NEWMAN SATELLITE DEVELOPMENT MINING OF OREBODY 23 BELOW THE WATERTABLE

CONSULTATIVE ENVIRONMENTAL REVIEW

Prepared for BHP Iron Ore by Woodward-Clyde

September 1997

BHP Iron Ore Pty Ltd

Orebody 23 Consultative Environmental Review

HOW TO MAKE PUBLIC SUBMISSIONS:

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

BHP Iron Ore Pty Ltd is proposing to extend the current mining operation at Orebody 23 to below the watertable level. Orebody 23 is located on Mineral Lease 244SA, 13 km north-east of Newman. In accordance with the *Environmental Protection Act 1986*, a CER has been prepared which describes this proposal and its likely effects on the environment. The CER is available for public review for a period of 4 weeks from Monday 1 September 1997 closing on Monday 29 September 1997.

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

Copies of the document may be obtained for the sum of $5.00 each from:

BHP Iron Ore Pty Ltd
200 St Georges Terrace
PERTH WA 6000

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 EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the *Freedom of Information Act*, and may be quoted in full or in part in each report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining a group or other groups 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 may people your submission represents.

Developing a submission

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

When making comments on specific proposals in the CER:

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

Points to keep in mind

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

- Attempt to list points so that the issues raised are clear. A summary of your submission is helpful.
- Refer each point to the appropriate section, chapter or recommendation in the CER.
- If you discuss different sections of the CER, keep them distinct and separate, so there is no confusion as to which section you are considering.
- 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.

More information on how to make a submission can be obtained from the free pamphlet "Environmental Impact Assessment - How to Make a Submission" available from the Library of the Department of Environmental Protection. Telephone: (09) 222 7127.

The closing date for submissions is: **Monday 29 September 1997.**

Submissions should be addressed to:

Environmental Protection Authority
Westralia Square
141 St Georges Terrace
PERTH WA 6000
Attention: Melinda Phillips

BHP Iron Ore Pty Ltd (BHP Iron Ore) proposes to extend bedrock mining at the current Orebody 23 operation to below the watertable level. The minesite is located approximately 13 km north-east of the Newman township on the Ophthalmia Range in the vicinity of the Fortescue River. The remaining ore reserve in the pit totals approximately 12 Mt and will be extracted over a four year period at a rate of between 2 and 4 Mt per year. The ore will be trucked to the existing Orebody 25 plant where it will be crushed and transported by rail to Port Hedland.

The current defined pit area at Orebody 23 will be marginally extended beyond the existing boundaries. The overburden material will be increased substantially, however, it will continue to be placed in the same location which will be blended into the surrounding landscape and rehabilitated. The Project (Orebody 23 and 25) will continue to be operated by a contractor workforce of approximately 60 people. This workforce will continue to be accommodated in the town of Newman.

A summary of the potential impacts associated with both current and proposed mining at Orebody 23, including predicted changes resulting from mining below the watertable and the management approaches adopted, is presented in the Executive Summary as Table ES-1. The draft Life of Project Environmental Management Plan addressing all environmental management aspects is attached as Appendix B. Key environmental aspects of the proposal include:

- groundwater hydrology;
- riverine vegetation;
- pyritic shale; and
- life of project environmental management plan.

These topics are briefly outlined below.

Groundwater Hydrology

Dewatering activities will be required for the four year mine life to allow recovery of the ore below the current watertable. This operation will lower the watertable level in the pit to maintain dry conditions for mining to a planned depth of 140 m.

Following the completion of mining and dewatering activities, the water level in the pit will rapidly return to near pre-mining levels. The pit will therefore contain an open waterbody. Modelling has indicated that the salinity levels in this waterbody will gradually increase over time. It is possible that, with the movement of water from the waterbody to the aquifer, salinity levels of the aquifer may also increase. Current aquifer water quality in the vicinity of the pit is typically below 1,000 mg/L (as measured by Total Dissolved Solids - TDS).

BHP Iron Ore commit to supplementing the existing groundwater monitoring system. Water quality in the pit and at appropriate monitoring bores will continue to be monitored after mine closure. If aquifer salinity levels immediately adjacent to the pit increase to 1,500 mg/L or more, means of limiting further increases will be investigated. If sustained levels in excess of 2,000 mg/L are recorded at selected bores for more than 12 months, BHP Iron Ore will implement suitable techniques to maintain water quality consistent with beneficial uses at that time.

Riverine Vegetation

Drawdown of the watertable will extend approximately 6 km upstream on Homestead Creek, 5.5 km on the Fortescue River, 6 km on Shovelanna Creek and 5 km downstream on the Fortescue River. To minimise the potential impact on riverine vegetation, particularly River Red Gums, BHP Iron Ore commit to establishing a vegetation and groundwater monitoring programme along the creeks with the objective of monitoring potential impacts of dewatering. A tree watering system will be established, if required, to sustain riverine vegetation. The results of the monitoring will be used to implement an irrigation programme and to adjust the programme to prevailing conditions.

Pyritic Shale

Geological drilling has indicated that approximately 1.5-2.0 Mt of potentially reactive black pyritic shale will be mined in the latter years of the operation. The management of pyritic overburden material will involve the selective removal of potentially reactive shale from the pit, its placement in layers within dedicated cells within the overburden storage area, regular covering of this material with at least 200 mm of non-reactive overburden and capping with at least 2 m with non-reactive material at the completion of mining.

The management of potentially reactive pyritic material exposed in the pit wall will aim to minimise exposure to air. Both horizontal and vertical surfaces will be sealed with impervious material.

Life of Project Environmental Management Plan

BHP Iron Ore has recently adopted the approach for satellite orebody development in the Newman area whereby environmental management practices are described in specific Life of Project Environmental Management Plans (EMP). This involves submitting a draft of the EMP to the EPA for assessment with the Project approval documentation. Following approval, the EMP will be periodically revised by BHP Iron Ore and submitted to the DEP for review as part of an effective environmental management system where practices are modified in response to the results of monitoring programmes and any operational changes.

TABLE ES-1
OREBODY 23 ENVIRONMENTAL FACTORS

CONTENT	SCOPE OF WORK		EXISTING ENVIRONMENT		BASELINE STUDIES	FUTURE ENVIRONMENT	
Factor	**EPA Objective**	**Work required for the Environmental Review**	**Existing Status**	**Existing Management**		**Potential Impacts**	**Proposed Management/Predicted Outcome**
BIOPHYSICAL							
Vegetation Communities	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.	Baseline studies to identify existing vegetation communities. Assessment of potential impacts (direct and indirect) on vegetation communities as a result of mining and associated activities, including dewatering and dewatering discharge. Proposed measures to manage impacts.	The existing operation has resulted in the loss of vegetation in the immediate vicinity of the mine and overburden storage through clearing activities. (37 ha total area of disturbance).	All clearing has been kept to a minimum. Clearing plans have been developed and monitored to ensure compliance.	Biological Survey. *ecologia* Environmental Consultants, 1997.	The expansion to the mining operation will require the clearing of vegetation in the vicinity of the pit and overburden storage areas. (100 ha additional area of disturbance)	Current management practices will be continued. Rehabilitation of the overburden storage and other disturbed areas will be undertaken progressively and at the completion of mining. (137 ha total area of disturbance).
Declared Rare and Priority Flora	Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950.*	Baseline studies to identify any Declared Rare and/or Priority Flora. Assessment of potential impacts (direct and indirect) on Declared Rare and Priority Flora as a result of mining and associated activities. Proposed measures to manage impacts.	No Declared Rare Flora identified in the Project Area. One Priority 2 species, *Scaevola acacioides*, recorded in the Project Area.	Clearing plans have been developed with regard to BHP Iron Ore's commitment to minimum disturbance.	Biological Survey. *ecologia* Environmental Consultants, 1997.	The Priority 2 species, *Scaevola acacioides*, will be impacted by the mining activities.	Current management practices will be continued. The habitat in which the Priority 2 species was identified as common within the Project Area and is expected to result in minimal local impact due to its disturbance.
Terrestrial Fauna	Maintain the abundance, species diversity and geographical distribution of terrestrial fauna.	Baseline studies to identify existing terrestrial fauna in the project area. Assessment of potential impacts (direct and indirect) on terrestrial fauna as a result of mining and associated activities. Proposed measures to manage impacts.	The operation of the mine has displaced fauna from the immediate vicinity of the operation.	To minimise the impact of habitat loss, BHP Iron Ore is committed to a policy of minimum disturbance with rehabilitation to occur as soon as practicable following mining.	Biological Survey. *ecologia* Environmental Consultants, 1997.	Mining and overburden placement will displace fauna from the immediate vicinity of the operation.	Current management practices will be continued. No change.
Specially Protected (Threatened) Fauna	Protect Threatened Fauna and Priority Fauna species and their habitats, consistent with the provisions of the *Wildlife Conservation Act 1950.*	Baseline studies to identify existing threatened fauna in the project area. Assessment of potential impacts (direct and indirect) on threatened fauna as a result of mining and associated activities. Proposed measures to manage impacts.	Ten species having conservation significance were recorded or have the potential to occur within the Project Area.	No special management measures adopted.	Biological Survey. *ecologia* Environmental Consultants, 1997.	The Project Area does not support habitats for the majority of significant fauna, therefore disturbance due to mining will result in minimal impacts.	Current management practices will be continued. No change.
Watercourses	Maintain the integrity, functions and environmental values of watercourses. Ensure that the quantity and seasonal variation in flow of surface and groundwater is maintained, throughout the life of the mine and after decommissioning. Ensure that alterations to surface water drainage do not adversly impact on indigenous vegetation.	Assessment of the potential impacts (direct and indirect) on watercourses. Assessment of impact on Homestead Creek during and subsequent to dewatering. Proposed measures to manage impacts.	Runoff is generated from disturbed areas on the mine-site following rainfall events. The mine has limited impact on the surface hydrology. Minor surface flows in the immediate vicinity are altered by the pit and overburden storage areas.	Surface water is discharged from minesite via settling ponds. Silt traps are installed on major watercourses downstream of disturbed areas. Water released to the environment is discharged via settling ponds.	N/A	A proportional increase in the volume of runoff generated from disturbed areas. The mine expansion will have a limited impact on the surface hydrology. Minor surface flows in the immediate vicinity will be disturbed by the pit and overburden storage areas.	The current management practices will be continued. No change.
Groundwater Quantity	Maintain the quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.	Detail of water requirements for any on-site processing and mine operations. Assessment of the implication(s) this may have on regional groundwater and phreatophytic vegetation. Proposed measures to manage impacts.	There is no drawdown associated with the current mining operation. Dewatering is not required for current mining operations.	N/A	Dewatering investigations and modelling. AGC Woodward-Clyde, 1997.	The expanded mining is predicted to result in a drawdown of the groundwater table by up to 140 m, depending on distance from the pit. Groundwater dewatering (up to 38,000 kL/day) will be distributed between: • maintaining raw water supply; • discharged to the creek system, as required, to irrigate vegetation; • discharged to Ophthalmia Dam; or • infiltrated through the Fortescue River channel downstream of the mining area to maintain groundwater throughflow.	Phreatophytic vegetation will be irrigated, as required, and regulated in accordance with the tree monitoring programme, until the groundwater levels return to current levels. A comprehensive groundwater and vegetation monitoring programme will be implemented in areas adjacent to the mining operation. No change.

