

2 The existing Ord River Irrigation Area

This chapter describes the existing development of ORIA Stage 1 by providing background information on the crops grown and the management responsibilities of the major stakeholders in the scheme. A brief discussion of the environmental issues of significance is provided, together with a discussion on how these issues are currently being managed. The chapter focuses on the implications for the Project—in essence, what can be learned from the existing development to minimise environmental impacts from the Project.

2.1 CROPS AND PRODUCTS

The existing ORIA Stage 1 comprises a cropped area of approximately 11,500 ha, and supports a broad range of agricultural production. In 1997–98, agricultural production had an estimated value of over \$56 million, as shown in Table 2.1.

Table 2.1 ORIA Stage 1—value of production 1997–98

Crop	Value 1997–98 (\$)
Sugarcane	17,334,345 *
Rockmelons	7,912,943
Bananas	4,465,124
Honeydew melons	4,383,855
Other horticulture**	3,470,723
Butternuts	3,076,961
Watermelons	2,856,209
Jarrahdale	2,065,267
Jap pumpkin	1,849,529
Leucaena/pasture	1,692,338
Sorghum	1,559,889
Cotton	1,508,716 *
Chick pea	945,000
Maize	909,800
Hay/dairying	794,800
Mangoes	714,872
Sunflower	411,000
Miscellaneous field crops	352,160
Miscellaneous hybrid seeds	180,000
Soy beans	92,799
Total	56,576,330

* Includes revenue from sugar-milling and cotton-ginning operations.

** Includes citrus, squash, zucchini, cucumbers, papaya, herbs, asparagus, jack fruit, okra, carambola, egg plant, sweetcorn, beans, nursery and seedless watermelon.

Source: Agriculture Western Australia 1998.

Historically a range of different crops has been trialled and grown commercially in ORIA Stage 1.

From the 1960s to the early 1970s, the principal crop grown was cotton. By 1970–71, cotton was grown on 3,600 ha of the 5,400 ha under cultivation, with grain sorghum and hay being the other recorded commercial crops.

By 1980, cotton was no longer grown due to the high susceptibility of the crop to local pest insects, and the area under cultivation had decreased to 4,800 ha. The greater part of the cropped area in 1980 was dedicated to sorghum, sunflower and hay. Other crops included rice, mung bean, seed crops and melons.

By 1990–91, the cropped area had decreased further to 4,300 ha. Rice and mung bean were no longer grown, and new crops included soy beans, maize, chick pea and peanuts. By this stage, horticulture had become an established industry, dominated by mangoes, bananas, and cucurbits (melons and pumpkins). Irrigated pasture, including leucaena, had become established to serve the local pastoral industry.

By 1996, a raw-sugar industry had been established in ORIA Stage 1 and in 1996–97, revenue generated by the local sugar industry was about \$17 million, or 27% of the total value of agricultural production. By 1998, an area of 3,800 ha of sugarcane was grown in ORIA Stage 1, and processed into 51,173 t of raw sugar.

The advent of transgenic cotton resulted in trial commercial plantings of 250 ha in 1996–97, and in 1998 a pilot cotton gin was commissioned to process the seed cotton.

An estimate of the area under cultivation by crop type over the period 1970–71 to 1997–98 is provided in Table 2.2.

Table 2.2 Estimated crop areas in ORIA Stage 1 (ha)

Crop	1970–71	1980–81	1990–91	1994–95	1996–97	1997–98
Sugarcane	–	–	–	2,900	3,793	3,800
Pasture crops and dairying	553	735	735	1,800	1,775	1,791
Chick pea	–	–	730	610	749	725
Sorghum	1,229	1,506	461	1,429	556	653
Rockmelon	–	26	366	477	897	615
Miscellaneous	–	125	25	675	387	567
Maize	–	–	880	560	512	544
Pumpkins	–	–	–	253	851	510
Cotton	3,617	–	–	–	250	447
Watermelon	–	26	110	320	554	375
Honeydew melons	–	–	–	–	–	300
Sunflower	–	1,772	500	385	138	137
Bananas	–	–	135	132	131	120
Mangoes	–	–	80	200	276	295
Culinary beans	–	–	–	75	591	–
Zucchini/cucumber	–	–	–	–	72	–
Soy bean	–	–	310	–	30	–
Rice	–	630	–	–	–	–
Sandalwood	–	–	–	–	–	240
Total	5,399	4,820	4,332	9,816	11,562	11,119*

* Land ploughed out due to aphid and mosaic virus infection not included in total.

Sources: Agriculture Western Australia 1998 and Governments of Western Australia and Northern Territory 1996.

The diversity of crop types grown in ORIA Stage 1 is attributable in part to the local variation in soil types. Broad-acre crops, such as sugarcane, cotton and leucaena, and some horticultural crops such as rockmelons, watermelons and pumpkins, are cultivated on black

cracking clays utilising furrow irrigation. Other crops, such as bananas and tree crops, are grown mainly on lighter textured levee soils utilising sprinkler or drip irrigation.

Post-harvest activities in ORIA Stage 1 include the milling of sugarcane, ginning of cotton and packaging of horticultural produce.

2.2 MANAGEMENT RESPONSIBILITIES

There are a number of individuals, grower groups, businesses and Government agencies with responsibility for various management functions in ORIA Stage 1, which impact the local environment. These responsibilities are summarised in the following sections.

2.2.1 Farmers

The majority of farms in ORIA Stage 1 are managed by owner/operators. Corporate farming currently utilises an area of approximately 3,200 ha, and is involved in the production of hybrid seeds, leucaena, sandalwood and host trees, cotton and mangoes.

The farmers in ORIA Stage 1 have the primary responsibility for the environmental management of land under their care. Farmers are responsible for the type and quantity of crops grown, and also for the application rates of water, fertilisers, herbicides and pesticides.

Farmers must comply with a range of State and Commonwealth legislation related to environmental issues, including:

- agricultural statutes such as the *Aerial Spraying Control Act 1996* and the *Soil and Land Conservation Act 1945*;
- land statutes such as the *Land Administration Act 1997*;
- planning and regional development statutes, such as the *Town Planning and Development Act 1985* and the *Local Government Act 1995*;
- Aboriginal and cultural heritage statutes such as the *Aboriginal Heritage Act 1972* and the *Native Title Act 1993*;
- environmental protection statutes such as the *Environmental Protection Act 1986*.

The farmers of ORIA Stage 1 have formed a range of industry groups, to promote good agriculture management techniques, market a range of produce and address environmental issues including:

- Ord River District Co-operative
- Ord Land and Water
- Kununurra Horticulture Producers Association
- Ord Mango Growers Association
- Leucaena Growers Association
- Ord Cucurbit Growers Group
- Ord Cane Growers Association
- Ord Sugar Industry Board

- Ord River Grain Pool.

The activities of the Ord River District Co-operative and the Ord Land and Water Management Plan Steering Committee are summarised in Sections 2.2.2 and 2.2.3 respectively.

