No 2 19-24.

Jaensch, R.P. 1994. *Waterbird Breeding and populations in the Barkly Lakes Region in the 1993-4 West Season.* Conservation Commission of the Northern Territory, Darwin.

Kay, W.R., M.J. Smith, A.M. Pinder, J.M. McRae, J.A. Davis and S.A. Halse. 1999. *Patterns of distribution of macroinvertebrate families in rivers of north-western Australia*. Freshwater Biology 299-316.

Lane, J.A.K. and A.J. McComb. 1988. *Western Australian Wetlands.* In A.J. McComb and P.S. Lake (Eds.) *The Conservation of Australian Wetlands*. Surrey Beatty and Sons Pty Ltd.

Larson, H. 1999. *MAGNT Research Project No 4. Keep River Aquatic Fauna Survey.* Museums and Art Galleries of the Northern Territory.

Larson, H.K. 1995. *Diversity of Fishes in Ranger and Comparison Billabongs, Kakadu National Park*; Report to CSIRO, Canberra.

Larson, H.K. 1996. *Report on the Biological Resource Survey of the Roper River System, Gulf of Carpentaria, Northern Territory, Australia: Coastal and Estuarine Fishes.* Report to Mount Isa Mines Holdings, Brisbane.

Larson, H.K. 1997. Report to Parks Australia North, on the estuarine fish inventory of Kakadu National Park, Northern Territory, Australia.

Larson. 1999.

RAMSAR Convention. 1990. List of Wetlands of International Importance Nominated by the Government of Western Australia and the Conservation and Land Management.

Richards, K.R. 1986. *A study of the insect pest complex of the Ord River Irrigation Area*. MSc thesis UWA.

Walker, D.I., F.E. Wells, J. Russell Hanley. (eds). 1996. *Marine Biological Survey of the Eastern Kimberley, Western Australia*. University of Western Australia., Western Australian Museum, Museum and Art Gallery of the Northern Territory.

Wells, F.E. 1981. *Molluscan Fauna of the Admiralty Gulf, Cape Voltaire, and the Institute Islands, Kimberley, Western Australia. Chitons, Meso- and Meogastropods* in *Biological Survey of Mitchell Plateau and Admiralty Gulf, Kimberley, Western Australia*. WA Museum, Perth.

Wheeler, J.R. (ed). 1992. *Flora of the Kimberley Region* Department of Conservation and Land Management, Perth.

Wilson and Stoddart 1979.

Wilson, B.R. and J.A. Stoddart. 1979. *A study of the freshwater molluscs of the Ord River Region of Western Australia with reference to their potential as trematode vectors.* Unpublished report Western Australian Museum.

Chapter Ten

Anon. 1996. *Proposed Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia*. A report by the Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee.

Bellamy, J.A and J. Robinson. 1998. *Breaking Down Fences: Engaging Stateholders in Integrated Catchment Management.* Paper for Conference on ESD at University of Queensland.

Burbidge, A.A., N.L. McKenzie, K.F. Kenneally. 1991. *Nature Conservation Reserves in the Kimberley Western Australia*. Department of Conservation and Land Management, Como.

Commonwealth of Australia. 1996. *The National Strategy for the Conservation of Australia's Biological Diversity*. Commonwealth Department of the Environment, Sport and Territories.

Connell Wagner Pty Ltd. 1997. *Draft Environmental Impact Statement and Environmental Management Plan Bradshaw Training Area*. Prepared for the Department of Defence

Connors, G., B. Oliver, and J. Woinarski. 1996. *Bioregions in the Northern Territory: conservation values, reservation status and information gaps.* Report to AVCA National Reserves System Cooperative Program. ANCA Canberra.

Department of Conservation and Land Management. 1998. Lower Ord Ramsar Site. CALM, Kununurra.

Department of Conservation and Land Management. 1999. *Draft Environmental Weed Strategy*. Upublished documents by the Department of Conservation and Land Management.

Ecologia Environmental Consultants. 1997. *Ord River Irrigation Area - Stage 2 M2 Development Area Terrestrial Biological Assessment.* Unpublished Report for the Western Australian Department of Resources Development.

Environment Western Australia. 1998. *State of the Environment Report.* Department of Environmental Protection.

Government of Western Australia. 1997a. *State of the Environment Reference Group Draft Working Papers Section 1: Regional Description*. Government of Western Australia, Perth WA.

Government of Western Australia. 1997b. *State of the Environment Reference Group Draft Working Papers Section 7: Maintaining Biodiversity*. Government of Western Australia, Perth WA.

Government of Western Australia. 1997c. *State of the Environment Reference Group Draft Working Papers Section 8: Tracking Progress Toward Ecologially Sustainable Development.* Government of Western Australia, Perth WA.

Halvorsen, L. 1998. *Riverine Vegetation Rids Canefields of Rats.* Australian Landcare April, p 6–7.

Kinhill Pty Ltd 1999. *Ord Sugar Project - A Fauna Survey of the M2 Development Area - May and June 1999.* Commissioned by Wesfarmers Limited, Marubeni Corporation and the Water Corporation of Western Australia.

Parks and Wildlife Commission Northern Territory. 1998. *Annual Report for the year ended 30 June 1998.* Northern Territory Government

Parks and Wildlife Commission Northern Territory. 1998. Northern Territory Parks Masterplan Government Printing Office, Northern Territory.

Woinarski, J. and G. Connors. 1997. *Ord River Irrigation Area Stage 2 Options for Conservation*. Parks and Wildlife Commission of the Northern Territory (unpublished report).

Chapter Eleven

Department of Lands Planning and Environment. 1998.*Pastoral Land Monitoring*. Northern Territory Department of Lands Planning and Environment Information Sheet Number 2.

Fisheries Western Australia and Kimberley Development Commission. 1995. *Kimberley Aquaculture Development Plan.* A report by the Fisheries Department of Western Australia and the Kimberley Development Commission.