TABLE ES-1
OREBODY 23 ENVIRONMENTAL FACTORS

CONTENT	SCOPE OF WORK		EXISTING ENVIRONMENT		BASELINE STUDIES	FUTURE ENVIRONMENT	
Factor	**EPA Objective**	**Work required for the Environmental Review**	**Existing Status**	**Existing Management**		**Potential Impacts**	**Proposed Management/Predicted Outcome**
Landform	Establish stable, sustainable landform consistent with surroundings.	Assessment of the potential impacts of the proposal on existing landforms. Detail of management of the final void, ie. backfilled or partially backfilled. If only partial, to what level. Detail of measures proposed to rehabilitate the impacted area, including removal of infastructure, clean-up of any contaminated areas and how ongoing environmental management of the site will not be required.	Overburden and low grade ore are currently stored in a designated site to the west of the pit resulting in the permanent alteration of the 25 ha. The existing pit covers an area of 12 ha and extends to a depth of approximately 3 m below the existing plain level.	The overburden storage area is constructed to blend with the surrounding landforms. It will be contoured, stabilised and revegetated during and after mining.	N/A	Approximately 50 Mt of overburden will be removed during the expansion of mining. The current overburden storage area will be extended to cover a total area of 105 ha. Mining will occur to a depth of 140 m below the existing plain level. This will impact on an additional 20 ha of land surface (total final pit area 32 ha).	Minimum practicable amount of overburden will be stored on storage areas. Current management practices will be continued. Stable post-mining landforms will remain. The pit will remain as an open waterbody for the foreseeable future.
POLLUTION MANAGEMENT							
Greenhouse Gases	Ensure that greenhouse gas emissions meet acceptable standards and requirements of Section 51 of the *Environmental Protection Act 1986* (all reasonable and practicable measures are taken to minimise greenhouse gas discharge).	Detail of potential source(s) of greenhouse gas emissions.	Greenhouse gases are generated through the use of equipment and fuels.	BHP Iron Ore is a member of the Greenhouse Challenge and minimises emissions of these gases through ensuring efficiency of mobile equipment, fuel selection and the efficient use of electricity.	BHP Iron Ore conducts monitoring of greenhouse emissions as part of the Greenhouse Challenge.	Greenhouse gases will continue to be generated through the use of equipment and fuels.	Management practices will continue to be reviewed and improved where practicable. No change.
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.	Baseline studies to identify existing sources of dust. Assessment of potential increases in dust resulting from the construction and operation of the mine and associated activities. Assessment of potential impacts of increased dust on the amenity of surrounding land users from the construction and operation of the mine and associated activities. Discussion should be given to the possibility of asbestos emissions occurring. Proposed measures to manage impacts.	Dust is generated from blasting activities, ore and overburden mining, road haulage and truck unloading.	Dust generation is controlled by watering from water trucks, water jets and water sprays.	Dust monitoring for Occupational Health and Safety purposes undertaken by Contractor on a regular basis. Environmental monitoring undertaken between 1995 and 1997 in the Newman area from all BHP Iron Ore sources. A new programme is currently being developed by the Company.	The expanded operation will not increase the levels of dust generated by the operation.	Current management practices will be continued. No change.
Groundwater Quality	Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected consistent with the draft *WA Guidelines for Fresh and Marine Water* (EPA, 1993) [and the NHMRC/ARMCANZ *Australian Drinking Water Quality - National Water Quality Management Strategy*].	Detail of water requirements for any on-site processing and mine operation. Detail of drainage and fate of water used in any on-site processing and mine operations. Detail of the possibility of acid mine drainage occurring, and potential impacts on the surrounding environment. Assessment of the implication(s) this may have on regional groundwater quality. Proposed measures to manage impacts.	The current operation uses and generates materials which have the potential to impact on the groundwater. The current operation has not extended below the groundwater table and has not intercepted potentially acid producing shales.	All potential hazardous materials are stored in accordance with the relevant legislation. Drainage from storage areas pass through appropriate treatment prior to discharge.	Dewatering investigations and modelling. AGC Woodward-Clyde, 1997. Ongoing monitoring of Ethel Creek Wellfield for Groundwater Well Licences.	The expanded operation will not generate increased materials of potentially hazardous substances. Later stages of mining will interrupt potentially acid generating pyritic black shale. An estimated 1.5 - 2 Mt of this material will be removed to the overburden storage.	The current management practices for potentially hazardous materials will be continued. No change. Pyritic black shale material will be selectively removed and encapsulated in dedicated cells to prevent acid rock drainage from occurring.

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Groundwater Quality (continued)			Minimal seepage.	Groundwater is monitored and sampled as part of Environmental Protection Act Pollution Control Licence conditions.		An open water body will form in the pit after the completion of mining and may gradually increase in salinity. Movement of saline water out of the pit may occur. Modelling predicts that the impact will be minimal as the salt levels will be diluted by surrounding groundwater.	The quality of the water in the pit and adjacent aquifer will be monitored. If aquifer salinity in selected bores reaches 1,500 ppm, techniques to manage salinity will be investigated. If levels of 2,000 ppm or more are recorded, in selected bores, for more than 12 months, appropriate management techniques will be implemented to maintain water quality consistent with agreed beneficial uses.
Surface Water Quality	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guideline for Fresh and Marine Waters (EPA, 1993) [and the NHMRC/ARMCANZ Australian Drinking Water Guidelines - National Water Quality Management Strategy].	Detail of water requirements for any on-site processing and mine operations. Detail of drainage and fate of water used in any on-site processing and mine operations, including dewatering. Detail of the possibility of acid mine drainage occurring, and potential impacts on the surrounding environment. Assessment of the implication(s) this may have on regional groundwater quality. Proposed measures to manage impacts.	The current mining operation intercepts minor surface water flows in the immediate mine area.	Silt traps are installed on drainage lines downstream of disturbed areas and stockpiles, where required. Water is discharged through settling ponds to meet the criteria specified in Licence conditions.	N/A	No additional surface water runoff will be generated by the expanded mining operation. Potentially acid generating pyritic black shales will be contained in the overburden storage.	The current management practices will be continued. No change. Pyritic black shale material will be selectively removed and encapsulated in dedicated cells within the overburden storage to prevent acid rock drainage from occurring.
Noise	Protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring that noise levels meet statutory requirements and acceptable standards.	Baseline studies to identify existing sources of noise. Assessment of potential increases in noise resulting from the construction and operation of the mine and associated activities. Assessment of potential impacts of increased noise on the amenity of surrounding land users form the construction and operation of the mine and associated activities. Proposed measures to manage impacts	Noise is generated in the current operation by blasting, operation of mine machinery and the movement of light vehicles. Noise levels have little impact on the surrounding community as the mine is 13 km from the nearest population centre.	To minimise noise from blasting, detonation is carried out at specific times during daylight hours.	Noise monitoring for Occupational Health and Safety purposes undertaken by the Contractor. No environmental noise monitoring undertaken.	The expanded mining operation will not increase the levels of noise at the mine.	The current management practices will be continued. No change.
SOCIAL SURROUNDINGS							
Public Health and Safety-Transport	Ensure that roads are maintained or improved and road traffic managed to meet an adequate standard of level of service and safety and MRWA requirements.	Detail of transport requirements for the proposal. Assessment of potential impacts from any transport works the result from the proposal. Proposed measures to manage impacts.	Most transport associated with the Orebody 23 operation is confined to private roads controlled and maintained by BHP Iron Ore.	Maintenance and access controlled to meet appropriate safety requirements.	N/A	The expansion to mining at Orebody 23 will not require additional use of the public road system.	The current management practices will be continued. No change.
Visual Amenity	Visual amenity of the area adjacent to the project should not be unduly affected by the proposal.	Assessment of potential impacts on visual amenity of the project area and surrounds from the proposal. Proposed measures to manage impacts.	Aspects of the current operation (e.g. pit, overburden storage areas and haul roads) impact on the visual character of the area.	Disturbed areas are progressively rehabilitated. Storage areas are designed to blend with the surrounding topography.	N/A	A greater area will be disturbed due to the expanded pit and overburden storage areas.	The current management practices will be continued. No change.
Aboriginal Culture and Heritage	Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972; and ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Identify Aboriginal cultural and Heritage sites of significance through archaeological and ethnographical surveys of the project area and through consultation with local Aboriginal groups and the Department of Aboriginal Affairs. Identify potential impacts on any identified sites. Proposed measures to manage impacts.	No Aboriginal sites have been identified in the area of the existing operation.	If any sites are identified, wherever possible they will be avoided. For sites that can not be avoided, approval will be sought to disturb the sites under Section 18 of the *Aboriginal Heritage Act 1970 - 1982*. All employees undergo a compulsory induction where they are advised of their obligations under the Act.	Aboriginal site surveys. Palmer, 1975. Troilett and Clarke, 1981. Clarke and Smith, 1979.	One Aboriginal sites has been identified to the western side of the overburden storage area. A number of archaeological and ethnographic sites have been identified in the area of influence of the mine dewatering operation. None of these sites will be disturbed by the operation.	Approval to disturb the site was granted in 1985 under the *Aboriginal Heritage Act 1972-1980*. Existing management practices will continue. No change.

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1.1 INTRODUCTION

BHP Iron Ore Pty Ltd (BHP Iron Ore) proposes to extend the current mining operation at Orebody 23 to below the watertable level.

Mining commenced at Orebody 23 in July 1992 after a proposal to recover scree ore was submitted to the Environmental Protection Authority (EPA) in September 1991 and informal advice forwarded in November 1991. The scree ore was hauled 6 km to the existing Orebody 25 scree plant for crushing and loading onto rail for transport to Port Hedland.

A proposal to mine Orebody 23 bedrock was submitted in March 1993 and informal advice forwarded in May 1993. Mining commenced soon after with a continuation of the practice of ore being hauled to the Orebody 25 plant for processing and trainloading.

A commitment was made in the March 1993 Proposal to restrict mining to above the watertable until the reserve details were established and an assessment could be undertaken of the environmental impacts of mining below the watertable.

The remaining ore reserve in the pit totals 12 Mt and is proposed to be extracted over a four year period at a rate of between 2 and 4 Mt per year. The ore will continue to be trucked to the existing Orebody 25 plant for processing and trainloading.

This document describes the proposed mining operation, assesses potential environmental impacts and describes management measures for the ongoing operation. A detailed Project description document was referred to the EPA which determined that the Project would be assessed as a Consultative Environmental Review (CER) under Part IV of the *Environmental Protection Act 1986*. Guidelines issued by the EPA for the preparation of the CER are provided in Appendix A. A draft Life of Project Environmental Management Plan (EMP) is provided in Appendix B.

1.2 THE PROPONENT

The proponent of this proposal is BHP Iron Ore Pty Ltd which is the manager for the Mount Newman Joint Venturers - the owners of the proposed project. These Joint Venturers are:

- BHP Minerals Pty Ltd 85 %
- Mitsui Itochu Iron Pty Ltd 10 %
- CI Minerals Aust Pty Ltd 5 %

The Joint Venture operates under the *Iron Ore (Mount Newman) Agreement Act 1964*.