2.2.2 Ord River District Co-operative

The Ord River District Co-operative was established in 1963 for the purposes of processing and marketing cotton. Over the years, it has become involved in the provision of supplies, processing, marketing and support services for a diverse range of crops and agricultural activities in ORIA Stage 1. The Ord River District Co-operative, now with approximately 110 shareholders and a seven-member Board, has an economic interest in the following:

- the local sugar mill
- port storage and handling facilities at Wyndham
- the local distribution of packaging products
- an aerial spraying business
- a local pilot cotton gin.

The Ord River District Co-operative is one of the preferred proponents investigating the feasibility of developing approximately 800 ha of irrigable land adjacent to ORIA Stage 1, known as 'Green Location', and is the manager of the operations of the port at Wyndham.

With respect to environmental issues, the Ord River District Co-operative is a supplier of fertilisers and agricultural advisory services to farmers in ORIA Stage 1, and its Board members are actively involved in a range of local industry, community and environmental groups. It also has quality standard certification for agricultural chemical storage and retailing, and manages an insect-scouting service as an agent of the Ord River Grain Pool.

2.2.3 Land and Water Management Plan Steering Committee

The initiative for preparing a Land and Water Management Plan came from local farmers in 1996 as a means to address the environmental issues relevant to ORIA Stage 1 at that time. Coordinators for the preparation of the Plan were employed in May 1997 and a Steering Committee was established in March 1998 following a public forum.

The Steering Committee has eight members elected from different sectors of the community: three members represent farming interests; one member represents conservation interests; one member represents business interests; one member represents river interests; there is ex-officio representation by the District Team Leader from Agriculture Western Australia (AGWEST); and one member is a Director from the Ord Irrigation Co-operative (Section 2.2.8 refers).

To date, the Steering Committee has convened a number of discussion forums, all well attended by a range of environmental stakeholders, and it is actively engaged in community consultation in ORIA Stage 1, with respect to the production of a Land and Water Management Plan (Section 2.3.5 refers).

2.2.4 Ord Development Council

The Ord Development Council (ODC) was established in 1991 by the Minister of Primary Industry with the objective of facilitating further agricultural development in the Ord River district. The council comprises twelve representatives from local industry and the community, and is administered by a full-time executive officer.

The ODC plays a pivotal role in the facilitation of local agricultural development.

2.2.5 Water and Rivers Commission

The Water and Rivers Commission, established under the *Water and Rivers Commission Act 1995*, is responsible for administering the *Rights in Water and Irrigation Act 1914*. The Act contains provisions relating to the conservation and utilisation of natural waters in Western Australia, and the Water and Rivers Commission is empowered to manage those waters.

Responsibilities of the Commission include the quantification of water that may be diverted from river systems and groundwater aquifers, a process known as water allocation planning. One of the aims of water allocation plans is to ensure that diversion of any natural waters does not compromise the integrity of water-dependent ecosystems. Allocation plans are implemented through licences, issued by the Commission, which clearly define the allowable water use and any relevant conditions necessary for good management of natural water resources.

Water used for the purposes of irrigation and agricultural processing in ORIA Stage 1 is subject to a licence issued by the Water and Rivers Commission. In the case of ORIA Stage 1, the licensee is the bulk-water provider, the Water Corporation (Section 2.2.7 refers).

To accommodate proposed ORIA Stage 2 developments, including the potential supply of irrigation water to the Project Area, the Commission has prepared a Draft Interim Water Allocation Plan for review by the EPA and the public. The Draft Interim Water Allocation Plan includes water allocations for ORIA Stage 1, ORIA Stage 2 (including the Project Area) and water-dependent ecosystems. The Plan includes the basis for a licensing system for all potential water users and is discussed further in Chapter 5.

2.2.6 Office of Water Regulation

The Office of Water Regulation was established to administer the *Water Services Coordination Act 1995*. Responsibilities of the Office include:

- regulation and licensing of water services provision in Western Australia;
- coordination of water services policy and provision of advice to the Minister for Water Resources.

Under the Act, any water service provider in Western Australia must have an operating licence, issued and administered by the Office of Water Regulation. Licences apply to the provision of water supply, sewerage, irrigation and drainage services.

Licensees must satisfy a number of conditions in relation to the provision of water services, including water quality and customer service. Compliance with licence conditions is monitored through regular audits performed by licensees and external audits performed by

the Office of Water Regulation. Licences are vested with the owner of the water assets, and are not transferable.

In the case of ORIA Stage 1, the irrigation infrastructure is owned by the Water Corporation (Section 2.2.7 refers). The Water Corporation holds an operating licence from the Office of Water Regulation for all of its water provision activities throughout Western Australia and that licence includes conditions relating to the provision of water services in ORIA Stage 1.

2.2.7 The Water Corporation

The Water Corporation is the licensed provider of water services to the town of Kununurra, and to farms and industry in ORIA Stage 1. Water services provided to the town of Kununurra include the supply and distribution of potable water, and the provision of wastewater collection and treatment services. Water services provided to ORIA Stage 1 include the provision of irrigation water and the collection of drainage waters.

Whilst ownership of the irrigation infrastructure assets in ORIA Stage 1 rests with the Water Corporation, operation of the system has been contracted to the Ord Irrigation Co-operative (OIC) (Section 2.2.8).

Water Corporation responsibilities in the region also include the management of Lake Argyle and Lake Kununurra (including the Diversion Dam).

The Water Corporation is an active participant, in conjunction with the Water and Rivers Commission and the OIC, in a programme for monitoring the quality of supply and drainage waters associated with ORIA Stage 1 and also a programme for monitoring groundwater levels.

2.2.8 Ord Irrigation Co-operative

The OIC was established in 1995 by local farmers to operate the irrigation system in ORIA Stage 1 on behalf of the asset owner, the Water Corporation. The OIC is owned by farmers in ORIA Stage 1 and is controlled by a seven-member Board. Prior to 1995, the irrigation system was operated by the Water Corporation, and it was the view of local farmers that the system could be operated in a more cost-effective manner by the OIC. The OIC contract includes the operation and maintenance of irrigation infrastructure assets and the provision of irrigation and drainage services in ORIA Stage 1.

The Water Corporation has retained ownership of the irrigation assets. As a consequence of retaining the ownership of assets, the Water Corporation holds an operating licence for the provision of water services in ORIA Stage 1 (Section 2.2.6). Future transfer of ownership of the ORIA Stage 1 assets is planned by the Water Corporation, at which time an operating licence would be required by the new owner.

The OIC, in conjunction with the Water and Rivers Commission, is currently involved in a monitoring programme of water quality and groundwater in ORIA Stage 1, and has ex-officio representation on the Ord Land and Water Management Plan Steering Committee discussed in Section 2.2.3.

2.2.9 AGWEST

AGWEST provides the full range of its services to growers in ORIA Stage 1. Research projects are undertaken by AGWEST at the Frank Wise Institute in the areas of horticulture, field crops, intensive beef production and new industries including cotton, sugar and processing tomatoes. Sustainability issues in ORIA Stage 1 are also addressed and other services are provided to address agricultural protection and quarantine issues.

AGWEST is an ex-officio member of the Steering Committee guiding the preparation of the Land and Water Management Plan, and operates an industry liaison group known as the Tropical Agriculture Team.

AGWEST has ten operational programmes that contain strategic directions. These include two industry-wide programmes—agriculture protection and sustainable rural development—and eight industry-development programmes.