Kimberley Tourism Association. 1998. *The Kimberley—Far North Western Australia—1998/99 Holiday Planner*.

Ministry for Planning and Kimberley Development Commission 1999 Kununurra-Wyndham Area Development Strategy Discussion Paper. Report prepared by in association with Shire of Wyndham—East Kimberley, Northern Territory Department of Lands, Planning and Environment for the Kununurra-Wyndham Area Development Strategy Steering Committee as part of the Western Australian Planning Commission Strategic Planning Programme. published by the Western Australian Planning Commission, Perth, Western Australia.

Sinclair, T. and C. Ostle. 1998. *Assessment of Potential Sites for Aquaculture in Stage II of the Ord River Irrigation Area.* A report for Fisheries Western Australia.

WA Government. 1964. Ord Irrigation Project. A Case for Financial Assistance from the Commonwealth Government. Government of Western Australia.

WA Government. 1967. Ord Irrigation Project. A Case for Financial Assistance from the Commonwealth Government. Government of Western Australia.

Chapter Twelve

AACM International Pty. Ltd. 1997. *Aboriginal Consultations Ord River Irrigation Scheme Stage II September 1997*. Unpublished report prepared for the Department of Resource Development, Western Australia.

Archae-Aus Pty Ltd. 1999. *A Report on the Monitoring for Aboriginal Archaeological Material for the Ord River Irrigation (Stage 2) First Stage Works, Northern Territory – Western Australian Border, for the Northern Land Council. January 1999*. Unpublished report to the Northern Land Council.

Barber, K. & H. Rumley. 1998. The first stage works programme clearance report. Work programme clearance report of the heritage survey for the proposed Wesfarmers, Marubeni and Water Corporation stage one works of the Ord River Irrigation Area (Stage 2) Project. Unpublished report.

Barber, K. H. Rumley. & L. Strawbridge. 1993. A heritage survey of SECWA's proposed Kununurra diversion dam hydro power station development and the Kununurra to Wyndham power line corridor. Unpublished report.

Commonwealth of Australia. 1978. *Ord River Irrigation Area Review*. A joint Commonwealth and Western Australian Review. Australian Government Printing Service, Canberra.

Dortch, C.E. 1977. *Early and Late Stone Industrial Phases in Western Australia*. In *Stone Tools as Culture Markers*. R.V.S.Wright (ed), Australian Institute of Aboriginal Studies, Canberra, 104-132.

East Kimberley Impact Assessment Project. 1985. Project description and feasibility study. East Kimberley Working Paper No.1. Centre for Resource and Environmental Studies and Australia Institute of Aboriginal Studies Press, Canberra.

Forrest, A. 1880. *Journal of Expedition from De Grey to Port Darwin*. Government Printer, Perth.

Fullagar, R. D. Price, L. Head. 1996. *Early Human Occupation of Northern Australia – Archaeology and Thermo-luminescence Dating of Jinmium Rockshelter, Northern Territory.* In Antiquity, No. 70:751-773.

Green, N. 1978. *Aborigines and settlers in the nineteenth century*. In *A New History of Western Australia.* C. Stannage (ed.), University of Western Australia Press, Perth.

Gregory, R. & S. Sutton. 1997. *Final Assessment of the Archaeological Resources of the Keep River Plain and the Knox Plain for the Ord Stage II Project.* Unpublished report prepared for the Northern Territory Department of Primary Industries and Fisheries.

Gregory, R. 1994. *Site patterning in the Ord-Victoria river region: a GIS database*. In *Australian Aboriginal Studies,* Journal of the Australian Institute of Aboriginal and Torres Strait Islander Studies, Canberra, Number 2:51-58.

Kimberley Land Council. 1992. *Report of Consultations with Kimberley Aboriginal people on the recommendations of the Royal Commission into Aboriginal Deaths in Custody*. Unpublished report.

Kirkby, I. 1985. *Aboriginal site survey: Kununurra to Halls Creek Road*. Unpublished report.

Lee, J. 1998. Native Title Determination Application WC94/2 – Miriuwung Gajerrong #1. Unpublished report prepared for the Federal Court of Australia.

Maurice, M. 1985. *Timber Creek Land Claim.* Report No. 21. Australian Government Publishing Service, Canberra.

Mulvaney, K. 1996. *What to do on a rainy day: reminiscences of Mirriuwung and Gadjerong artists.* In Rock Art Research, Volume 13, Number 1:3-20.

Novak, V. 1980. *Derby-Wyndham Telecom*. Unpublished report prepared for the Western Australian Museum.

Quartermaine, G. S. 1990. *Report on a survey for Aboriginal sites, Ord Hydroelectric Project, East Kimberley*. Unpublished report prepared for the Snowy Mountains Engineering Corporation Ltd.

Quartermaine, G. S. and R. O'Conner. 1991. *Report on a survey for Aboriginal sites Lake Kununurra foreshore study area, East Kimberley*. Unpublished report prepared for the Shire of Wyndham-East Kimberley (2 Volumes).

Roberts, R. M. Bird, J. Olley, R. Galbraith, E. Lawson, G. Lazlett, H. Yoshida, R. Jones, R. Fullagar, G. Jacobson, and Q. Hua. 1998. *Optical and Radiocarcon Dating for Jinmium Rockshelter in Northern Australia*. In Nature, 393:358-362.

Ross, H. and E. Bray. 1989. *Impact Stories of the East Kimberley*. East Kimberley Working Paper No.28. Centre for Resource and Environmental Studies and Australian Institute of Aboriginal Studies Press, Canberra.

Shaw, B. 1981. *My Country of the Pelican Dreaming. The Life of an Australian Aborigine of the Gadjerrong, Grant Ngabidj, 1904-1977*. Australian Institute of Aboriginal Studies, Canberra.