The head office of BHP Iron Ore Pty Ltd is located at 200 St George's Terrace, Perth, Western Australia.

BHP Iron Ore has had a long involvement with iron ore mining in the Pilbara region of Western Australia. The major centre of BHP Iron Ore's mining activity is Mt Whaleback, which commenced operation in 1969. This development includes 426 km of heavy duty standard gauge railway and shiploading facilities at Port Hedland. BHP Iron Ore currently operates a number of other iron ore mines in the Pilbara including the Yarrie, Marillana Creek, Orebody 29, Orebody 25 and Jimblebar mines (Figures 1.1 and 1.2). In 1995-1996, BHP Iron Ore shipped a total of 57.2 million tonnes of iron ore.

1.3 LOCATION AND TENURE

Orebody 23 is located in the Pilbara region of the north-west division of Western Australia (Figure 1.1). The mine is situated within Mineral Lease 244SA (Figure 1.2), approximately 13 km north-east of the township of Newman.

Orebody 23 is located on vacant Crown land.

1.4 LEGISLATIVE REQUIREMENTS AND PROCEDURES

This proposal is subject to formal assessment at the level of Consultative Environmental Review, pursuant to the provisions of Part IV of the *Environmental Protection Act 1986*. Should approval for development be granted, the State Minister for the Environment will issue a statement under Section 45 of the *Environmental Protection Act 1986* listing the management and environmental protection conditions to be applied to the operation. In addition, works approval and licensing under Part V of the *Environmental Protection Act 1986* will be sought.

In addition to obtaining approval from the State Minister for the Environment, the Proponent will also comply with relevant legislation and regulations administered by other State and Federal Government agencies. These Acts and their application to Orebody 23 are listed in Table 1-1.

1.5 PROJECT JUSTIFICATION

1.5.1 National and State Benefits

The continued mining operation at Orebody 23 will result in economic benefits for the community through:

- the State Government receiving additional revenue in the form of royalties, payroll tax and other charges;
- increased income flow to the Federal Government through tax revenue (personal income tax and corporate tax);
- demand for goods and services which will generate income and create opportunities for other Australian business sectors; and
- returns to shareholders.

Ongoing mining at Orebody 23 will also provide continued employment for the contract workforce operating between Orebody 25 and 23.

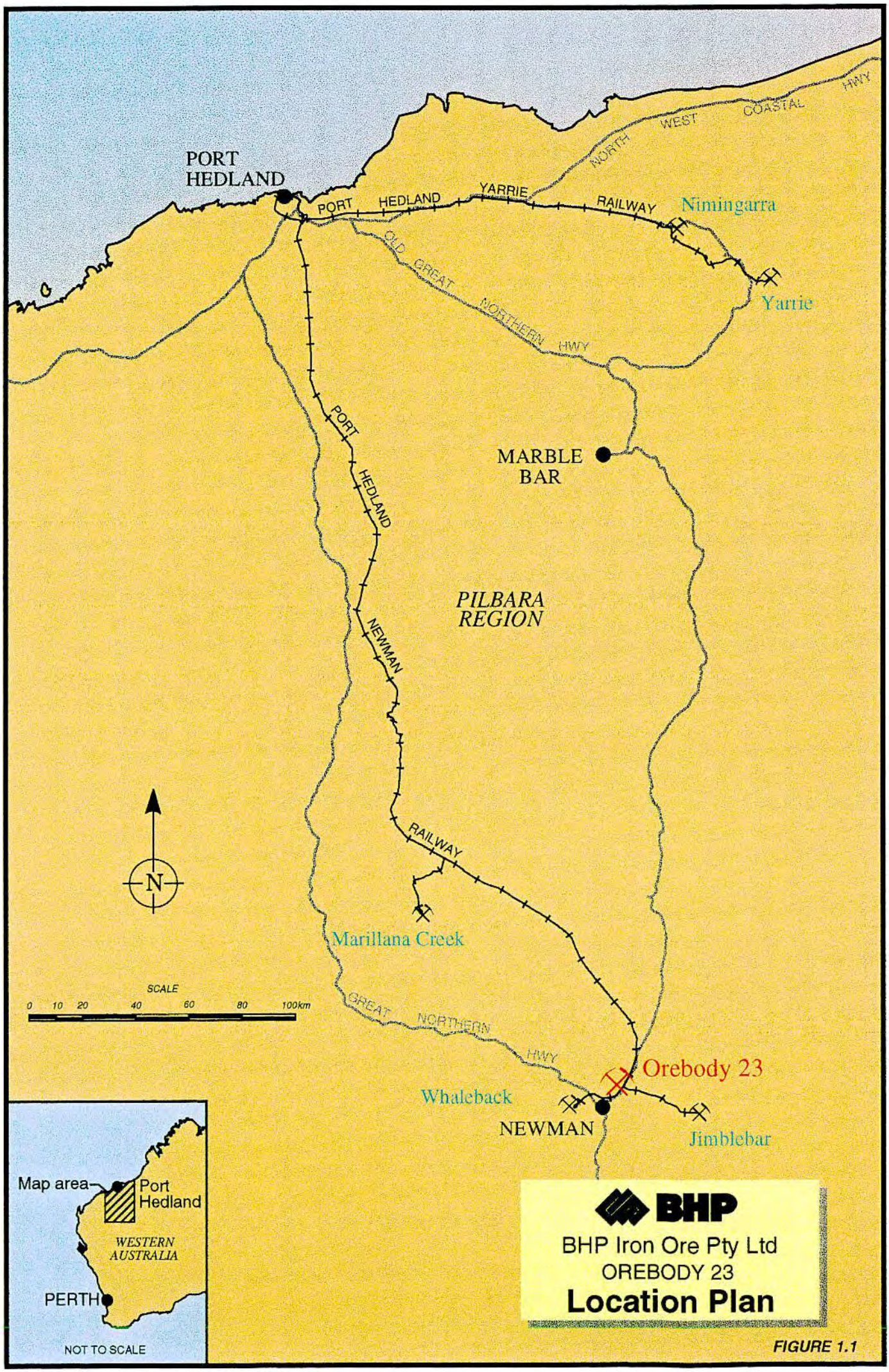

FIGURE 1.1

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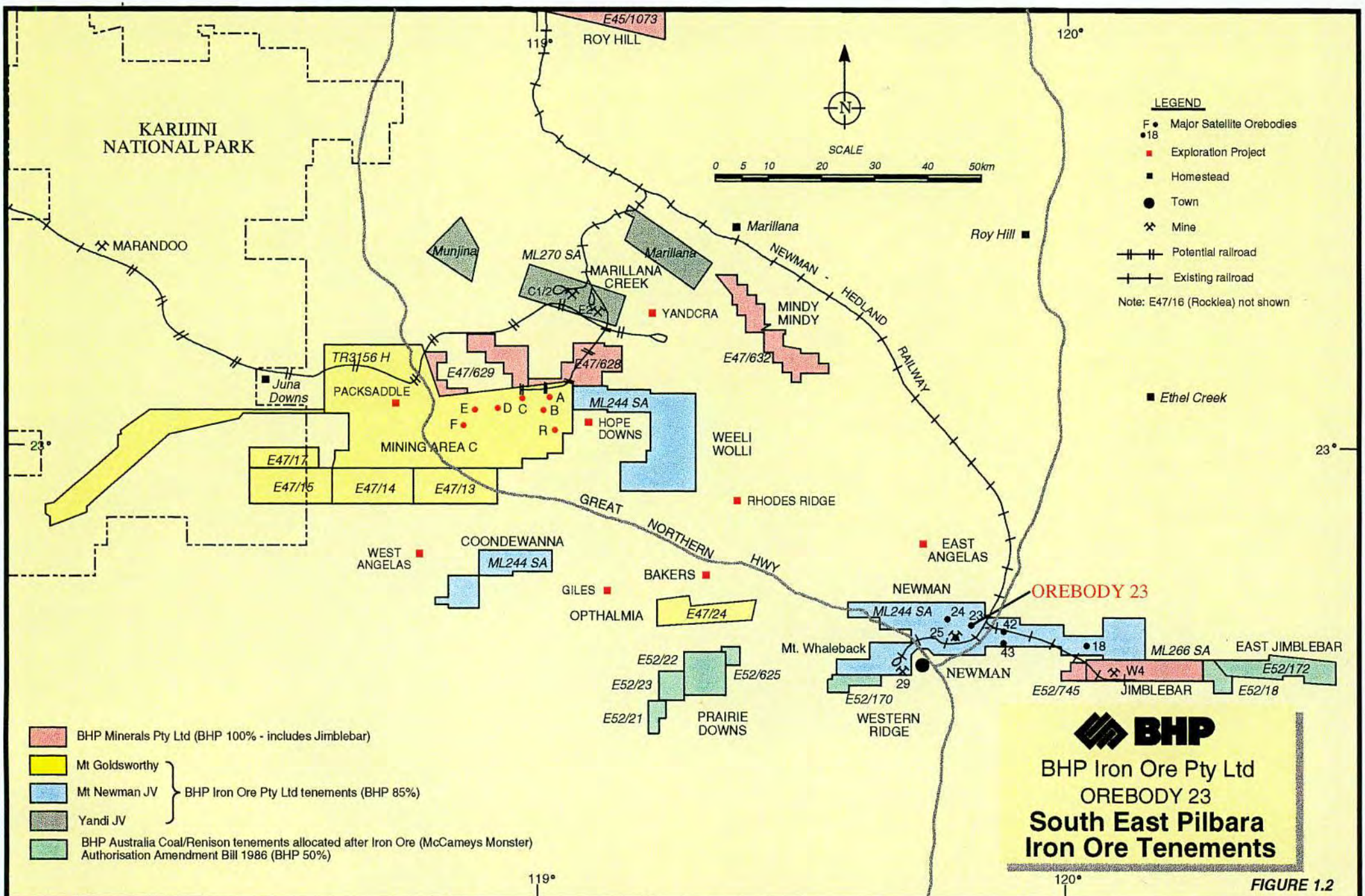

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TABLE 1-1

ENVIRONMENTAL LEGISLATION AND ITS APPLICATION

Act	Application	Responsible Department
Environmental Protection Act 1986	Works Approvals, Pollution Prevention Licences	Dept. Environmental Protection.
Wildlife Conservation Act 1950	Rare Flora and Fauna Protection	Dept. Conservation and Land Management.
Conservation and Land Management Act 1984	Management of Flora and Fauna and Reserves	Dept. Conservation and Land Management.
Rights in Water and Irrigation Act 1914	Water Use, Pollution of Water Resources	Water and Rivers Commission.
Water Authority Act 1984	Licensing of Groundwater Abstraction	Water and Rivers Commission.
Bush Fires Act 1954	Management of Fire Safety	Bush Fires Board.
Agriculture and Related Resources Protection Act 1976	Management of Weeds and Pests	Agriculture WA.
Soil and Land Conservation Act 1945	Controls Land Degradation and Clearing of Land	Agriculture WA.
Land Act 1933	Classification of Land Tenure	Dept. Land Administration.
Mines Safety and Inspection Act 1995	Occupational Health and Safety Issues	Dept Minerals and Energy.
Explosives and Dangerous Goods Act 1961	Specifies Storage, Handling and Blasting Requirements	Dept Minerals and Energy.
Aboriginal Heritage Act 1972-1980 (in particular Section 18)	Controls Aboriginal Sites, Particularly Disturbance	Dept. Aboriginal Affairs
Australian Heritage Commission Act 1975	Lists Areas of National Heritage Significance	Australian Heritage Commission.
Native Title Act 1993	Deals with Aboriginal Claims for Land Ownership	Dept. Premier and Cabinet.
Health Act 1911 - 1979	Sewage Disposal Facilities	Dept. Health.
Iron Ore (Mount Newman) Agreement Act 1964	Controls Mining Developments by the Joint Venturers	Dept. Resources Development.