The Sustainable Rural Development Programme applies the internationally agreed principles of ecologically sustainable development for agriculture. Its scope extends from on-farm production to off-farm considerations such as value-adding and community development opportunities associated with agriculture, and the social and environmental impacts of agricultural activities. The programme focuses on four key Statewide areas including regional strategic planning, catchment management, property management planning and rural community development. It is funded and managed in six regions, including the Kimberley (Agriculture Western Australia 1998).

The Agriculture Protection Program has two main objectives:

- to assist the agricultural industry to access premium markets for agricultural products that meet specifications for safety and quality;
- to help protect the State's agricultural industry from production and sustainability risks posed by animal and plant pests and diseases, and weeds.

AGWEST has also produced a series of Farmnotes' that sets out the responsibilities of landholders under agricultural Acts for:

- land use and general property management (Farmnote 8/91 Agdex 838)
- water and drainage (Farmnote 9/91 Agdex 838)
- livestock (Farmnote 10/91)
- cropping and horticulture (Farmnote 11/91 Agdex 838).

2.2.10 Commissioner for Soil and Land Conservation

The Commissioner for Soil and Land Conservation administers the *Soil and Land Conservation Act 1945*.

Under the legislation, notices of intention to clear land areas in excess of 1 ha must be lodged with the Commissioner for Soil and Land Conservation. When considering the notices of intention to clear, the Commissioner would normally seek comments from various Government agencies.

Land Conservation Districts can also be established under the *Soil and Land Conservation Act 1945*. Land Conservation District committees comprise groups of land users who

address local land degradation and management issues, and address long-term sustainable land use issues. The Commissioner is represented on all Land Conservation District committees, and the committees receive funding assistance through State Landcare WA.

There is an established Land Conservation District Committee for ORIA Stage 1 that consists of representatives from land users, the community, the Water Corporation, the Water and Rivers Commission, the Department of Conservation and Land Management (CALM), the OIC and AGWEST. The Committee meets monthly and, while its area of responsibility is ORIA Stage 1, it has in the past reviewed conservation issues in the broader region.

2.2.11 Ministry for Planning

The Ministry for Planning (MfP) was established in its current form in 1995 under the *Public Sector Management Act 1994*. Its major legislative responsibilities concern the administration of a number of statutes on behalf of the Western Australian Planning Commission. The Commission is responsible for granting subdivision, development, strata title, lease and licence approvals, and it also provides advice to the MfP on town planning schemes.

The MfP is preparing a Kununurra–Wyndham Area Development Strategy, which encompasses the north-eastern part of the Shire of Wyndham – East Kimberley, and includes ORIA Stage 1 and ORIA Stage 2. These documents are discussed further in Chapter 11.

In respect to ORIA Stage 1, the role of the MfP is to ensure that the Shire of Wyndham–East Kimberley Town Planning Scheme is effectively implemented. Recently, a new town planning scheme has been prepared by the Shire and this is currently being assessed by the MfP. Permission to advertise the scheme for public comment has been granted by the Western Australian Planning Commission and the MfP.

Any land rezoning in ORIA Stage 1 (and within the State in general) must be approved by the Western Australian Planning Commission. With specific reference to ORIA Stage 1, Commission approval would be required for any zoning of vacant Crown land or excissions from pastoral lease to facilitate expansion of irrigated agricultural activities.

2.2.12 Kimberley Development Commission

The Kimberley Development Commission (KDC) was established as a statutory authority under the *Regional Development Commissions Act 1993*. The purpose of the KDC is to promote an environment that is conducive to the balanced economic and social development of the Kimberley region. The KDC's statutory objectives are as follows:

- to maximise job creation and improve career opportunities in the region;
- to develop and broaden the economic base of the region;
- to identify infrastructure services to promote economic and social development within the region;
- to ensure that the general standard of Government services and access to those services in the region are comparable to that which applies in the Perth metropolitan area;
- to encourage, promote, facilitate and monitor the economic development in the region.

The KDC provides an integral component of a ‘whole-of-Government’ approach to the requirements of regional development. It assists in the coordination of responsibilities of a wide range of agencies having impact on regional development, and performs a role in identifying needs and ensuring a rationalised and appropriate application of Government resources to the region.

Whilst the KDC does not have an ongoing management role in ORIA Stage 1, it has participated in the facilitation of the preparation of the Land and Water Management Plan via enlistment of support from the Minister for Primary Industries.

2.2.13 Department of Conservation and Land Management

CALM was established under the *Conservation and Land Management Act 1984*. CALM is the State Government agency with responsibility for the conservation of Western Australia’s wildlife and with the management of lands and waters entrusted to it.

CALM manages more than 20 million ha of the State’s land and waters. The management role includes conservation functions, and management for recreation and tourism, to facilitate public enjoyment of the natural attributes of public lands and reserved waters in a manner that does not compromise conservation and other management objectives.

CALM involvement in ORIA Stage 1 has included:

- provision of advice on activities on land adjoining existing or proposed nature reserves or conservation zones;
- promotion of the reservation of the Packsaddle Swamp and Carr Boyd Ranges for conservation purposes;
- facilitation of the management of the impact of native animals on horticultural crops;
- research on the cultivation of tropical tree crops;
- provision of advice on the growing of tree crops, such as sandalwood;
- assistance with the assessment of actual and potential environmental weed species.

2.2.14 Department of Resources Development

The Department of Resources Development (DRD) is the State Government agency that facilitates the development of major industrial or resource-related projects in Western Australia. DRD functions include assisting project developers in the achievement of all necessary Government development approvals. It is also responsible for the negotiation of State Agreements between the Government and developers for subsequent ratification by Parliament.

DRD has recently been involved in the planning and facilitation of agricultural land development in and around ORIA Stage 1, and ORIA Stage 2 (including the Project Area).

2.2.15 Fisheries

Fisheries is responsible for the management of Western Australia’s fish resources and of the local pearling industry. Fisheries operates under Section 35 of the *Public Sector Management Act 1994* and administers four separate Acts:

- the *Fish Resources Management Act 1994*
- the *Fisheries Adjustment Schemes Act 1987*
- the *Pearling Act 1990*
- the *Fishing Industry Promotion Training and Management Levy Act 1994*.

Fisheries is also responsible for compliance with the *Commonwealth Fisheries Management Act 1991* in the Australian Fishing Zone.

Fisheries' key objectives are as follows:

- to uphold the harvesting and fishing of fisheries resources at ecologically sustainable levels;
- to maximise the economic, social and other benefits derived from Western Australia's aquatic biological resources;
- to increase the level of understanding of, and support for, strategies used by Fisheries to manage the State's fisheries resources;
- to minimise adverse human impacts on the aquatic environment;
- to assign access to aquatic biological resources in accordance with community priorities.

With respect to ORIA Stage 1, Fisheries has developed a commercial and recreational fishing management strategy for the Ord River. The goal of the strategy is to maintain the high quality recreational fishing and aquatic ecotourism industry currently found in the Ord River.

2.2.16 Environmental Protection Authority

The EPA is a statutory authority established under the *Environmental Protection Act 1986*. The key role of the EPA is to provide independent advice on environmental matters to the Western Australian Government.