Thoorrbiliny, R. 1987. *The effect of white land use on the Miriwoong people.* In Aborigines and Development in the East Kimberley, Australian National University Public Affairs Conference.

Western Australian Planning Commission and Kimberley Development Corporation. 1999. Kununurra – Wyndham Area Development Strategy. Prepared in association with Shire of Wyndham—East Kimberley, Northern Territory Department of Lands Planning and Environment for the Kununurra-Wyndham Area Development Strategy Steering Committee as part of the Western Australian Planning Commission Strategic Programme. Published by the Western Australian Planning Commission, Perth, Western Australia.

Willis, P. 1980. *Patrons and Riders: Conflicting Roles and Hidden Objectives in an Aboriginal Development Programme at Kununurra*. Unpublished MA Thesis, Australian National University.

Chapter Thirteen

Australian Environmental Council and National Health and Medical Research Council. 1986. *National guidelines for control of emission of air pollutants from new stationary sources. Recommended methods for monitoring air pollutants in the environment. 1985*. Canberra: Australian Government Publishing Service.

Barratt P. 1998. *Implications of the Kyoto Protocol for Australian Government and policy makers*. Paper delivered to the Greenhouse Beyond Kyoto - Conference, 1998.

Bureau of Meteorology. 1998. *Wind frequency analyses and wind roses between 1986 and 1998 for Kununurra Aero.*

Chapman L.S., M.B.C. Hayson, and P.G. Stafigna. 1992. *N cycling in cane fields is N labelled trash and residual fertiliser,* Proceedings of the Society of Sugar Cane Technologists 1992.

Cook L. A. 1997. *A report on aerial application for weed insect and disease control currently in use on the Ord River Irrigation Scheme.* Agriculture WA, April 1997.

Department of Resources Development. 1996. *Ord River Irrigation Project, A review of its expansion potential, Government of Western Australia, August 1996.*

Howden M.S., D.H. White, G.M. McKeon, J.C. Scanlan and J.O. Carter. 1994. *Methods for exploring management options to reduce greenhouse emissions from tropical grazing systems.* Journal of Climatic Change 27:49-70, 1994.

Langton, M. 1998. *Burning Questions - Emerging Environmental Issues for Indigenous Peoples in Northern Australia*. Centre for Indigenous Natural and Cultural Resource Management (CINCRM).

Weier K.L. 1998. *Sugar cane fields: sources or sinks for greenhouse gas emissions,* CSIRO Australia, 1998.

Chapter Fourteen

Aldred J. et al. 1992 *Australian encephalitis: sentinel chicken surveillance programme—serological results for March 1992,* Communicable Diseases Intelligence (Australia) 16, 169.

Broom A. K. et al. 1995. *Two possible mechanisms for survival and initiation of Murray Valley encephalitis virus activity in the Kimberley region of Western Australia.* American Journal of Tropical Medicine and Hygiene, 53, 95–99.

Broom A. et al. 1998. *Report of surveillance of mosquito-borne virus activity in the proposed extension of the Ord River Irrigation area near Kununurra, 1996-97.* (not yet published)

Broom, A.K. and M.C. Lindsay. 1998. *Ord River Irrigation Area Stage II: monitoring the impact of the development on mosquito-borne virus activity and the risk to human health*. Arbovirus Surveillance and Research Laboratory, Department of Microbiology, The University of Western Australia, Perth.

Edge, V.E. 1996. *Environmental Issues Facing the Cotton Industry Related to Pesticide Use.* Proceedings of the Eighth Australian Cotton Conference, gold Coast, Australia 14-16 August 1996. pp. 47-54.

Mackenzie J. S. and A.K. Broom. 1999. *Ord River irrigation area: the effect of dam construction and irrigation on the incidence of Murray Valley encephalitis virus.* In: Water Resources - Health, Environment and Development (B.H. Kay ed). E & FN Spon, London, pp108–122.

Mackenzie J. S. et al. 1992. *Australian encephalitis: sentinel chicken surveillance programme.* Communicable Diseases Intelligence (Australia) 16, 55–57.

Mackenzie J. S. 1998. *Arbovirus in the Australian region, 1990 to 1998.* Communicable Diseases Intelligence (Australia) 22, 93–100.

Schofield, N.J. and B.W. Simpson 1996. Pesticides—An Emerging Issue for Water and the Environment. 23rd Hydrology and Water Resources Symposium, Hobart, Australia 21-24 May 1996. pp. 229-236.

Stanley N. F. 1972; *Ord River ecology.* Search 3, 7–12.

Woods, N and R. Lisle. 1988. *Pilots and Operators Manual.* Aerial Agricultural Association of Australia, Sydney.

Woods, N. and G. Dorr. 1997. *Aerial spray drift under the spotlight.* Farming Ahead No.62, 57-59.

Wylie, P. 1997. *Avoiding spray drift onto fodder crops*, Lotfeeding, February 1997.

Chapter Fifteen

Australian Bureau of Statistics. *1995 Census of Population and housing*. Canberra Australian Bureau of Statistics.

Beckwith & Associates 1997. *Ord River Irrigation Area Stage 2 Expansion - Social Impact Assessment.* Report prepared for the Western Australian Department of Resources Development, Perth Western Australia.

Kewagam Research. 1996. *Ord River Fishing Survey.* A Report to the East Kimberly Recreational Fishing Advisory Council.

Kimberley Development Commission and Department of Commerce and Trade 1999. *Kimberley Economic Perspective.* An Update on the Economy of WA's Kimberley Region.

Kimberley Development Commission and Department of Commerce and Trade. 1996. *Kimberley Economic Perspective.* An Update on the Economy of WA's Kimberley Region.

Kimberley Development Commission. 1993. *Kimberley Population and Settlement Technical Paper.* Perth.

Kimberley Development Commission. 1996a. *Kimberley Economic Perspective*. An update on the economy of Western Australia's Kimberley Region.