1.5.2 Regional Benefits

Mineral and resource based industries provide valuable infrastructure and employment in the east Pilbara.

Mining is the major contributor to the Pilbara economy. In 1996, Western Australia exported 134 Mt of iron ore at an estimated value of over $2,924M of which over 90% came from the Pilbara region (Chamber of Minerals and Energy of Western Australia, 1997). Approximately half of this iron ore was produced from BHP Iron Ore mines at Mt Whaleback, Jimblebar, Goldsworthy and Marillana Creek in the Pilbara area.

BHP Iron Ore has demonstrated a strong commitment to regional conservation and land management through the implementation of research and management programmes, including the following:

- Western Pebble-mound Mouse research and management strategy at Jimblebar and Yarrie, in consultation with the Department of Conservation and Land Management (CALM).
- Survey work for the Priority 3 plant species *Ptilotus aphyllus*, in consultation with CALM.
- Rehabilitation of over 16,000 ha of degraded pastoral stations.
- Decommissioning and rehabilitation of the Goldsworthy, Shay Gap and Koolan Island iron ore operations, including their associated towns.
- Initiation of a Recreation Management Plan for the Weeli Wolli Springs area.
- Initiation of Marillana Creek hydrological and hydrogeological studies.
- Establishing and maintaining a herbarium of Pilbara plant species.

1.5.3 Alternative Ore Supplies

Various options for alternative iron ore supplies have been evaluated by BHP Iron Ore to supply both current and projected market demands. The options considered for this proposal were Orebody 24 and deposits at Jimblebar to the east of Newman.

Continuation of mining at Orebody 23 is the preferred immediate development option due to the quality and quantity of ore available. This option is further justified as the required infrastructure is already in place through current operations at Orebody 23 and Orebody 25.

In the longer-term it is anticipated that all the identified ore reserves will be developed. BHP Iron Ore is also planning to develop mining operations along the Northern Flank of Mining Area C to the north of Newman which is the subject of separate assessment as a Public Environmental Review.

1.6 PUBLIC CONSULTATION

Assessment of this proposal at the CER level is designed to provide information to the public and EPA about the environmental aspects of the proposal and their management. The CER is subject to a four week public review period during which interested people and organisations are encouraged to make submissions to the EPA regarding the proposal. This assists the EPA in assessing the proposal and providing advice to the Minister for the Environment. A guide to the preparation of submissions is included as a preface to this CER.

In addition to the requirement for the public review of the CER, BHP Iron Ore is undertaking a consultation programme to inform interested parties of the proposal and seek feedback from Government authorities and the community.

The programme includes discussing the proposal with the following:

- East Pilbara Shire;
- relevant government agencies
- Members of Parliament;
- Aboriginal people who speak for the area;
- local pastoralists;
- Chamber of Commerce in Newman;
- interested members of the public; and
- BHP Iron Ore employees.

2.1 INTRODUCTION

Mining of scree ore at Orebody 23 commenced in July 1992. This was followed by the mining of bedrock ore above the watertable commencing in 1993. This proposal is for the continuation of the current mining operation at Orebody 23 to below the watertable level. A general layout of the Orebody 23 operation and the Project Area are presented on Figure 2.1. A summary of the main elements of the proposed operation as described in the following sections is presented in Table 2-1.

TABLE 2-1

KEY PROPOSAL CHARACTERISTICS

Characteristics	Current Operation (to date)	Proposed Expansion[1]	Life of Mine
Project Life	5 years (intermittent)	4 years	9 years
Ore Reserves	3.4 Mt	12 Mt	15.4 Mt
Ore Mining Rate	0-2 Mtpa	2-4 Mtpa	N/A
Overburden	4.2 Mt	50 Mt	54.2 Mt
Average Stripping Rates	1.2:1	4.2:1	3.5:1
Pit Depth (below existing plain level)	3 m [2]	140 m	140 m
Pit Area	12 ha	20 ha	32 ha
Overburden Storage Area	25 ha [3]	80 ha	105 ha
Total Area Disturbed	37 ha	100 ha	137 ha
Water Abstraction	14,000 kL/day [4]	38,000 kL/day (maximum)	N/A
Area of Influence[5]	N/A	360 ha	0 ha
Ore Processing and Trainloading	Orebody 25 infrastructure	Orebody 25 infrastructure	Orebody 25 infrastructure
Workforce (shared with Orebody 25)	60	60	60

1 Figures are based on current mine design work to date. However, due to the nature of mining, they may change in the future.
2 Previous operations mined scree and bedrock from a hillside to approximately 3 m below the existing plain level.
3 Including low grade ore stockpile
4 Production bores between Ophthalmia Dam and Ethel Gorge for Whaleback operations.
5 Area within the 10 m drawdown contour.

2.2 MINING

To date, the total saleable ore recovered from Orebody 23 (scree and bedrock ore) is 3.4 Mt. The remaining mineable ore reserve of approximately 12 Mt occurs below the watertable. The strip ratio to recover this ore is 4.2:1 (overburden:ore). The ore will be mined over a four year period at a rate of between 2 and 4 Mt per year.

The mining of Orebody 23 will continue as a contract operation. Overburden and ore will be selectively mined by conventional open cut mining methods. Material will be drilled, blasted and loaded by hydraulic excavators and/or front end loaders into off-highway rear dump haul trucks for transport to the crusher located at Orebody 25 or hauled to adjacent overburden storage areas (Figure 2.1).

The height of the mining face has been designed at 6 m for drilling and blasting and will be excavated at either a 6 m height or in two 3 m passes. Blast hole drilling will produce a hole in the order of 150 mm diameter. Ammonium nitrate fuel oil (ANFO) and water proof emulsions will be employed as the blasting agents.

The major pieces of mining equipment currently used on-site by the contractor are:

- Excavators (backhoe configuration) — Cat 5130 (170 t); Liebherr 994 (190 t);
- Front end loaders — Cat 992; and
- Off highway trucks — Cat 777 (100 t).

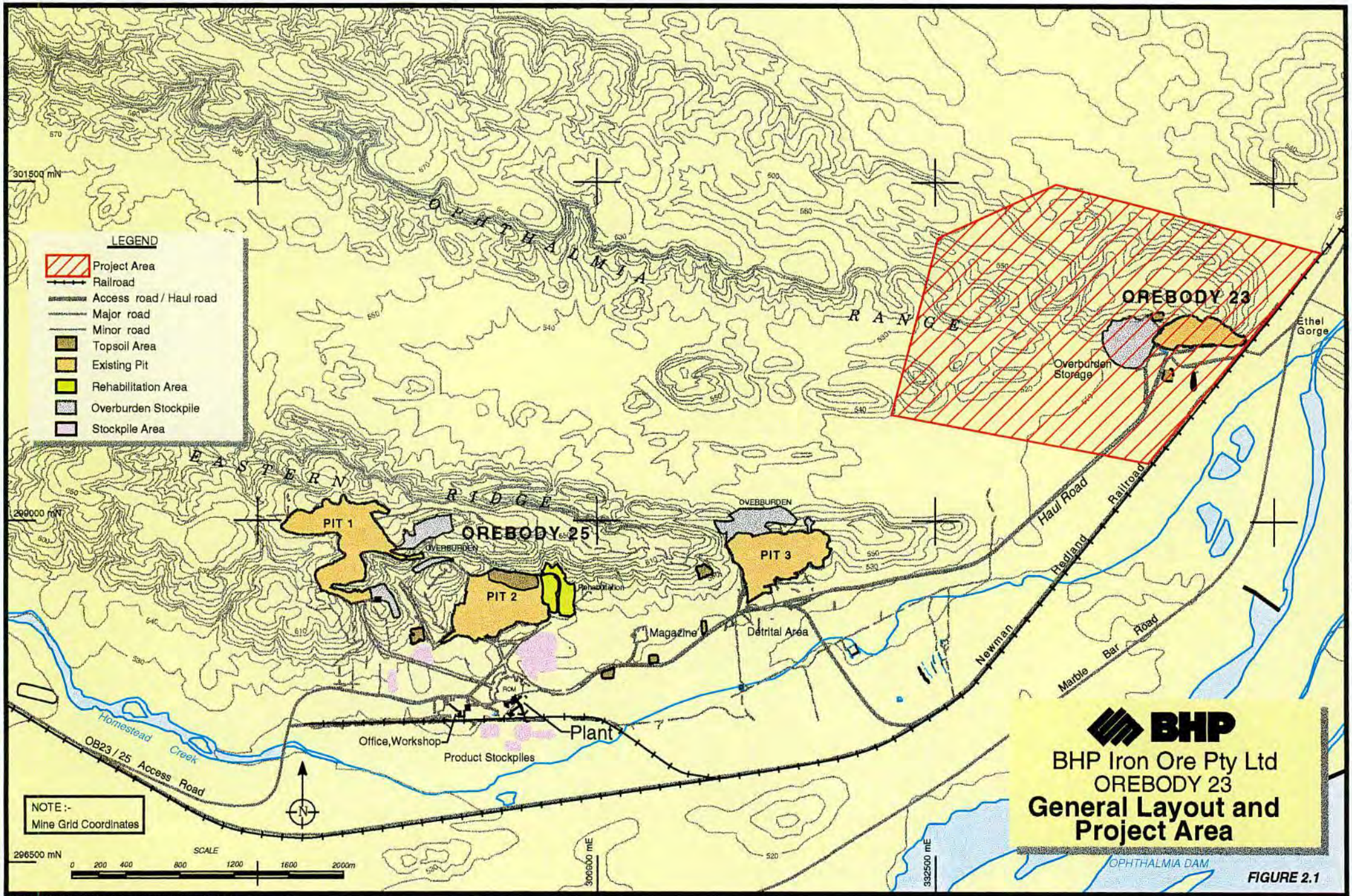
The choice of mining equipment rests with the mining contractor. If the contractor prefers to operate larger pieces of equipment, the face height may increase, depending on dilution considerations, to match the capabilities of the equipment employed.

The pit has been designed based on the following criteria:

- final wall bench height — 18 m;
- final wall bench angle — 65°;
- berm width — 12.4 m;
- overall slope angle — 40°;
- road width — 25 m; and
- road gradient — 1 in 10.