Functions of the EPA include:

- the assessment of the environmental acceptability of development proposals and the provision of advice on these to the Minister for Environment;
- the formulation of environmental protection policies;
- the coordination of activities necessary to protect, restore or improve the environment of Western Australia.

With respect to ORIA Stage 1, the EPA is to review the Draft Interim Water Allocation Plan produced by the Water and Rivers Commission, and may assess any proposed extensions to ORIA Stage 1, and the proposed transfer of irrigation and drainage infrastructure in ORIA Stage 1 (Section 2.3.5).

2.2.17 Department of Environmental Protection

The Department of Environmental Protection (DEP) was established under the *Environmental Protection Act 1986*. Key functions of the DEP include:

- environmental systems management;
- the management of waste to meet health and environmental standards;
- the enforcement of pollution prevention and clean-up laws;
- environmental policy coordination;
- the provision of professional and technical support to the EPA, particularly in the area of environmental impact assessment of proposals and policy formulation.

The DEP's functions also include the study of environmental problems and the recommendation of solutions, the licensing of industries, and the delivery of environmental education and community awareness programmes.

In ORIA Stage 1, the DEP is responsible for environmental licensing of the existing raw-sugar mill. In the future, the DEP may be called upon to provide technical advice to the EPA in relation to EPA assessment work in and around ORIA Stage 1 (Section 2.2.16).

2.2.18 Shire of Wyndham – East Kimberley

The Shire of Wyndham – East Kimberley covers an area of approximately 121,000 km² and includes the townships of Wyndham and Kununurra, ORIA Stage 1, and the portion of ORIA Stage 2 within Western Australia. The Shire has offices in Wyndham and Kununurra, and council meetings are alternated between the two offices.

The Shire's responsibilities include, but are not limited to, the administration of planning requirements, development approvals, building licences, road maintenance and upgrading, and parks and reserves.

The Shire of Wyndham – East Kimberley Town Planning Scheme No. 4, currently under review, controls the planning and development of Kununurra and its surroundings, including ORIA Stage 1. As a consequence, buildings and land uses within ORIA Stage 1 require development consent from the Shire. Whilst it does not have a management role once land uses are approved in ORIA Stage 1, the Shire of Wyndham – East Kimberley ensures that ongoing compliance monitoring takes place. It is also represented on a number of management and consultation groups within the district.

2.2.19 Department of Land Administration

The Department of Land Administration (DOLA) was established to provide land administration products, services and information in Western Australia.

The primary role of DOLA is to provide the legal, geographic and administrative base for the orderly use of land by the Western Australian community. It does this by providing three key services: access to land information, a process for transacting land dealings, and administration of the Crown estate.

In recent years, DOLA has managed the conversion of vacant Crown land to leasehold or freehold title in relation to extensions of ORIA Stage 1 and the town of Kununurra. Future development of ORIA Stage 1 involving alterations to land tenure would require approval from DOLA, in addition to the compliance with all other relevant State and Federal legislation.

2.3 ENVIRONMENTAL ISSUES AND THEIR MANAGEMENT

ORIA Stage 1 has been operating for the purposes of irrigated agriculture since 1963, a period of over thirty years. Over that period, a wide range of commercial crops have been grown and farm management practices have changed in response to new crops, improved knowledge of local conditions and improvements in agricultural practices generally.

The following sections discuss environmental issues of relevance to ORIA Stage 1 and how they are currently being managed. A major initiative in this regard is the commencement of the development of a Land and Water Management Plan, a process incorporating significant community input. The Land and Water Management Plan is discussed separately in Section 2.3.5. Lessons learnt from ORIA Stage 1 and how these lessons have been applied to the Project are discussed in Section 2.4.

2.3.1 Pesticide and chemical use

A wide range of crops have been grown in ORIA Stage 1 from its establishment to the present day. Over the same period there have been a number of developments in the practices of irrigated agriculture relating to on-farm management. One of the major changes has been in the use of pesticides and chemicals. Current practices are profoundly different from those of the early development period of ORIA Stage 1, when the use of agricultural chemicals was extensive. The current use of chemicals has been tempered by lessons learnt from past practices, a shift in the mix of crops and the implementation of an integrated pest management strategy.

The integrated pest management strategy recently developed by AGWEST, in conjunction with local farmers, is an important facet of farm management. The strategy consists of a number of complementary activities designed to reduce the requirement for the application of chemicals to crops, including:

- the optimisation of chemical usage patterns and companion planting to complement and encourage the presence of beneficial insects;
- the eradication of disease host plants;
- the destruction of crops where appropriate;
- use of trap crops at the beginning and end of the season.

However, the integrated strategy does not eliminate the continued application of a variety of agricultural chemicals deemed necessary to maintain the agricultural and commercial viability of ORIA Stage 1.

In the early years, much of the chemical usage was associated with the cultivation of cotton. Cotton is currently grown in ORIA Stage 1 as large-scale trials in conjunction with the integrated pest management strategy, and the cotton grown has been genetically modified to increase its resistance to insect attack.

The range of chemicals currently utilised on farmland in ORIA Stage 1 is summarised in Table 2.3.

Table 2.3 Insect, Weed and Disease control chemicals in recent use on farmland in ORIA Stage 1

Crop	Insect Control*	Weed Control*	Disease Control*
FallowH		Atrazine Diquat Diuron Glyphosate Oxyflurofen Paraquat	
Soya bean	Chlorpyrifos Diazinon Endosulfan Methomyl Monocrotophos Synthetic pyrethroids Trichlorphon	Bentazone Diphenylether compound Diquat Trifluralin	
Sugarcane		Asulam Atrazine Bromoxynil Diquat Diuron Loxynil M.S.M.A Paraquat	Prochloraz
Maize	Chorpyrifos Primicarb Synthetic pyrethroids Trichlorfon	Atrazine Diquat Glyphosate Oxyflurofen Paraquat	
Hybrid seeds - Maize and Sorghum	Chlorpyrifos Endsulfan Methomyl Primicarb Synthetic pyrethroids	Atrazine Diquat Oxyflurofen Paraquat	
Cucurbits	Carbaryl Chlorpyrifos Dimethoate Endosulfan Metasystox Methomyl Parathoin Primicarb Sethoxydim Synthetic pyrethroids Trichlofon	Fluazifop Sethoxydim	Copper compounds Mancozeb Oxadixyl Propineb Pyrazophos Triadimenol Tridemorph
Chick Pea	Chlorpyrifos Endosulfan Methomyl Monocrotophos Parathion Synthetic pyrethroids	Diquat Flauzifop Paraquat Sethoxydim Trifluralin	

Table 2.3 Insect, Weed and Disease control chemicals in recent use on farmland in ORIA Stage 1 (cont)

Crop	Insect Control*	Weed Control*	Disease Control*
Sunflower Hybrid Seed	Carbaryl Chlorpyrifos Endosulfan Methomyl Synthetic pyrethroids	Diquat Fluazifop Glyphosate Oxyflorfen Paraquat Sethoxydim Trifluralin	
Cotton ^o	Amitrez Bifenthrin Chlorpyrifos Diafenthiuron Methomyl Monocrotophos Piperonyl Butoxide Pirimicarb Sponsad Synthetic pyrethroids Thiocarb	Pyriithiobac-sodium	

* Many chemicals have similar properties, hence only a small range of those shown are generally used on any particular crop. Selection depends upon pest species present and farmer preference.