Kimberley Development Commission. 1996b. *The Economic Impact of Irrigated Agriculture in the Ord River Area*. Technical Paper.

Kimberley Development Commission. 1997. *Kimberley Economic Development Strategy*. Perth.

Ministry for Planning and Kimberley Development Commission 1999. Kununurra-Wyndham Area Development Strategy. Report prepared in association with Shire of Wyndham—East Kimberley, Northern Territory Department of Lands, Planning and Environment of the Kununurra-Wyndham

Area Development Strategy Steering Committee as part of the Western Australian Planning Commission, Perth, Western Australia.

Chapter Sixteen

Crabb. P. 1997. *Murray Darling Basin Resources*. Murray Darling Basin Commission, Canberra.

Chapter Seventeen

There are no references for this Chapter.

APPENDIX E

ORGANISATIONS CONSULTED DURING ERMP/EIS PREPARATION

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Aboriginal Affairs Department (WA)

Aboriginal Areas Protection Authority

Aboriginal Legal Service of Western Australia

Agriculture Protection Board (WA)

Agriculture Western Australia

Australian Conservation Foundation

Australian Heritage Commission

Booker Tate Limited

Care of the Ord Valley Environment

Commissioner for Soil and Land Conservation

Conservation Council of Western Australia

Consolidated Pastoral Company (lessee of Carlton Hill Station, Ivanhoe Station and sub lessee of Spirit Hills Station)

Department of Conservation and Land Management (WA)

Department of Environmental Protection (WA)

Department of Land Administration (WA)

Department of Lands Planning and Environment (NT)

Department of Minerals and Energy (WA)

Department of Mines and Energy (NT)

Department of Resources Development (WA)

Department of Transport (Maritime) (WA)

Department of Transport and Works (NT)

East Kimberley Recreational Fishing Group

Environment Australia

Environmental Protection Authority (WA)

Fisheries Western Australia

Health Department of Western Australia

Heritage Council of Western Australia

Joorook Ngarni Aboriginal Corporation

Kimberley Development Commission

Kimberley Land Council

Kimberley Region Economic Aboriginal Corporation

Kununurra Rotary

Legune Station

Mains Roads Western Australia

Ministry for Planning (WA)

Mirima Dawang Woorlab-Gerring Language Centre

Miriuwung and Gajerrong Families Heritage and Land Council

National Native Title Tribunal

Northern Land Council

Northern Territory Land Corporation

Office of Resource Development

Office of Water Regulation (WA)

Ord Development Council

Ord Irrigation Cooperative Ltd

Ord Land and Water Steering Committee

Ord River District Co-operative Ltd

Ord River Grain Pool

Ord River Irrigation Area Land Conservation District Committee

Parks and Wildlife Commission of the Northern Territory

Shire of Wyndham – East Kimberley

South West Irrigation

Steering Committee for the Land and Water Management Plan

Telstra

Tropical Agriculture Team

University of Western Australia (Arbovirus Surveillance and Research Laboratory, Department of Microbiology)

Warrangarri Aboriginal Corporation

Water and Rivers Commission

Western Power

Wyndham Action Group

Wyndham Port Authority

APPENDIX F
STUDY TEAM

APPENDIX F
STUDY TEAM

KINHILL PTY LTD

Management

G. R. Puglisi	Project Manager
Dr A. R. Milton	Project Director
T. R. Salmon	Project Engineer

Technical

J. S. Abbott	Irrigation and sodicity issues
Dr R. J. Anderson	Biological environment
Dr E. M. Bennett	Biological environment
G. Boyer	Community issues
A. T. Brown	Biological environment
I. Cameron	Air quality and public health
P. G. Ellery	Biological environment
C. N. Gomes	Surface water modelling
J. C. Greig	Editing
C. F. Harris	Library
W. N. Horwood	Water quality
S. J. Kenway	Physical environment
R. S. Pyle	Biological environment
Dr K. Zic	Groundwater and surface water modelling

Subconsultants

L. D. Ahearn Nature Scope Pty Ltd	Technical Review (biological environment)
Dr R. E. Black RE Black Consultants Pty Ltd	Technical Review
B. A. Boyes Groundwater Services Pty Ltd	Groundwater environment

S. Churchill S. A. Development of Natural Resources and Environment	Biological survey (bats)
G. Connell Ecologia Environmental Consultants	Regional biodiversity
N. Green Anthropos Australis Pty Ltd	Anthropology
Dr R. Hart Hart Simpson Pty Ltd	Biological survey (mammals)
Dr W. F. Humphreys Museum of Natural Science	Stygofauna
L. Lumsden Arthur Rylah Institute for Environmental Research	Biological survey (bats)
Dr H. Larson, P. Horner and G. Brown Museums and Art Galleries of the Northern Territory	Aquatic environment
C. Martens and D. Watts Queensland Department of Natural Resources	Geographical information system based graphics
J. Porter Frog Design	Graphics
P. Robertson Wildlife Profiles Pty Ltd	Biological survey (herpetofauna)
G. Harold Malloch Fauna	Biological survey (herpetofauna)

ACKNOWLEDGEMENTS

The following organisations are gratefully acknowledged for contributing background information used in compiling this ERMP/EIS:

Book Tate Limited - sugar cane cultivation, farm management and sugar milling.

Sinclair Knight Merz - unpublished draft Public Environmental Report for the Project Area commissioned by the Western Australia Department of Resource Development.

APPENDIX G
WATER QUALITY DATA

ORD RIVER IRRIGATION AREA STAGE 2 PROPOSED DEVELOPMENT OF THE M2 AREA

A compilation of Water Quality Data for the Keep River and other watercourses

Prepared for:

WESFARMERS LIMITED,

MARUBENI CORPORATION AND THE WATER

CORPORATION OF WESTERN AUSTRALIA

Level 7, 40 The Esplanade
Perth WA 6000

Prepared by:

Kinhill Pty Ltd
ACN 007 660 317
47 Burswood Road, Victoria Park WA 6100
Telephone 08 9362 5900, Facsimile 08 9362 5627

August 1999

PV8009-FC-011 Rev. 0

1 Scope

This document provides a compilation of water quality data for the Keep River and other watercourses in the vicinity of the M2 Development Area of the Ord River Irrigation Scheme. It also contains water quality data from Stage One of the Ord River Irrigation Area.