The proposed pit design is shown in Figure 2.2. The final surface area of the pit will be approximately 32 ha (the existing pit has a surface area of 12 ha). Mining will progress to a depth of 220 m below the highest point mined or 140 m below the existing plain level. The watertable level is nominally at 505 m RL or 3 m below plain level. The exposed surface area at the watertable level of the ultimate pit will be 24 ha. Minor modifications may be made to this design as more detailed information regarding the nature of the orebody is obtained.

The mining schedule commences on the upper benches and due to the small nature of the pit only two benches will be extracted together on the upper levels. As mining progresses to the lower levels, each individual bench will be fully extracted at a time before progression to the next bench below.



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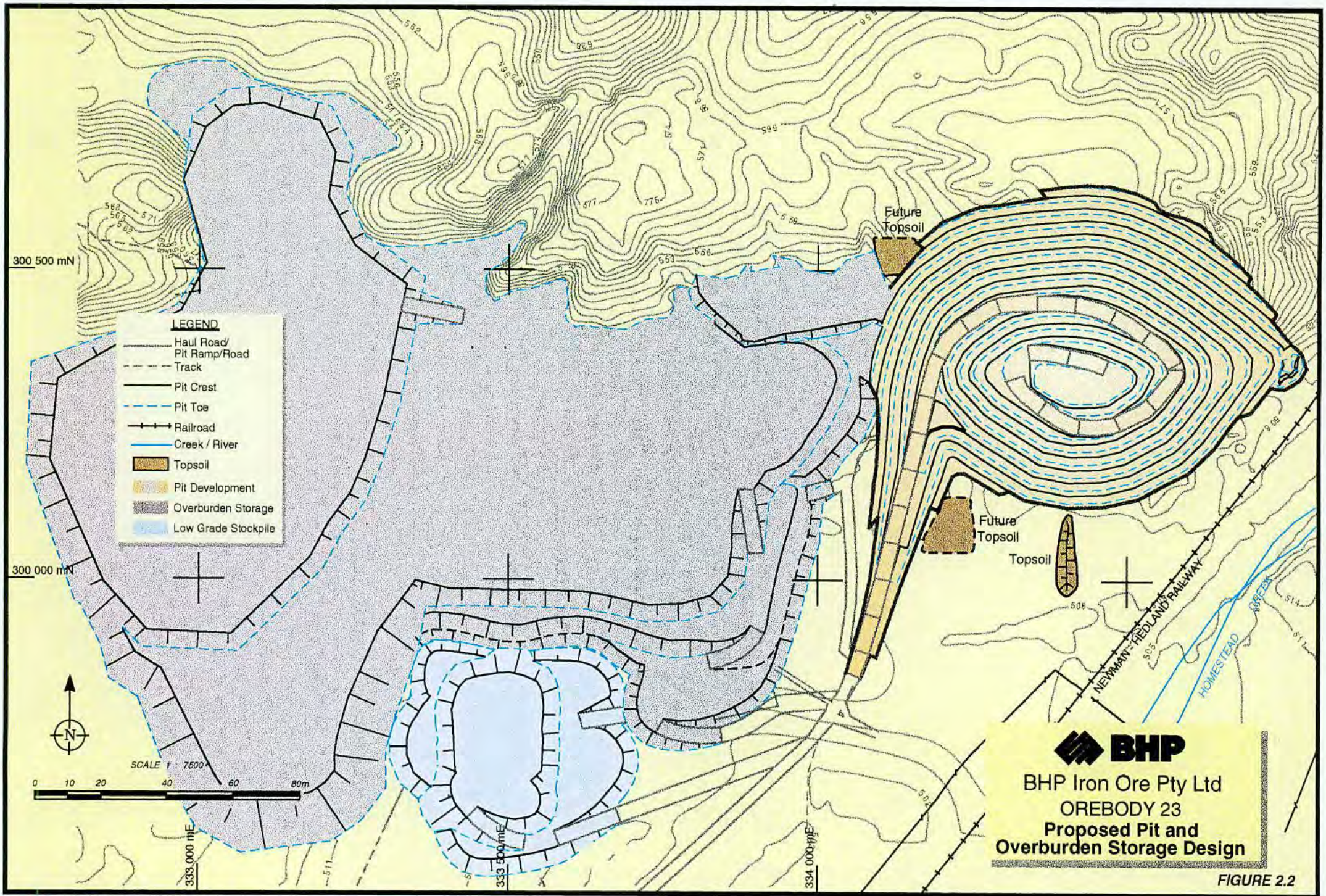
300 500 mN
300 000 mN
LEGEND
Haul Road/ Pit Ramp/Road
Track
Pit Crest
Pit Toe
Railroad
Creek / River
Topsoil
Pit Development
Overburden Storage
Low Grade Stockpile
Future Topsoil
Future Topsoil
Topsoil
NEWMAN - HEDLAND RAILWAY
HOMESTEAD CREEK
N
SCALE 1 : 7500
0 10 20 40 60 80m
333 000 mE
333 500 mE
334 000 mE
BHP
BHP Iron Ore Pty Ltd
OREBODY 23
Proposed Pit and Overburden Storage Design
FIGURE 2.2
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2.3 MINE DEWATERING

Orebody 23 lies in the Fortescue River aquifer at the junction of Homestead Creek and the Fortescue River at Ethel Gorge (Figure 2.3). On average, 14,000 kL/day of raw water is currently abstracted from production bores between Ophthalmia Dam and Ethel Gorge for the Whaleback operations and Newman town water supply.

Current mining at Orebody 23 has not extended below the existing watertable level. However, the remaining ore reserve lies below the 505 m RL watertable level and dewatering will be necessary for its recovery.

Dewatering bores will be positioned outside of the final pit limits to depress the watertable level to maintain relatively dry conditions for mining. Pumping will commence ahead of mining and the water will be used as part of the existing BHP Whaleback mine raw water supply system by connecting the dewatering pumps to the supply pipeline.

It is estimated that the dewatering of Orebody 23 will result in the abstraction of up to 38,000 kL/day. Dewatering production will therefore exceed the daily water requirements for the Whaleback operation (@14,000 kL/day) by up to 24,000 kL/day.

Some of this water, approximately 1,000 kL/day, will be used for dust suppression at Orebodies 23 and 25. A further proportion of the excess water may be pumped back into the Fortescue River valley (estimated in the order of 3,000 kL/day) to irrigate vegetation that might be at threat from lowered watertable levels as a result of dewatering. The remainder of the excess water will be distributed between:

- discharge to the Ophthalmia Dam (approximately 14,000-19,000 kL/day); and
- infiltration through the Fortescue River channel downstream of the mining areas to maintain groundwater throughflow (approximately 1,000 kL/day).

A detailed description for the management of excess water and a water balance are presented in Section 3.6.3.

At the completion of mining, water abstraction from the area will be reduced to match the requirements of the Whaleback operation. This water will be sourced from a combination of some of the original water bores and some of the newly established dewatering bores.

2.4 OVERBURDEN REMOVAL

Approximately 50 Mt of overburden is required to be moved for the recovery of high grade iron ore below the watertable. This material will be stored in designated areas to the west of the pit (Figure 2.2).

The height of the overburden storage area will not exceed 70 m which is compatible with the surrounding ridges. The final storage area will cover a total footprint area of approximately 105 ha. This figure includes the footprint of the existing overburden storage area of 14 ha and 11 ha of low grade ore stockpiles.

Rehabilitation of available areas will be progressively undertaken during the mining phase. At the completion of mining, all remaining surfaces will be rehabilitated.

A small quantity of pyritic black shale (1.5-2 Mt) is required to be removed for ore recovery. The potentially reactive shale will be encountered after the removal of approximately 24 Mt of material comprising roughly 3 Mt of ore, 5 Mt of low grade ore and 16 Mt of overburden.

The shale will be selectively removed concurrent with the remaining 20 Mt of overburden to allow the recovery of the 7.5 Mt of ore in the lower benches of the pit. This shale will be encapsulated in dedicated cells within the overburden storage area as discussed in Section 3.4.4.

To recover the high grade ore at depth, the Orebody 23 pit will be deep, near vertical and cover a relatively small area. Therefore, there is no opportunity to directly infill overburden from the operation into mined out areas of the pit during ore extraction.

2.5 ORE PROCESSING

Ore from Orebody 23 will continue to be hauled by off-highway trucks approximately 6 km to the existing Orebody 25 crusher location which is adjacent to the rail siding (Figure 2.4).

The high grade ore will be directly tipped into run-of-mine stockpiles which are then loader fed to the primary crusher. Primary and secondary crushing and screening then takes place to produce a nominal -100 mm size product.

An option exists within the plant whereby the crushed material can be separated into a -100 + 6 mm coarse product and a -6 mm fines product.

No additional ore handling infrastructure is required under this proposal.

2.6 RAIL TRANSPORTATION

The Project area is serviced by a railway spur line leading from the main Newman to Hedland line. No additional trackwork will be required.

The crushed ore is placed in stockpiles adjacent to the Orebody 25 spur line and loaded into wagons by front-end loaders. The ore is then railed to Port Hedland for further treatment and blending before shiploading.

No additional port infrastructure is required under this proposal.

2.7 WORKFORCE

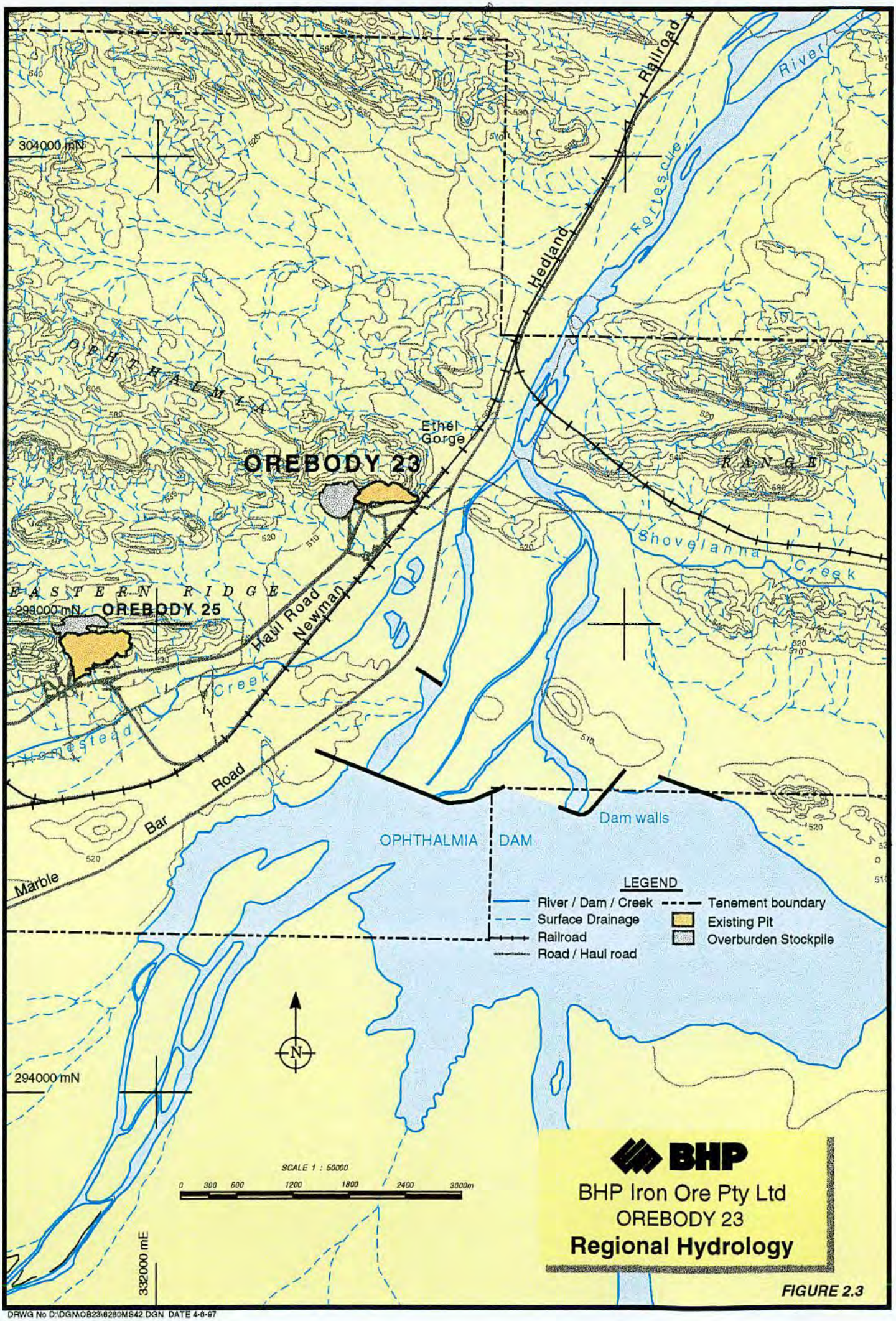
A single contractor is employed to recover, process and train load ore simultaneously from both Orebody 23 and Orebody 25. The contractor employs a workforce of 60 people who operate on 2 shifts/day nominally 6 days/week. This system will remain unchanged.