H Generally applies to most crops prior to planting in conjunction with mechanical cultivation.

^o Grown as part of large scale crop trials

Sources: Cook 1997 and R Leonard, Ord District Co-Operative Limited pers. comm. December 1999.

In addition to chemical usage on farmland, chemicals such as acrolein are used for control of aquatic weeds in the irrigation infrastructure (Section 2.3.4).

The pesticide currently of most concern in ORIA Stage 1 is endosulfan, a chemical known to be highly toxic to some fish and other aquatic species. Endosulfan is used extensively throughout ORIA Stage 1 on approximately 7,000 ha of the cropped area. The pesticide is used to control caterpillar pests in melon crops, soy beans, sweet corn, chick pea, culinary beans and hybrid seed crops. Endosulfan is used within a spray calendar in order to prevent over-use and any resultant build-up in resistance among target pests. It has very little effect on the beneficial insects that are part of the integrated pest management strategy.

Endosulfan usage was implicated in fish kills reported between 28 June 1997 and 25 August 1997 in the Dunham River, mainly between the Dunham River bridge and the confluence of the Dunham River and the Ord River. These incidents involved a gross estimate of some 200 to 300 fish killed, including bony bream, catfish, barramundi, archer fish and pop-eyed mullet.

A joint investigation into the fish kills was undertaken by the Water and Rivers Commission, and Fisheries. The investigation comprised an extensive 'snapshot' of water quality in the Ord River and environs and included data collected by the OIC. The Water and Rivers Commission (1998) investigation concluded that the Dunham River fish kills appeared to have been caused by endosulfan toxicity, which might have been exacerbated by stagnant water conditions in the Dunham River.

It is believed that mobilisation of endosulfan from farms is due mostly to molecular adsorption by very fine colloids such as clay particles, and that lesser amounts of mobilisation may be via solutions as endosulfan sulphate (Doupé et al. 1998). AGWEST

has been working with local farmers to refine a management strategy, aimed at reducing endosulfan loads in water exported from farms. The AGWEST integrated pest management strategy comprises the following recommendations:

- a voluntary ban on the use of endosulfan during the wet season;
- adoption of endosulfan spraying practices that:
 - comply with the National Registration Authority for Agricultural and Veterinary Chemicals (NRA) review recommendations on endosulfan usage (described below);
 - prevent the application of the chemical to areas having free-standing water in either the furrows or tail drains;
- examination of alternative pesticides to endosulfan that have similar low toxicity to beneficial insects.

The Ord Cucurbit Growers Group introduced a draft Code of Practice for Endosulfan Use in 1998. Based on experience in that year a revised Code of Practice using scouting for insect populations on crops, insect pest thresholds and spray strategies has been implemented for 1999.

The NRA recently completed a review of endosulfan resulting in a range of new restrictions on its use. Most of these restrictions will appear as new instructions on the registered label of endosulfan products by 30 June 1999, and will have the following effects:

- Endosulfan will become a restricted product and only persons with Farmcare training or similar accreditation will be able to purchase and use endosulfan products.
- Records of all endosulfan applications will need to be kept in accordance with Farmcare guidelines acceptable to the NRA.
- Except for orchards and cotton, all other crops will be restricted to two applications of endosulfan per year, unless irrigation tailwater and storm runoff water can be captured on farm (up to a 25 mm of isolated rainfall event).
- When endosulfan is used on cotton, current industry best management practices will have to be followed, in addition to the following restrictions:
 - There will be an absolute limit of three sprays or equivalent (not exceeding a total of 2,250 g of active ingredient per hectare) per crop per season of endosulfan.
 - Aerial application of endosulfan will only be permitted during specified time windows—1 December to 15 January for ultra-low-volume (ULV) application, and 15 November to 15 January for emulsifiable concentrate application (note that cotton is not grown in the ORIA during these periods).
 - Aerial application will be restricted to crops over 30 cm in height for ULV application and 20 cm in height for emulsifiable concentrate.
 - Mandatory downwind buffer zones will be required unless the appropriate neighbour gives written permission to waive the buffer. The buffer will depend on the formulation or application method as follows: 1,500 m for ULV application, 750 m for application of emulsifiable concentrate by air and 200 m by ground respectively.

- The use of high-volume, large-droplet-placement technology will be required for all emulsifiable concentrate applications, whether by air or ground, according to NRA specifications, yet to be published.
- Mandatory prior notification of neighbours surrounding the sprayed areas will be required for application within 1,500 m for ULV application, 750 m for emulsifiable concentrate application by air and 200 m for emulsifiable concentrate application on the ground.
- Workers will not be permitted to enter a crop within two days of treatment with endosulfan, unless they are wearing the personal protective equipment specified on the label. In the case of hand-weeders, no entry into the treated area will be permitted for two days following treatment and some personal protective equipment will be required after that period.
- Wherever possible, farmers should use spray equipment with enclosed cabins.
- Manual flagging for aerial application will not be acceptable unless an enclosed cabin or other engineering controls protect the flagger.
- Withholding periods will not be less than two days. Users should ensure that they identify the appropriate withholding period before they use the product.

The NRA has also determined that many of the existing uses of endosulfan will not continue beyond 1999–2000, unless producer industries and the chemical manufacturers can satisfy the NRA that endosulfan can continue to be used without unnecessary risk to the environment, consumer and worker safety.

The NRA has also specifically requested:

- worker exposure data for the handling and application of endosulfan in a range of agricultural industries;
- evidence of reduced environmental contamination with endosulfan;
- residue data to support maximum residue limits for most of the existing uses;
- implementation of spray drift minimisation strategies for all crops.

At the time of development of ORIA Stage 1 in the early 1960s, irrigation systems were commonly designed as ‘flow through’ or flushing systems. However, such designs do not constrain the pesticides within the farm boundaries. In more recent times, irrigation systems in Australia have been designed around the need to capture irrigation tailwater and return it for use on farms. This practice was initially developed as a means of augmenting irrigation water supplies but has since been shown also to be beneficial in reducing off-farm impacts from pesticides in general.

Large areas of sugarcane have been grown in ORIA Stage 1 in recent years. This crop has a low requirement for chemicals compared with other crops, which has reduced the risks associated with off-farm impacts. In addition, sugarcane is a perennial crop, providing cover during the wet season and thereby reducing sediment loss from farms.

Strategies for the management of pesticides and chemicals in ORIA Stage 1 are being developed and implemented. Endosulfan usage in the future will be more tightly controlled and imminent changes to State legislation will require training for farm staff involved in the

spraying of chemicals, and accreditation of commercial spray operators under a national standards system.

2.3.2 Groundwater issues

Extensive historical data exist on the behaviour of groundwater in ORIA Stage 1. Groundwater monitoring bores were installed by the Public Works Department in 1964, and in subsequent years those bores have been augmented by additional bores installed by the Water and Rivers Commission and AGWEST. The current database of groundwater information includes time period analysis of groundwater levels and salinity in a number of locations in ORIA Stage 1.