The data is presented according to the source of the data as follows:

- Table G.1 Field (1998)
- Table G.2 Ribbons of Blue (1995 and 1997)
- Table G.3 for M1 Channel collected by the Water Corporation (December 1995 to July 1996), Ord Irrigation Co-operative Limited (April 1996 to February 1997) and CSR Limited (April 1996 to November 1996).
- Table G.4 Department of Lands, Planning and Environment (January 1995 to October 1996)
- Table G5 Department of Lands, Planning and Environment (1997 to 1998)
- Table G.6 Larson (1999).

2 References

Field, D.G. 1998 Baseflow Water Quality Surveys in Rivers of the Northern Territory - Volume 12 The Keep River. Report 11/1988. Power and Water Authority Water Directorate, Water Resources Group.

Larson, H. 1999, Keep River Aquatic Fauna Survey. Museums and Art Galleries of the Northern Territory Research Report No. 4 February 1999.

Table G.1 Water Quality Data from Field (1988)

Watercourse	Distance from River Mouth (km)	Sample Point	Conductivity (µS/cm)	Temp (deg Cel)	pH	Dissolved Oxygen (% sat)	Turbidity (NTU)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Total hardness (mg/L)	Total Alkalinity (mg/L)	Total Iron (mg/L)	Silica (mg/L)	Chloride (mg/L)	Sulphate (mg/L)	Nitrate (mg/L)	Phosphate (µg/L)	Bicarbonate (mg/L)	Fluoride (mg/L)	Sodium Chloride (mg/L)
Keep River	33	1	37600	22.9	8.4	100	57					4200	139			11860			13	169		19542
Keep River	38	2	13880	18.4	8.6	100	5					1750	119			4600			9	145		7591
Keep River	43	3	240	21.7	8.4	88	16	20	4	20	13	102	117	7	16	18	12	1	9	143	0.4	30
Keep River	140	4	485	17.3	8.4	95	4	29	4	44	31	228	265	<0.1	23	16	13	<1	23	323	0.3	25
Keep River	144	5	450	25.3	8.5	150	2	31	4	46	28	226	260	0.1	29	14	13	<1	6	317	0.2	21
Keep River	150	6	380	25.3	8.4	89	2	36	4	34	25	179	230	<0.1	33	14	8	<1	14	280	0.2	23
Keep River	156.5	7	410	22.4	8.4	99	1	35	4	32	28	190	245	0.1	43	12	8	<1	33	299	0.4	20
Keep River	160.5	8	510	24.4	8.1	100	1	30	3	49	35	260	305	<0.1	58	8	10	<1	23	372	0.9	13
Keep River	163	9	417	24	8.1	110	1	23	3	45	26	216	247	<0.1	52	6	9	<1	35	301	0.3	8
Sandy Creek	21	9A	36900	22.3	8.5		16					4260	130			12700			8	159		20949
Sandy Creek	25	9A2	28700	24.4	8.4		11					3230	131			9250			<5	160		15246
Sandy Creek	28	9A3	13700	22.3	8.5		16	2320	150	128	298	1502	117	0.3	12	4190	644	2	8	143	0.7	6910
Sandy Creek	30	9A4	190	24.1	8.3	85	5	18	4	14	11	78	75	<0.1	11	25	10	1	15	91	0.9	40
Sandy Creek	35	9A5	98	24.8	8.1	100	2	5	3	14	10	76	73	<0.1	12	7	7	<1	14	89	<0.1	10
Sandy Creek	42	9A6	100	24.4	8.2	97	2	4	3	14	10	77	72	0.2	15	6	6	<1	15	88	0.7	10
Sandy Creek	50	9A7	100	22.1	9.1	99	1	4	2	13	10	74	70	0.3	15	6	6	<1	16	85	0.3	10
Sandy Creek	61	9A8	110	21.4	7.9	98	3	3	2	14	10	76	72	0.3	13	6	7	<1	13	88	0.4	8
Sandy Creek	74	9A9	52	23.3	7.8	110	3	5	2	7	5	37	38	0.6	15	8	4	<1	19	46	0.1	12
Sandy Creek	90.5	9A10	340	22.4	7.8	87	1	6	4	33	32	206	198	0.1	13	12	10	<1	14	241	0.4	18
Sandy Creek	72	9AA	300	23.7	8.3	98	1	5	3	27	29	187	178	<0.1	14	8	15	<1	25	217	0.2	10
Sandy Creek	74	9AB	210	24.5	8.5	110	8	2	3	27	19	141	140	<0.1	15	6	7	<1	15	171	0.1	8
Sandy Creek	82	9AC	<5	22.6	6.8	94	1	2	1	<1	<1	3	5	0.1	12	4	<1	<1	11	6	0.2	7
Sandy Creek	86	9AD	40	24	7.4	82	6	5	2	7	4	32	30	0.5	14	6	3	<1	14	37	0.2	10
Sandy Creek	91	9AE	420	21.3	8.2	104	1	8	4	36	38	243	233	<0.1	11	18	11	<1	24	284	0.1	28
Moriaty Creek	147	9B	560	17.2	8.3	83	1	38	4	52	36	267	326	<0.1	46	12	11	<1	25	397	0.5	20
Moriaty Creek	154	9B2	440	19.6	7.5	73	1	27	3	48	26	220	258	<0.1	42	13	9	<1	23	314	0.5	20
Moriaty Creek	154	9BA	440	19.7	7.6	88	1	25	2	45	27	218	260	<0.1	38	6	5	<1	45	317	0.3	10
Keep River	146	9C	540	22.2	8.2	85	2	42	5	43	34	248	303	0.2	32	16	11	1	19	369	0.4	26
Keep River	155	9D	540	22	8.3	100	2	44	2	53	29	250	324	<0.1	59	10	15	<1	25	395	0.2	16
Keep River	156.5	9E	380	22.8	8.3	108	2	26	3	41	24	196	237	<0.1	43	8	10	<1	22	289	0.4	12
Keep River	161	9F	740	25.1	7.7	92	2	50	1	68	50	360	433	<0.1	72	18	12	<1	56	528	0.6	28