The contract workforce will continue to be housed in the town of Newman and commute to the minesite via a bitumen and well maintained unsealed road.

2.8 SUPPORT FACILITIES

Existing support facilities for the Orebody 23 operation are located at Orebody 25 and comprise:

- mine offices;
- workshop;
- fuelling facilities;
- power generating facilities;


304000 mN
294000 mN
332000 mE
Railroad
River
Hedland
Fortescue
OPHTHALMIA
RANGE
Ethel Gorge
OREBODY 23
EASTERN RIDGE
OREBODY 25
299000 mN
Haul Road
Newman
Shovelanna Creek
Homestead Creek
Bar
Road
Marble
Dam walls
OPHTHALMIA DAM
LEGEND
River / Dam / Creek
Surface Drainage
Railroad
Road / Haul road
Tenement boundary
Existing Pit
Overburden Stockpile
N
SCALE 1 : 50000
0 300 600 1200 1800 2400 3000m
BHP
BHP Iron Ore Pty Ltd
OREBODY 23
Regional Hydrology
FIGURE 2.3
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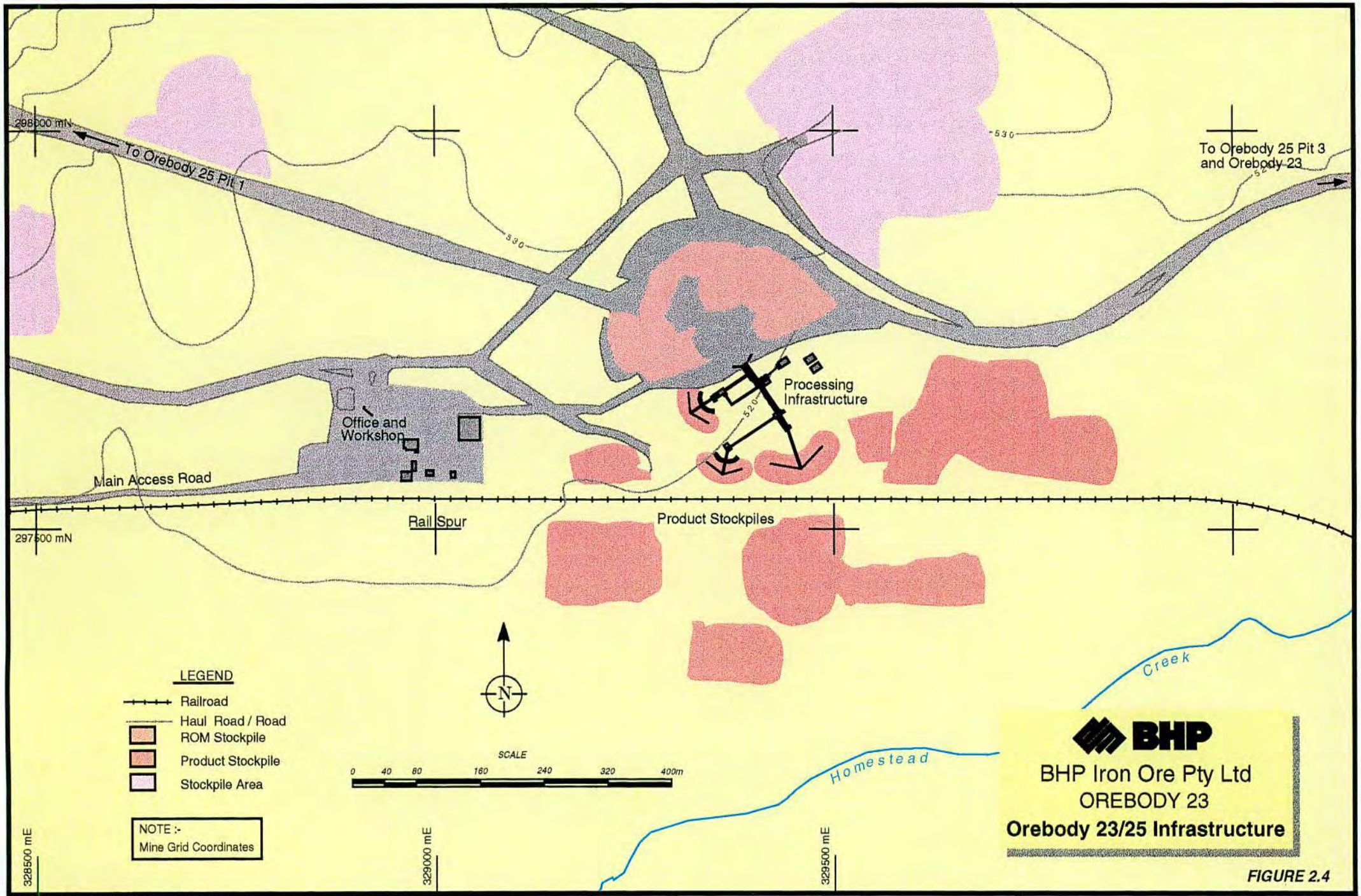
298000 mN
To Orebody 25 Pit 1
To Orebody 25 Pit 3
and Orebody 23
530
520
Processing
Infrastructure
Office and
Workshop
Main Access Road
297500 mN
Rail Spur
Product Stockpiles
Creek
Homestead
LEGEND
Railroad
Haul Road / Road
ROM Stockpile
Product Stockpile
Stockpile Area
N
SCALE
0 40 80 160 240 320 400m
NOTE :-
Mine Grid Coordinates
328500 mE
329000 mE
329500 mE
BHP
BHP Iron Ore Pty Ltd
OREBODY 23
Orebody 23/25 Infrastructure
FIGURE 2.4
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- water facilities; and
- explosive store.

No additional infrastructure is required.

Fuel for the operation is delivered to the site by the local distributor and stored in bulk fuel tanks in accordance with statutory regulations.

Power for the site is currently diesel generated. Plans are in place to supply electricity to the site via an overhead line from the Newman power station.

Water for the operation (dust suppression) will be obtained from the dewatering bores at Orebody 23. No additional water requirements are expected.

The current system of waste disposal from site will remain in place. Sewage is discharged to a septic tank and, once full, is pumped out and transported to the treatment facility at Newman. Wherever practical, solid wastes are recycled. Oil wastes are collected by a registered agent for recycling. All other rubbish is collected in 'marryl pans' and disposed of at the Newman rubbish tip. No other waste material disposal occurs on site.

An explosives storage facility has been erected on-site to supply the current mining operation. This facility is in an area remote from other infrastructure and is constructed in accordance with Explosives and Dangerous Goods Regulations. No additions to this facility will be required.

3.1 INTRODUCTION

This section presents a description of the regional and local environmental characteristics of the Project area. Potential impacts of the proposed extension to mining at Orebody 23 and the management approaches to be adopted to minimise these impacts are also described.

A summary of the potential impacts associated with both current and proposed mining at Orebody 23, including predicted changes resulting from mining below the watertable and the management approaches adopted, are presented in the Executive Summary as Table ES-1.

3.2 CLIMATE

The Newman area is located within the subtropical summer rainfall zone. The general seasonal characteristics of this zone are hot summers with periodic heavy rains and mild winters with occasional rainfalls. There are four specific weather phenomena which are of greatest importance to the region. These are:

i) summer monsoon which brings most of the annual rainfall;

ii) tropical cyclones which are also associated with damaging winds and flooding;

iii) strong easterly winds in winter caused by the development or intensification of anti-cyclones over southern Western Australia or South Australia; and

iv) major cloud bands that develop in winter and extend from the north-west coast across the continent bringing significant rain to the north west and the interior of the country.

A weather station is not located at Orebody 23 but meteorological data has been recorded since 1965 at Newman Post Office. The mine site is located 13 km to the north-east of Newman and these records will give a good indication of the variation and range of climatic conditions that may be experienced at the site.

Data are compiled on the mean 9 am and 3 pm temperatures and mean relative humidity (22 years of record), mean daily maxima and minima, mean and median rainfall and mean number of raindays. No pan evaporation data is collected at the Newman meteorological station.

A summary of climatic data from the Newman meteorological station is given in Table 3-1. These values are based on up to 30 years of records from the Australian Bureau of Meteorology (1997).

3.2.1 Temperature

The Pilbara region has an extreme temperature range, from 46°C during the summer to a low of minus 2.6°C in winter. Light frosts are occasionally experienced during June through to August. The high temperatures and humidity seldom occur together giving the Pilbara its very dry climate.

The expected mean annual maximum and minimum temperatures for Orebody 23 are 31.4°C and 17.3°C, respectively. Mean monthly maximum temperatures range from 38.9°C in January to 22.3°C in July, while mean monthly minimum temperatures range from 25.3°C in January to 7.9°C in July. The annual mean daily maxima is 31.4°C, while the average minimum is 17.3°C.

TABLE 3-1

SUMMARY OF CLIMATIC DATA FOR NEWMAN

Month	Temperature (°C)		Humidity (%)		Rainfall (mm)		Evaporation (mm)[1]
	Mean Daily Max	Mean Daily Min	9 am Mean	3 pm Mean	Mean	Mean No. Raindays	Mean
January	38.9	25.3	34	22	49	7	11.8
February	37.2	24.4	39	24	71	7	10.2
March	35.8	22.4	35	22	41	5	9.5
April	31.7	18.5	39	25	24	4	7.9
May	26.1	13.1	48	30	23	4	5.8
June	22.4	9.4	54	33	26	4	4.8
July	22.3	7.9	48	28	11	2	5.2
August	24.7	10.1	41	23	11	2	6.3
September	29.3	13.7	29	16	4	1	8.7
October	33.6	17.9	23	13	4	1	11.0
November	36.5	21.3	23	14	11	3	12.5
December	38.4	24.0	28	17	27	5	12.4
ANNUAL MEAN	**31.4**	**17.3**	**36.8**	**22.1**	**25**	**45**	**8.8**

Note: 1. Wittenoom.
Source: Australian Bureau of Meteorology, 1997 (Newman Post Office).