Data gathered from the network of monitoring bores indicate that groundwater levels in ORIA Stage 1 have risen over a significant proportion of the area. However, it is noted that after more than thirty years of irrigation, in only two localised areas is groundwater now less than 2 m from the surface. Groundwater levels have not affected land use in ORIA Stage 1 to date and groundwater remedial measures have therefore not been required.

The monitoring data also show that no areas in ORIA Stage 1 have been affected by salinity, and groundwater salinity levels are generally within the range tolerated by most crop species. However, in certain areas, groundwater salinity levels may be sufficient to reduce yields if groundwater were to rise to the surface.

A water and nutrient balance of the Ivanhoe Plain was commissioned by the Water Corporation in 1997 in order to investigate and quantify the sources of accession of groundwater. Results of the analysis are as follows:

- There is significant contribution to groundwater recharge from Lake Kununurra in the southern portion of the Ivanhoe Plain, but the recharge is well drained to the Ord River through highly transmissive river gravels.
- The M1 Channel has a significant influence on the groundwater levels in its vicinity, but the contribution to groundwater recharge by the channel has decreased slightly in absolute terms in recent years.
- The volume of recharge from irrigated farmland has increased since 1970, and especially since 1990.
- Groundwater accession from 1966 to 1990 averaged approximately 5% of the applied irrigation water volume, and since 1990 has been approximately 10%.
- The proportion and volume of recharge from the M1 Channel versus recharge from the irrigated farmland has changed considerably over time, ranging from an estimated 69% contribution from the M1 Channel and 31% accession from farmland in 1970; through to an estimated 19% recharge from the M1 Channel and 81% accession from farmland in 1996.

Groundwater levels in ORIA Stage 1 may require management at some point in the future. Numerous management options are available, including extraction of groundwater from permeable gravel beds via dewatering bores, installation of subsurface drains, tree plantings and improved farm drainage systems.

Management of groundwater issues in ORIA Stage 1 is receiving considerable attention as part of the development of the Land and Water Management Plan (Section 2.3.5).

2.3.3 Surface water issues

Drainage waters from ORIA Stage 1 are discharged into the Lower Ord River at a number of locations, predominantly between the mouth of the Dunham River and Drover's Rest. In addition, drainage waters from the Packsaddle Plain are discharged into the Dunham River, a tributary of the Ord River, via Packsaddle Creek. Drainage waters comprise farm irrigation water and rainfall runoff.

Water quality monitoring has been implemented in ORIA Stage 1 since the late 1970s. Over that period, the mix of crop types grown in ORIA Stage 1 has changed considerably and much of the early data have limited relevance to current practices. However, in more recent times, various water monitoring programmes have been undertaken in and around ORIA Stage 1.

In January 1996 a monitoring programme was instigated by the OIC, the Water Corporation and the Water and Rivers Commission. The water quality parameters monitored at approximately thirty sites include salinity, electrical conductivity, turbidity, alkalinity, pH, hardness, and the presence or concentration of iron, manganese, sodium, nitrous oxide, ammonia, and various trace elements. Sampling for pesticide residues including dieldrin, DDE (the breakdown product of DDT) metabolites, organochlorines and organophosphates has also been undertaken at irregular intervals.

Schoolchildren have also analysed water quality in ORIA Stage 1 during the period May to September since 1997 as part of the 'Ribbons of Blue' programme, the Western Australian component of the national Waterwatch Australia programme.

Additional water quality data also exist from an investigation by Doupé et al. (1998) and from ongoing monitoring by the Water Corporation and Ord Sugar Pty Ltd in the M1 Channel, upstream and downstream of the discharge points for the Kununurra Wastewater Treatment Plant and the sugar mill respectively.

The results of the water quality monitoring have shown that the sugar mill and, to a lesser extent, the Kununurra Wastewater Treatment Plant have been sources of the nutrients phosphorus and nitrogen for water in the M1 Channel. While not large in absolute terms, these sources were significant in comparison with the low levels of nutrients generally found in the water in Lake Kununurra. The sugar mill discharge has recently been modified to avoid the discharge of silt and nutrients into the M1 Channel.

Drains discharging into the Ord and Dunham rivers from ORIA Stage 1 contain varying quantities of nutrients. As expected, measured nutrient levels downstream of the drain discharges are slightly above the low natural level of nutrients in the Ord River due to the significant dilution provided from river flows.

A number of chemicals detected in the monthly water quality samples collected by the Water and Rivers Commission and the OIC are no longer in use in ORIA Stage 1; these include dieldrin, chlordane, heptachlor and DDT. The long half-lives of these compounds mean that they will continue to be detected for many years. Chlordane has been found at levels of 0.01–0.06 µg/L, DDE at levels of 0.02–0.39 µg/L and heptachlor in the range of 0–0.2 µg/L. While some of these levels are currently above guidelines applicable to the receiving waters, the chemicals are no longer in use and their concentration in the receiving waters should continue to reduce with time.

Endosulfan levels recorded in irrigation drains are in the range of 0–1.1 µg/L, with the majority of levels ranging from undetectable to 0.2 µg/L. Endosulfan recordings in the Ord River, with the exception of one reading, have all been below 0.1 µg/L. Higher readings have been recorded during the dry season in the Dunham River, when flows in this river are predominantly composed of irrigation tailwater.

2.3.4 Terrestrial and aquatic weeds

Terrestrial weeds occurring in and around ORIA Stage 1 are predominantly introduced plant species that are able to out-compete native species. These species include *Parkinsonia aculeata*, *Leucaena leucocephala*, *Calotropis procera* and *Xanthium strumarium* (Noogoora burr).

Responsibility for weed management varies with species and location. CALM has responsibility for the management of weeds growing in or near conservation reserves under its management. In other instances control of weeds is the responsibility of the landowner, especially for species declared noxious weeds by the Agriculture Protection Board under the *Agriculture and Related Resources Protection Act 1976*.

A large area of land on both banks of the Lower Ord River is in quarantine for the control of Noogoora burr. Quarantine restrictions in the Mantinea area were lifted by AGWEST in 1997. AGWEST is also currently investigating the introduction of a natural predator (a bruchid beetle) of *Leucaena leucocephala*, to control its spread outside areas where it is grown for cattle feed.

The Ord River is currently free of any introduced aquatic weeds. However, the control in water levels brought about by the irrigation scheme infrastructure has led to proliferation of a *Typha* (Cumbungi) in Lake Kununurra and along the banks of the lower Ord River. This growth reduces access to the water edge, interferes with navigation and restricts the ability of farmers to pump directly from Lake Kununurra.

Irrigation channels provide ideal growing conditions for other native aquatic species such as *Vallisneria* sp. (ribbon weed) and *Potamogeton* sp. (curly pond weed). The Water Corporation has used a combination of mechanical clearing and herbicides to control the weed growth in the irrigation channels. Herbicides, containing acrolein as the active ingredient, are introduced at strategic locations along the channels approximately eight times a year.

2.3.5 Environmental management framework

ORIA Stage 1 was developed before environmental legislation existed in Western Australia. As a consequence, no environmental assessment or management plan has ever been developed for ORIA Stage 1. Environmental management in ORIA Stage 1 currently relies upon the compliance of all individuals, groups and agencies with laws and statutes that apply to prevent pollution and degradation of land. This approach is common for agricultural schemes throughout Australia.