Table G.2 Ribbons of Blue Water Quality Data (1995 and 1997)

Water course	Month	Year	Nirtrate (mg/L0	Phosphate (mg/L)
Border Creek	Feb	1997	0.557	0.150
Keep River	Feb	1997	0.620	0.057
Keep River (upstream of ORIA M2 Development Area)	Feb	1997	0.512	0.031
Milligan Lagoon	Feb	1997	0.492	0.044
Knox Creek	Feb	1997	0.500	0.039
Keep River (Policemans Waterhole)	Jan	1995	0.426	0.046
Keep River (upstream of Legune Road crossing)	Jan	1995	0.648	0.049

Table G.3 Monthly Water Quality Data from the M1 Channel

Source of Data	Month	Year	Conductivity (µS/cm)	pH	Turbidity (NTU)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Total hardness (mg/L)	Total Alkalinity (meq)	Nitrate (mg/L)	Phosphate (mg/L)
Ord Irrigation Co-operative Ltd	January											0.405	0.017
Ord Irrigation Co-operative Ltd	January											0.249	0.009
Ord Irrigation Co-operative Ltd	January											0.303	0.022
Ord Irrigation Co-operative Ltd	January											0.254	0.021
Ord Irrigation Co-operative Ltd	February											0.210	0.012
Ord Irrigation Co-operative Ltd	February											0.307	0.010
Ord Irrigation Co-operative Ltd	February											0.505	0.009
Ord Irrigation Co-operative Ltd	March											0.264	0.021
Ord Irrigation Co-operative Ltd	April											0.026	0.027
Ord Irrigation Co-operative Ltd	May											0.198	0.027
Ord Irrigation Co-operative Ltd	June											0.163	0.009
Ord Irrigation Co-operative Ltd	July											0.165	0.008
Ord Irrigation Co-operative Ltd	September											0.396	0.006
Ord Irrigation Co-operative Ltd	November											0.276	0.009
Ord Irrigation Co-operative Ltd	December											0.285	0.017
Water Corporation	February											0.223	0.014
Water Corporation	April											0.238	0.011
Water Corporation	May											0.15	0.009
Water Corporation	June											0.2	
Water Corporation	July											0.17	0.003
Water Corporation	October											0.28	0.009
Water Corporation	November											0.189	0.013
Water Corporation	December											0.179	0.005
Water Corporation	December											0.155	0.0043
CSR Limited	April											0.2	0.02
CSR Limited	May											0.3	0.06
CSR Limited	June											0.2	0.02
CSR Limited	July											0.2	
CSR Limited	August											0.2	0.02
CSR Limited	September											0.2	0.02
CSR Limited	October												0.03
Water Corporation	November	98	270	9	1	22	3	22	10	90	2	<0.05	

Source: Water Corporation - M1 Channel upstream of town effluent disposal taken between December 1995 and July 1996; Ord Irrigation Co-operative Limited - M1 offtake between April 1996 and February 1997; CSR Limited - M1 offtake between April 1996 and November 1996

Table G.4 Water Quality Data from Department of Lands, Planning and Environment January 1995 to October 1996

Watercourse	Description	Month	Year	Conductivity (µS/cm)	Temp (Celcius)	pH	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Nitrate and Nitrite (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Free reactive phosphorus (mg/L)
MR-KP-01	Keep River (Policemans) Waterhole	7	95	127	25.2	7.75	8	13	0.013	0.339	0.059	0.28	0.002
MR-KP-01	Keep River (Policemans) Waterhole	11	95	209	32.6	8.28	6.63	12	0.013	0.245	0.005	0.24	0.006
MR-KP-01	Keep River (Policemans) Waterhole	7	96	134	25.2	7.86	7.91	8					
MR-KP-01	Keep River (Policemans) Waterhole	10	96	173	32.9	8.1	6.65	11					
MR-KP-02	Keep River (Keep Yard u/s Legune Rd crossing)	7	95	182	22.5	7.76	7.95	19	0.018	0.355	0.005	0.35	0.002
MR-KP-02	Keep River (Keep Yard u/s Legune Rd crossing)	11	95	313	33.3	8.37	6.55	22	0.008	0.281	0.001	0.28	0.003
MR-KP-02	Keep River (Keep Yard u/s Legune Rd crossing)	7	96	210	24.4	8	9.05	20					
MR-KP-02	Keep River (Keep Yard u/s Legune Rd crossing)	10	96		33	8.05	6.6	39					
MR-KP-03	Bubble Bubble Springs	7	95	210	23.7	7.56	5.9	10	0.013	0.084	0.004	0.08	0.004
MR-KP-03	Bubble Bubble Springs	11	95	316	30.1	7.93	5.25	2	0.009	0.123	0.003	0.12	0.007
MR-KP-03	Bubble Bubble Springs	7	96	230	20.3	8.16	8.45	10					
MR-KP-03	Bubble Bubble Springs	10	96	298	30.1	7.55	4.58	0					
MR-KP-04	Keep River (Milligan Lagoon)	7	95	45	23.4	6.94	6	10	0.028	0.444	0.004	0.44	0.007
MR-KP-04	Keep River (Milligan Lagoon)	11	95	73	28.3	6.8	4.3	11	0.024	0.712	0.002	0.71	0.004
MR-KP-04	Keep River (Milligan Lagoon)	7	96	51	23.6	7.24	7.72	8					
MR-KP-04	Keep River (Milligan Lagoon)	10	96	51	33.3	6.69	2.9	1					
MR-KP-05	Alligator Springs Waterhole	7	95	49	27.1	6.02	4.7	10	0.03	0.352	0.002	0.35	0.009
MR-KP-05	Alligator Springs Waterhole	11	95	77	33.4	5.84	6.03	10	0.031	0.481	0.001	0.48	0.01
MR-KP-05	Alligator Springs Waterhole	7	96	87		5.67	5.64	5					
MR-KP-05	Alligator Springs Waterhole	10	96	112		5.03	6.93	3					