3.2.2 Rainfall and Evaporation

The southern Pilbara has a highly variable rainfall. Rainfall has a bimodal distribution, with two rainfall maxima per year. Sporadic and drenching thunderstorms may occur from January through to March as a result of moist tropical storms penetrating from the north. Tropical cyclones from northern Australian waters also bring sporadic heavy rains. Extensive cold fronts move in an easterly direction across the State and sometimes reach the Pilbara between May and June producing light winter rains (*ecologia* Environmental Consultants, 1995).

Newman's average annual rainfall is 300 mm, occurring over 45 raindays, on average (Table 3-1).

Rainfall at Newman follows the typical Pilbara pattern with most rainfall occurring during the summer period from January to March, with a smaller peak between April and June.

No evaporation figures are available for Newman, but Wittenoom experiences its highest evaporation from September through to March and can exceed rainfall by as much as 2,500 mm per year (Australian Bureau of Meteorology, 1997).

3.2.3 Wind

Wind data collected from Bureau of Meteorology weather stations indicate the dominant winds in the Pilbara region are of an easterly pattern throughout the year.

Newman is dominated by easterly winds with a north easterly/south easterly component. Winds speeds can often exceed 40 km/hr throughout the year with the strongest winds generally from the east.

3.3 TOPOGRAPHY

3.3.1 Existing Topography

Orebody 23 is located on the southern side of the Ophthalmia Range approximately 13 km north-east of Newman. This area is adjacent to where the Fortescue River cuts the Range at Ethel Gorge.

Three main landform units have been identified in the Project area. These are based on the landform-vegetation classification system developed by Dawe and Dunlop (1983).

- Ridges and Hills - high ridges and hills rising above the surrounding plains. The surface is largely covered with skeletal soils with areas of exposed rock.
- Scree Slopes - gravely loams with pockets of skeletal soil and stones on slopes of 12° - 15°, elevation to 40 m and undulating.
- Outwash Plains - flat plains of deep loams or clayey soils with associated drainage lines.

3.3.2 Potential Impacts

Temporary and permanent changes to the topography resulting from the Project will be caused by:

- temporary changes:
  - access and haul roads;
  - ore stockpiles; and
  - mine site buildings.
- permanent changes:
  - the mine pit; and
  - overburden storage areas.

Substantial change to the landform has previously occurred at Orebody 23. Scree ore from the surface has been recovered and mining of the bedrock ore to the watertable level has created an existing pit with an area of 12 ha. The final surface of the proposed pit will be approximately 32 ha including the existing pit.

Overburden, removed for the recovery of bedrock ore, has been stored in an area to the west of the pit and currently covers an area of 14 ha. An additional 11 ha is covered by low grade ore stockpiles. The final overburden storage area is proposed to cover a total footprint area of approximately 105 ha.

3.3.3 Management

BHP Iron Ore has a policy of minimum disturbance and this practice will be applied with respect to the expansion of mining at Orebody 23.

Measures to be undertaken to mitigate the effects of unavoidable disturbance will include:

- the recovery and storage of topsoil in disturbed areas to be used in rehabilitation;
- the positioning of the overburden storage area to blend with the surrounding landforms;
- the battering of exposed faces on the overburden storage area to an angle of 20° or less, application of water harvesting techniques and revegetation;
- the progressive rehabilitation of disturbed areas (with exception of the mined pit) throughout the Project's life;
- the progressive rehabilitation of completed pit berms protruding above the plain level by ripping and seeding with native species to improve visual effects;
- the removal of infrastructure no longer required; and
- the completion of rehabilitation at the conclusion of mining.

3.4 GEOLOGY AND SOILS

3.4.1 Geology

Regional Geology

The Pilbara Region comprises a large part of the ancient continental shield of Western Australia. The underlying Archaean rocks of the shield constitute the Pilbara Block, the southern portion of which is occupied by the Hamersley Basin. Iron ores are contained in the rocks originally deposited as sediments in this Basin. The Hamersley Basin can be divided into three stratigraphic groups: the Fortescue; Hamersley; and Turee Creek Groups.

The Hamersley Group is seen throughout the Hamersley Basin and is the most relevant to this proposal. It is a sequence of sedimentary rocks including iron formations interbedded with minor felsic volcanic rocks and intruded doleritic dykes and sills. The group is generally 2.5 km thick and contains both the Brockman (approximately 600 m thick) and Marra Mamba (approximately 230 m thick) Iron Formations. Together, these formations provide most of the known major iron ore deposits in the Pilbara Region (O'Brien and Associates Pty Ltd, 1993).

Deposit Geology

The iron ore deposit at Orebody 23 is derived from the Brockman Iron Formation. This is economically the most important iron formation in the Hamersley Group occurring widely throughout the iron ore province. It bears the highest grade iron ore containing low levels of phosphorus and aluminium. The formation is composed of a banded iron formation (BIF) with chert and minor shale bands and forms prominent strike ridges rising 200 m - 400 m above the surrounding countryside.

The resource at Orebody 23 is located within the Dales Gorge Member of the Brockman Iron Formation. The Dales Gorge Member comprises an alternating sequence of BIF and shale 'macrobands' (Geological Survey, 1991). Macrobands are the alteration between two different lithologies (Geological Survey, 1970). A typical geological cross section together with the proposed pit outline is shown in Figure 3-1.

The Dales Gorge Member is flanked to the south (and stratigraphically underlain) by the Mt McRae Shale and Mt Sylvia Formations and to the north (and stratigraphically overlain by the Whaleback Shale and Joffre Member of the Brockman Iron Formation and the Welli Wolli Formation.

3.4.2 Soils

Soils of the Pilbara region have been defined and mapped at a scale of 1:2,000,000 by Bettenay et. al. (1967). The dominant soil types covering the Project area are shallow, coherent and porous loamy soils with weak pedologic development.

These soils are associated with the Ophthalmia and Hamersley Ranges. They are mainly stony, earthy, shallow loams, however there are wide areas without soil cover. Much of the soil on the hills has been transported down to the valleys and plains (*ecologia* Environmental Consultants, 1995). Therefore, the vegetation of the hills and slopes tends to be correlated to geology rather than to soil type (Beard, 1975).

3.4.3 Potential Impacts

Pyritic Shale

Geological drilling and modelling has indicated that pyritic black shale is present in a portion of the pit area and a small quantity (1.5-2.0 Mt) will be mined in the latter years of mining to enable the recovery of the high grade iron ore reserve. This material has the potential to create acid upon exposure to air, water and bacteria over a period of time.

3.4.4 Management

Management strategies for pyritic shale material to be implemented during mining will aim to minimise the exposure of the material to rapid oxidation and surface water.

Out of Pit Handling of Pyritic Shale

BHP Iron Ore has had experience in handling potentially reactive material at other mines in the Newman area. This experience indicates that the best method of preventing the acid generating process from occurring is to encapsulate potentially acid producing material within non-reactive overburden material. A 1 m cover of overburden has been found to be sufficient to prevent the infiltration of water into the storage areas and that water trapped in this layer is subsequently released through evaporation.

The steps outlined below and illustrated on Figure 3-2 will be implemented to manage potentially reactive shales encountered during mining.

- Construction of a pad of non-reactive material within the overburden storage area to ensure the material is stored above the ground watertable.
- The creation of cells within the storage area with non-reactive overburden material.
- The selective removal of potentially reactive shale during the mining operation.
- Placement of potentially reactive material in layers within the cells, as it is mined, followed by regular covering with at least 200 mm of overburden to reduce the period of exposure.
- Capping the pyritic shale with at least 2 m of non-reactive material at the completion of mining.

Pyritic Shale Exposed in the Pit Wall

Not all pyritic material encountered in the pit will be removed as overburden. An area of approximately 35,000 m^2 will be exposed on the pit wall. Management of this area will aim at minimising exposure to air. The horizontal faces will be sheeted with impervious material such as finely screened clays and sands rejected from processing scree ores.

Vertical faces will also be sealed to prevent exposure to air. This will also prevent exposed material coming in contact with storm runoff resulting in acid generation. Methods of sealing the face being considered include the use of geomembrane, shotcrete or other sprayed concrete product or an epoxy coating. The exact method which will be used is unknown at this time, however, the technical and cost effectiveness of several alternatives are being considered.

Commitment 1: Pyritic Shales

BHP Iron Ore will ensure that potentially reactive pyritic shales are managed within the overburden storage areas to prevent acid generating processes occurring. Pyritic materials exposed in the pit walls will be sealed to prevent exposure to air.

3.5 SURFACE WATER

3.5.1 Existing Conditions

All creeks in the area are intermittent and flow only after major rainfall. The main Fortescue River course flows south to north through Ethel Gorge. Ophthalmia Dam impounds the Fortescue River upstream of Ethel Gorge. Surface flow in the Fortescue River, therefore, results from releases, infiltration or overflow from the dam and runoff generated downstream of the dam catchment.

Homestead Creek flows from the west, within 140 m of the proposed expanded pit, and joins with the Fortescue River adjacent to Orebody 23 before it flows through Ethel Gorge (Figure 2.3). Shovelanna Creek joins the Fortescue River slightly downstream (north) of Orebody 23.