Absence of a clear management framework can have limitations:

- The responsibility for environmental management is not always clear for trans-boundary issues such as ground- and surface water management.

- Difficulties can arise if responsibilities for environmental management belong to individuals or groups who do not have adequate technical or financial resources.
- Minimum standards may be achieved rather than best-practice performance in environmental management.

The need for a co-ordinated approach to the management of environmental issues has been recognised by the various stakeholders in ORIA Stage 1. Two important initiatives are being undertaken to address this issue; the preparation of a Land and Water Management Plan and an assessment of the environmental implications of the proposed handover of irrigation scheme assets.

The Land and Water Management Plan

The local farming community has taken the initiative in commencing preparation of a Land and Water Management Plan to address the environmental issues, and ensure long-term sustainability of ORIA Stage 1.

Preparation of the Land and Water Management Plan commenced in 1996, and since March 1998 has been directed by a Steering Committee (Section 2.2.3). Financial contributions, or contributions in kind, for the purposes of employing coordinators and completing various studies and monitoring programmes have been supplied by a range of organisations including the Tropical Agriculture Team, AGWEST, the National Landcare Program, the Water and Rivers Commission, the Water Corporation, the OIC and local farmers.

The Land and Water Management Plan is to address the potential impact, both environmental and economic, of all uses of land and water resources of ORIA Stage 1. The output from the Land and Water Management Plan is to be a framework for the implementation of appropriate environmental management practices and will result in an increased awareness and understanding of environmental issues by farmers and the wider community.

From the inception of the Land and Water Management Plan, there has been extensive community consultation on environmental issues relevant to ORIA Stage 1. Community consultation has been supported through the production of a bimonthly newsletter distributed to approximately 300 people.

In March 1998, an Environmental Symposium was convened in Kununurra, attended by about 100 people. At the symposium, papers were presented by representatives from AGWEST, the Water and Rivers Commission, the Conservation Council of Western Australia, Fisheries, local farmers and industry, and other interested parties. The purpose of the symposium was to raise awareness of local environmental issues. The Land and Water Management Plan Steering Committee was elected by those people who were present at the symposium.

Discussion meetings with interested community groups started after the symposium. Over the past year contact was made with a large number of groups with interests in land and water management issues. The community consultation was synthesised into an Issues Paper published in November 1998. Groups who had input into the Issues Paper included:

- the East Kimberley Recreational Fisheries Advisory Council
- the Lower Ord Management Group

- the Tropical Agriculture Team
- the Kununurra Horticulture Producers Association
- the Ord Cucurbit Growers Group
- the ORIA Land Conservation District Committee
- the Care of the Ord Valley Environment Group
- the Ord Mango Growers Association
- the Kununurra Ratepayers Association
- the Ord Development Council
- the Shire of Wyndham – East Kimberley
- the Ord River District Co-operative
- the OIC.

In March 1999, a community meeting was convened in Kununurra to finalise the key issues that would be addressed by the Land and Water Management Plan and to develop implementation strategies. Recommendations adopted at the meeting were as follows:

- The best way to develop strategies would be to coordinate working groups, known as ‘Local Action Groups’, which would focus on particular issues.
- Issues would be consolidated in four areas—‘river’, ‘land’, ‘town’ and ‘conservation’—and a Local Action Group would be assigned to each.
- Local Action Groups would include representatives from different sectors of the community as well as a representative of the Land and Water Management Plan Steering Committee, the latter to help with communication between groups as well as with coordination and organisation.
- A Technical Advisory Group, comprising representatives from agencies and local industry should be formed and its expertise made available to the Local Action Groups.

The meeting confirmed that a high level of community involvement was desired during the development of the Land and Water Management Plan so that the final plan would benefit from a corresponding high level of community ownership. Completion of the final plan is scheduled for March 2000, after which there will be a period of negotiation with stakeholders to confirm roles and responsibilities for implementation of the Plan.

Future Responsibility for Irrigation Scheme Assets

The Water Corporation intends to hand over the bulk of the existing irrigation scheme assets to the OIC (Sections 2.2.7 and 2.2.8 refer). It is envisaged that after the transfer, the Water Corporation would retain ownership of and operating responsibilities for the Ord River Dam, the Diversion Dam, the bulkwater metering assets for each of the Ivanhoe and Packsaddle irrigation areas, and the M1 Channel. In doing so, the Water Corporation would become a supplier of bulk water, rather than the owner/operator of the whole scheme.

The proposed transfer of assets and responsibilities from the Water Corporation to the OIC has raised the issue of ongoing responsibility for environmental issues and their management. The Water Corporation and the OIC have agreed to define their individual

environmental responsibilities, and those that would remain as joint responsibilities, and have them assessed by the EPA.

Under recent amendments to Administrative procedures for Environmental Impact Assessment under the *Environmental Protection Act 1986*, there is now provision to assess and set environmental conditions on a proposal of this nature with a new form of environmental document known as an Environmental Protection Statement. An Environmental Protection Statement may be prepared in the near future in relation to the proposed transfer of irrigation scheme assets should the EPA agree to this approach.

2.4 IMPLICATIONS FOR THE PROPOSED DEVELOPMENT OF THE PROJECT AREA

The development of ORIA Stage 1 pre-dated the establishment of institutionalised and formal environmental impact assessment procedures that currently exist under the *Environmental Protection Act 1986*.

As stated previously, since the early years of development of ORIA Stage 1 there has been significant change, both in Australia and overseas, with respect to irrigated agriculture techniques and community awareness of environmental issues. Over the same period, there has also been a significant change in the mix of crops grown in ORIA Stage 1, and in the resultant environmental implications of commercial cultivation of those crops.

The impacts of ORIA Stage 1 on the environment, and the management of environmental issues, are now priority concerns for local farmers and a range of stakeholder groups. This is clearly evidenced by the initiatives to prepare a Land and Water Management Plan and to have the EPA review new management arrangements and responsibilities.

Currently, various groups and individuals hold a range of opinions on the status of the environment in and surrounding ORIA Stage 1. Whilst many argue that environmental issues are being managed in a pragmatic fashion in ORIA Stage 1, others take the view that existing environmental issues should be resolved completely prior to any consideration of expansion of ORIA Stage 1 and/or development of ORIA Stage 2 (including the Project Area).

It is the view of Wesfarmers–Marubeni and the Water Corporation that development of the Project Area could be managed in an environmentally sustainable manner. However, it is only natural that any expansion should take into account environmental issues identified in ORIA Stage 1. The following sections summarise the approach proposed in relation to the Project, with particular reference to some of the environmental issues that have arisen in ORIA Stage 1.

2.4.1 Pesticide and chemical use

The greater part of the Project Area would be devoted to the growing of sugarcane, a crop that has a low requirement for pesticides, and no requirement for the use of endosulfan.

Experience from ORIA Stage 1, and from other irrigation areas around Australia, has shown that on-farm management of irrigation and stormwater is required in order to manage the off-farm impacts of sediment, pesticides and other agricultural chemicals. For this reason, current best-practice on-farm water management measures would be adopted for the Project.