Table G.5 Water Quality Data from Department of Lands, Planning and Environment 1997–1998

Watercourse	Sample Location	Month	Year	Conductivity (µS/cm)	pH	Turbidity (NTU)	Nitrate, NO3 (mg/L)	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Total Kjeldahl Nitrogen (mg/L)
Keep River	G8100226									
Keep River	G8100227	Dec	97	304			19.0	0.054	37	
Keep River	G8100228	Dec	97	290			2.9	0.022	61	
Keep River	G8100229	Dec	97	290			8.3	0.294	71	
Keep River	G8100230	Dec	97	187			3.7	0.070	88	
Keep River	G8100231	Dec	97	153			1.9	0.082	161	
Keep River	G8100232	Dec	97	107			6.0	0.101	254	
Keep River	G8100233	Dec	97	92			4.4	0.110	508	
Keep River	G8100234	Dec	97	83			<0.2	0.066	253	
Keep River	G8100235	Dec	97	68			3.3	0.057	210	
Keep River	G8100236	Dec	97	67			3.6	0.064	193	
Keep River	G8100237	Dec	97	67			1.4	0.062	180	
Keep River	G8100238	Dec	97	69			2.3	0.086	255	
Keep River	G8100239	Dec	97	77			2.8	0.104	394	
Keep River	G8100240	Dec	97	54			7.1	0.095	381	
Keep River	G8100241	Dec	97	80			<0.2	0.048	101	
Keep River	G8100242	Dec	97	54			4.8	0.540	225	
Keep River	G8100243	Dec	97	58			3.4	0.035	66	
Keep River	G8100244	Dec	97	55			5.7	0.070	249	
Keep River	G8100245	Dec	97	61			2.3	0.059	166	
Keep River	G8100246	Dec	97	86			<0.2	0.068	155	
Keep River	G8100247	Dec	97	65			1.3	0.052	118	
Keep River	G8100248	Dec	97	92			4.4	0.072	150	
Keep River	G8100249	Dec	97	95			3.2	0.085	221	
Keep River	G8100250	Jan	98	60			3.4	0.122	127	
Keep River	G8100251	Jan	98	47			<0.2	0.069	129	
Keep River	G8100252	Jan	98	50			2.0	0.084	428	
Keep River	G8100253	Jan	98	56			0.6	0.214	1821	
Keep River	G8100254	Jan	98	52			0.2	0.084	1313	
Keep River	G8100255	Jan	98	48			2.7	0.140	819	
Keep River	G8100256	Jan	98	54			3.3	0.136	622	
Keep River	G8100257	Jan	98	45			0.7	0.110	777	
Keep River	G8100258	Jan	98	48			2.7	0.096	646	
Keep River	G8100259	Jan	98	45			1.8	0.090	432	
Keep River	G8100260	Jan	98	56			0.2	0.064	186	
Keep River	G8100261	Feb	98	55			2.0	0.074	181	1.00
Keep River	G8100262	Feb	98	52			1.0	0.062	151	0.54
Keep River	G8100263	Feb	98	53			1.0	0.055	143	0.50
Keep River	G8100264	Feb	98	59			<1.0	0.047	105	1.36
Keep River	G8100265	Feb	98	60			<1.0	0.052	103	1.23
Keep River	G8100266	Feb	98	76			<1.0	0.054	65	2.25

Watercourse	Sample Location	Month	Year	Conductivity	pH	Turbidity	Nitrate, NO3	Total Phosphorus	Total Suspended Solids	Total Kjeldahl Nitrogen
Keep River	G8100267	Feb	98	75			<1.0	0.076	202	1.33
Keep River	G8100268	Feb	98	64			2.0	0.086	540	0.36
Keep River	G8100269	Feb	98	50			3.0	0.110	676	0.40
Keep River	G8100270	Feb	98	65			<1.0	0.079	201	1.76
Keep River	G8100271	Feb	98	65			<1.0	0.051	93	1.78
Keep River	G8100272	Mar	98	81	5.6	58	<1.0		85	
Sandy Creek	G8100210	Dec	97							
Sandy Creek	G8100211	Dec	97							
Sandy Creek	G8100212	Dec	97							
Sandy Creek	G8100213	Dec	97							
Sandy Creek	G8100214	Dec	97							
Sandy Creek	G8100215	Dec	97							
Sandy Creek	G8100216	Dec	97							
Sandy Creek	G8100217	Dec	97							
Sandy Creek	G8100218	Dec	97	141			3.5	0.040	15	
Sandy Creek	G8100219	Dec	97	180			6.9	0.031	33	
Sandy Creek	G8100220	Dec	97	173			4.2	0.029	38	
Sandy Creek	G8100221	Dec	97	73			7.1	0.043	85	
Sandy Creek	G8100222	Dec	97	78			<0.2	0.014	14	
Sandy Creek	G8100223	Dec	97	75			<0.2	0.024	46	
Sandy Creek	G8100224	Dec	97	104			<0.2	0.016	16	
Sandy Creek	G8100225	Jan	98	66			3.9	0.039	96	
Sandy Creek	G8100226	Jan	98	118			<0.2	0.015	28	
Sandy Creek	G8100227	Jan	98	118			<0.2	0.011	8	