All farm units within the Project Area would be developed with tailwater return systems capable of collecting and returning on-farm all irrigation water runoff. The tailwater return systems would be designed in such a way as to also perform the function of first-flush stormwater collection systems, with the collected stormwater also being returned on-farm for use as irrigation water. The design capacity of the first-flush stormwater collection systems would be 12 mm of stormwater runoff for farm units devoted to sugarcane and 25 mm for farm units which may be used to grow crops that require the use of endosulfan or similar pesticides.

Recent advances achieved in pesticide use and management in ORIA Stage 1 would be adopted, and wherever possible enhanced, in the Project Area. As a minimum this would include:

- provision of buffers between farms and water courses;
- the adoption of the integrated pest management strategy developed in ORIA Stage 1 where appropriate;
- the adoption of the spray calendar developed each year for ORIA Stage 1;
- the adoption of AGWEST recommendations (Section 2.3.1) for on-farm management of endosulfan;
- compulsory training for all farm staff who would be required to handle and spray chemicals;
- compulsory accreditation of all commercial spray operators to a national standards system.

In addition, the above management measures would be supported by a comprehensive monitoring programme for pesticides and chemicals in the receiving environment. The monitoring programme would be undertaken as part of the environmental management framework for the Project Area (Section 2.4.5 and Chapter 15), and the results would be used to modify on-farm practices wherever necessary.

2.4.2 Groundwater issues

Experience gained in ORIA Stage 1 with respect to the rise of groundwater levels underlying irrigated black soil plains has been applied to numerical groundwater modelling of the Project Area (Chapter 6 refers). In addition, results gained from test pumping from gravel aquifers underlying the black soils in ORIA Stage 1 have confirmed that approach as a means of satisfactorily controlling groundwater levels. Pumping from bores now forms the basis of the groundwater control plan being developed for ORIA Stage 1.

A proactive groundwater management strategy is proposed as part of the Project. This strategy seeks to manage groundwater levels from project inception to ensure the sustainability of irrigated agriculture on the Project Area. Key elements of the strategy are as follows:

- engineering design standards would comply with current best practice for all irrigation channels and regulating storages intended to convey or store water for prolonged periods. These design standards would specify the minimum thickness and compaction levels of the clay lining systems provided to minimise accessions to groundwater;

- regulating storages would be sited to areas that naturally contain greater surface thickness of the less permeable Aquitaine clays;
- drains for stormwater runoff would be designed with broad channel inverts to minimise excavation, thereby containing the channel inverts where possible in the naturally occurring less permeable surface soils;
- comprehensive supervision and quality assurance procedures would be adopted to ensure that the design intent is fulfilled during construction;
- crop watering strategies that maximise the water uptake by crops and minimise the water loss to groundwater would be utilised;
- groundwater levels would be controlled via the utilisation of bores and subsoil drains;
- a comprehensive monitoring programme for groundwater levels and quality, and use of the collected data to modify management practices would be practiced.

An important lesson learned from the experiences with ORIA Stage 1 is that clear responsibility for groundwater management is required together with responsibility for funding of groundwater control measures. Unlike ORIA Stage 1, where it has been difficult to allocate such responsibilities, the Project would involve the clear allocation of responsibilities for groundwater management at inception through the proposed environmental management framework (Chapter 16 refers). The benefit of this approach is that it allows the cost of sustainable groundwater management to be included in project feasibility calculations. In addition, it would allow all current and future participants in the Project to be aware of their long-term financial commitment with respect to groundwater management, and permit them to plan accordingly.

2.4.3 Surface water issues

The Project would be designed, constructed and operated in accordance with current best-practice requirements with respect to surface water management. In particular, this would involve the following features:

- Irrigation water would be provided on a full economic cost recovery basis, which would provide a strong economic incentive for efficient water usage on farms.
- All farm units would be provided with tailwater return systems that would also act as first-flush stormwater collection systems, aimed at protecting the quality of receiving waters as well as promoting efficient water use.
- The irrigation water distribution infrastructure would be operated from a centralised control centre to provide a high level of water distribution efficiency.
- Regulating storages would be provided along the route of the main supply channels in order to provide additional capacity for times of peak water use. At other times they would provide buffer capacity that would even out flows in the channels, thereby minimising the need to discharge water to the drainage system.

By comparison with ORIA Stage 1, the above features should result in higher efficiency of water use as well as a greater level of containment of silt and agricultural chemicals on the farms. The most obvious difference would be the virtual elimination of dry season flows from the Project Area.

2.4.4 Terrestrial and aquatic weeds

Existing statutory requirements in Western Australia for the control of weeds in and around ORIA Stage 1 would also apply to the Project Area. These requirements would be augmented or modified as appropriate by the statutory requirements applicable within the Northern Territory.

The Project allows for the monitoring and management of terrestrial and aquatic weeds in a defined buffer zone within the Project Area. This responsibility would be fulfilled as part of the environmental management framework to be established as part of the Project (Section 2.4.5 and Chapter 15).

2.4.5 Environmental management framework

Section 2.2 provides a brief description of the individuals, grower groups, businesses and Government agencies that are identified in this ERMP/draft EIS as currently having an interest in ORIA Stage 1 and possibly sharing responsibility for environmental management in some way. Difficulties associated with such a diverse distribution of responsibilities, sometimes to groups without adequate technical or financial resources, have been recognised by farmers within ORIA Stage 1. This recognition has led to the inception of the development of a Land and Water Management Plan, which is to guide environmental management of ORIA Stage 1.

The Project has an advantage over ORIA Stage 1 in that current knowledge and expectations with regard to environmental management can be incorporated into development plans from the outset. For example, as mentioned in previous sections, all farm units would be equipped with current best practice on-farm water management measures comprising first-flush stormwater collection and irrigation tailwater return systems.

In addition, the early years of project development and operation would largely be undertaken by one corporate farmer, which would make it easier to develop environmental management systems and easier to account for responsibility for their implementation than would be the case if a large number of smaller farmers were involved. An environmental management framework, described in detail in Chapter 16, would be established at Project inception to ensure that environmental management responsibilities are clearly identified and appropriately implemented and funded as part of the Project.

An important objective taken into consideration during the development of the proposed environmental management framework was the need for it to deal efficiently and fairly with respect to future ownership, particularly to cater for a potential sell-down in part or whole of the corporate farm. The proposed framework fulfills this objective by clearly identifying the roles and responsibilities of all parties and by providing a mechanism for the transfer of these responsibilities via contractual arrangements.

The proposed environmental management framework has been developed in accordance with the concept of self-regulation in order to promote greater ownership by all parties of the responsibilities for environmental management. However, a high level of public and regulatory authority review would be provided, involving:

- review of this ERMP/draft EIS and completion of the environmental impact assessment procedure, including the setting of environmental conditions;

- the potential for focussed and ongoing community consultation within the proposed environmental management framework;
- public scoping of the Environmental Management Plan for the Project, including subsequent revisions and updates;
- publication of annual reports containing results of ongoing monitoring programmes, developed as part of the environmental management plan, and compliance with environmental conditions.

It is noted that the Land and Water Management Plan proposed for ORIA Stage 1 is also being developed with extensive community involvement in order to increase ownership and awareness of environmental management by farmers and the wider community.