Table G.5 Water Quality Data from Department of Lands, Planning and Environment 1997–1998 (continued)

Watercourse	Sample Location	Month	Year	Conductivity (µS/cm)	pH	Turbidity (NTU)	Nitrate, NO3 (mg/L)	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Total Kjeldahl Nitrogen (mg/L)
Sandy Creek	G8100228	Jan	98	119			<0.2	0.014	14	
Sandy Creek	G8100229	Jan	98	95			0.8	0.030	78	
Sandy Creek	G8100230	Jan	98	79			<0.2	0.010	12	
Sandy Creek	G8100231	Jan	98	78			1.3	0.020	68	
Sandy Creek	G8100232	Jan	98	66			<0.2	0.022	60	
Sandy Creek	G8100233	Jan	98	48			0.4	0.029	109	
Sandy Creek	G8100234	Jan	98	36			0.5	0.032	147	
Sandy Creek	G8100235	Jan	98	35			0.6	0.050	202	
Sandy Creek	G8100236	Jan	98	49			0.7	0.050	229	
Sandy Creek	G8100237	Jan	98	34			<0.2	0.037	139	
Sandy Creek	G8100238	Feb	98	39			1.2	0.019	33	
Sandy Creek	G8100239	Mar	98	84	5.7	11	<1.0		70	
Border Ck	G8100106	Dec	97	59			15.7	0.122	3342	
Border Ck	G8100107	Dec	97	33			3.8	0.134	2351	
Border Ck	G8100108	Dec	97	47			3.7	0.110	3351	
Border Ck	G8100109	Dec	97	48			3.3	0.134	3037	
Border Ck	G8100110	Dec	97	38			6.6	0.188	1058	
Border Ck	G8100111	Dec	97	40			4.7	0.226	645	
Border Ck	G8100112	Jan	98	94			2.0	0.072	2580	
Border Ck	G8100113	Jan	98	40			2.1	0.107	2132	
Border Ck	G8100114	Jan	98	24			3.9	0.132	942	
Border Ck	G8100115	Jan	98	56			2.5	0.100	2556	
Border Ck	G8100116	Jan	98	28			3.2	0.115	932	
Border Ck	G8100117	Jan	98	21			1.0	0.113	677	
Border Ck	G8100118	Jan	98	27			1.3	0.111	1369	
Border Ck	G8100119	Jan	98	28			1.4	0.107	1050	
Border Ck	G8100120	Jan	98	42			<0.2	0.088	434	
Border Ck	G8100121	Jan	98	42			<0.2	0.062	191	
Border Ck	G8100122	Jan	98	57			<0.2	0.047	151	
Border Ck	G8100123	Feb	98	57			<0.2	0.050	135	
Border Ck	G8100124	Feb	98	62			1.0	0.110	113	0.84
Border Ck	G8100125	Feb	98	62			<1.0	0.130	99	0.85
Border Ck	G8100126	Feb	98	65			1.0	0.082	107	0.70
Border Ck	G8100127	Feb	98	70			<1.0	0.073	102	0.57
Border Ck	G8100128	Feb	98	69			<1.0	0.081	103	0.51
Border Ck	G8100129	Feb	98	74			10.0	0.190	967	2.09
Border Ck	G8100130	Feb	98	66			1.0	0.210	998	0.66
Border Ck	G8100131	Feb	98	40			<1.0	0.220	2146	1.84
Border Ck	G8100132	Feb	98	35			<1.0	0.088	2081	3.88
Border Ck	G8100133	Feb	98	34			<1.0	0.180	1154	2.18
Border Ck	G8100134	Feb	98	28			<1.0	0.150	489	0.94
Border Ck	G8100135	Feb	98	45			1.0	0.150	205	1.05

Watercourse	Sample Location	Month	Year	Conductivity	pH	Turbidity	Nitrate, NO3	Total Phosphorus	Total Suspended Solids	Total Kjeldahl Nitrogen
Border Ck	G8100136	Feb	98	67			2.0	0.120	221	0.78
Border Ck	G8100137	Feb	98	77			1.0	0.110	173	0.71
Border Ck	G8100138	Feb	98	83			1.0	0.110	141	0.68
Border Ck	G8100139	Feb	98	91			<1.0	0.067	124	0.76
Border Ck	G8100140	Feb	98	47			7.0	0.140	418	1.04
Border Ck	G8100141	Feb	98	91			<1.0	0.130	122	0.63
Border Ck	G8100142	Feb	98	52			2.0	0.100	350	0.52
Border Ck	G8100143	Mar	98	51			3.0	0.180	308	0.90

Table G.6 Water Quality Data from Larson (1999)

River	Month	Year	Conductivity (µS/cm)	Temp (Celcius)	pH	Salinity (ppt)
Bucket Spring	October	98	426	27.7		0.2
Bucket Spring	October	98	431	27.7	7.6	0.2
Bucket Spring	October	98	434	28.9	7.6	
Bucket Spring	October	98	475	28.9	7.6	
Alligator Hole	October	98	82	30.6	6.8	0.0
Milligan Lagoon	October	98	82	31.1	7.2	0.0
Augustus Hole	October	98	312	32.7	7.6	0.1
Augustus Hole	October	98	312	30.8	7.6	0.2
Augustus Hole	October	98	333	30.9	7.6	0.2
Augustus Hole	October	98	312	32.7	7.6	0.1
Emerald Spring	October	98	21	32.0	6.4	0.0
Oakes Creek	October	98		35.1		48.8
Oakes Creek	October	98		33.3		47.0
Sandy Creek	October	98	100	32.8	7.2	0.1
Sandy Creek	October	98		30.1		40.5
Sandy Creek	October	98		34.6		45.3
Sandy Creek	October	98		39.0		61.1
Keep River	October	98	163	32.5	7.2	0.1