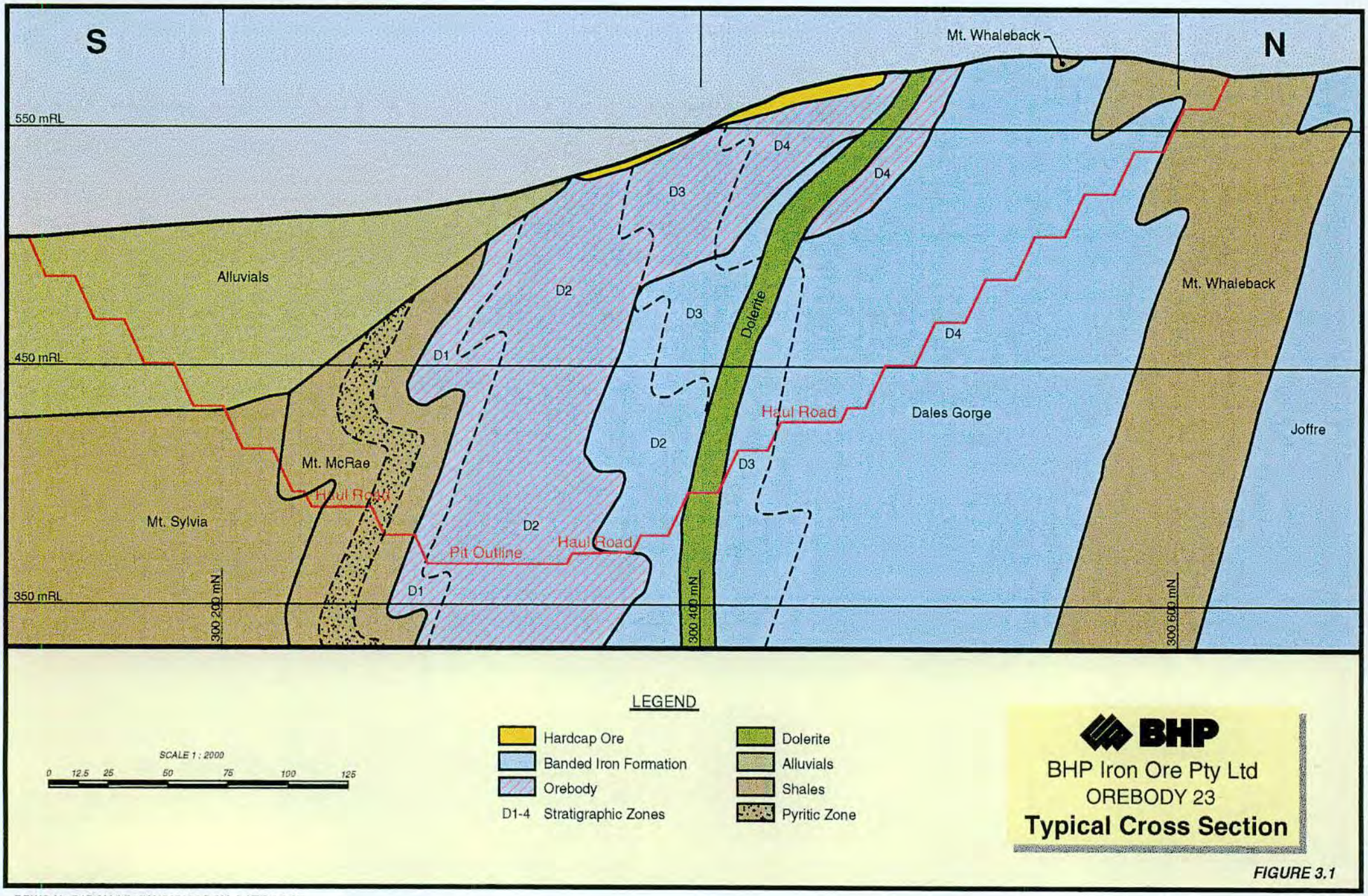

FIGURE 3.1

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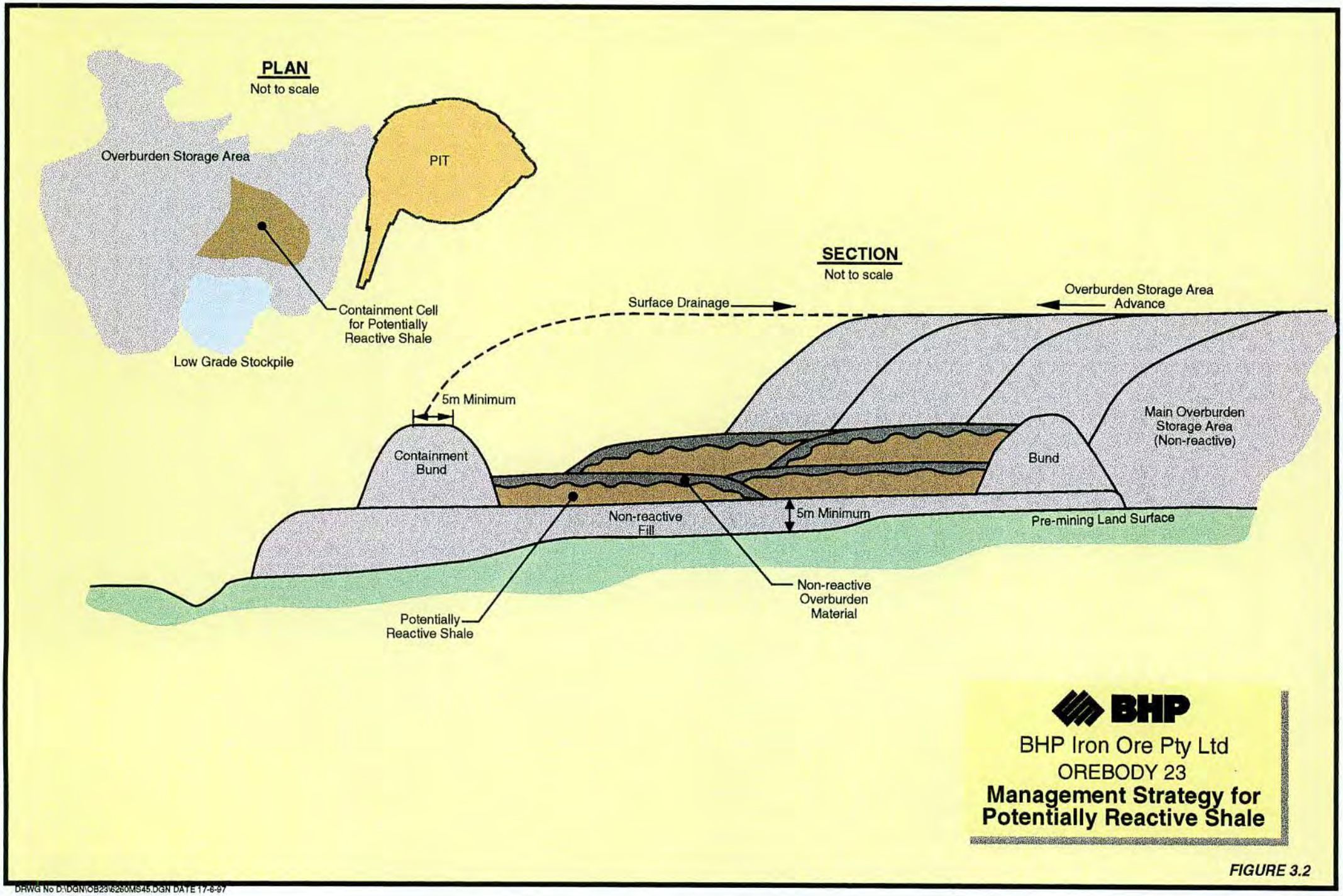

BHP

BHP Iron Ore Pty Ltd

OREBODY 23

Management Strategy for Potentially Reactive Shale

FIGURE 3.2

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3.5.2 Potential Impacts

The Orebody 23 mine expansion will have a limited impact on the surface water resources in the area. However, the pit and overburden storage areas will intercept some minor surface flows in the immediate mine area.

3.5.3 Management

BHP Iron Ore will design, install and maintain silt traps, as required, on larger watercourses downstream of disturbed areas and stockpiles. Any water released from the site will meet Pollution Prevention Licence conditions.

3.6 GROUNDWATER

3.6.1 Existing Conditions

Investigations and Existing Data

The Ethel Gorge - Newman area has been the subject of numerous groundwater investigations associated with the feasibility, design, operation and potential impacts of Ophthalmia Dam and the Newman Water Supply Scheme.

Further understanding of the hydrogeology of the area has been obtained from recent investigations specifically in the Orebody 23 area. These included the drilling, construction and testing of seven production bores and numerous monitor bores around the Orebody 23 pit area and the development, calibration and running of a groundwater flow model of the area. Comprehensive modelling for proposed mine dewatering has also contributed to the understanding of the hydrological system.

Hydrogeological System

The Fortescue River and its main tributaries (Homestead, Shovelanna, Whaleback and Warrawanda Creeks) join prior to cutting through the Ophthalmia Range in the 400 m wide Ethel Gorge. The alluvial filled palaeovalleys of these creek systems form the regional groundwater drainage system. Groundwater flow is to the north through Ethel Gorge and, ultimately, to the Fortescue Marshes.

The palaeovalleys have been variously eroded into basement rocks of the Wittenoom, Mt Sylvia, Mt McRae Shale and Brockman Iron Formations. The alluvial infill is up to 90 m deep.

Permanent aquifers are found in shallow alluvial calcretes and deeper sand and gravel deposits. These aquifers are typically separated by a sequence of clays which act as a confining layer for the lower aquifer unit. Local, perched aquifers may develop for short periods when the deposits of the active creek beds are saturated during river flow events.

Recharge to the alluvial system occurs both naturally through direct rainfall infiltration and river flow and artificially via recharge ponds that are fed from Ophthalmia Dam, some 3 km upstream of Ethel Gorge.

Some of the basement rock formations also form good aquifers due to the mineralisation and structurally induced development of secondary permeability. Notable, basement rock aquifers in the region include the mineralised Dales Gorge (and sometimes Joffre) member of the Brockman Iron Formation, the Newman Member of the Marra Mamba Formation and dolomites of the Wittenoom Formation.

The host formation for Orebody 23 is the mineralised Dales Gorge Member of the Brockman Iron Formation. Previous investigations identify this as a major aquifer at this location.

Groundwater Availability

Groundwater supplies for the Newman area are currently abstracted from wellfields at Homestead Creek and Ethel Gorge. Potable water for the Newman townsite is supplied from the Homestead Creek borefield approximately 7 km upstream of Orebody 23. Approximately 14,000 kL/ day is abstracted from the Ethel Gorge wellfield to supply raw water for Mt Whaleback mine. This wellfield abstracts groundwater from the entire alluvial sequence. It has been estimated that the aquifer storage is mainly replenished through seepage from Ophthalmia Dam in the order of 24,000 kL/day. It is also estimated that approximately 10,000 kL/day is lost through evapo-transporation (AGC Woodward-Clyde, 1997).

Several estimates of groundwater throughflow in Ethel Gorge to the north have been made (Geological Survey of Western Australia, 1972; Australian Groundwater Consultants - now AGC Woodward-Clyde - 1980 and Tahal, 1981). For natural conditions (i.e. pre-mine, pre-wellfield development), outflow is likely to have been in the order of 1,000 - 2,000 kL/day. However, due to the effects of abstraction from the Ethel Gorge and Homestead Creek wellfields, current outflow from the northern end of Ethel Gorge is likely to be in the order of 500-700 kL/day.

Hydrogeology of Orebody 23

Aquifer parameters for the orebody itself have been estimated from the trial dewatering exercise. Transmissivity is in the order of 400-500 m^2/d and specific yield is about 5%.

To the north and west, the orebody is in contact with other low permeability basement formations. To the south, the upper part of the orebody is in contact (between RL 460 and RL 505 - watertable) with highly permeable detrital scree. This lenses into the main alluvial sequence, resulting in hydraulic contact between aquifers. At depth, the orebody is in contact with the low permeability basement units. To the east, the orebody is overlain entirely by alluvium.

To the east and south the pit intersects substantial thicknesses of alluvium (Figure 3.1).

Hydrochemistry of Orebody 23 Aquifer

A number of water samples were taken from piezometers intersecting the orebody and the palaeovalley aquifers. The analyses of the samples are presented in Table 3-2 and the location of water quality monitoring bores on Figure 3.3.

The ranges in salinity, pH and major ions in the analyses presented are well within the ranges commonly found within palaeovalley aquifers throughout the Pilbara.

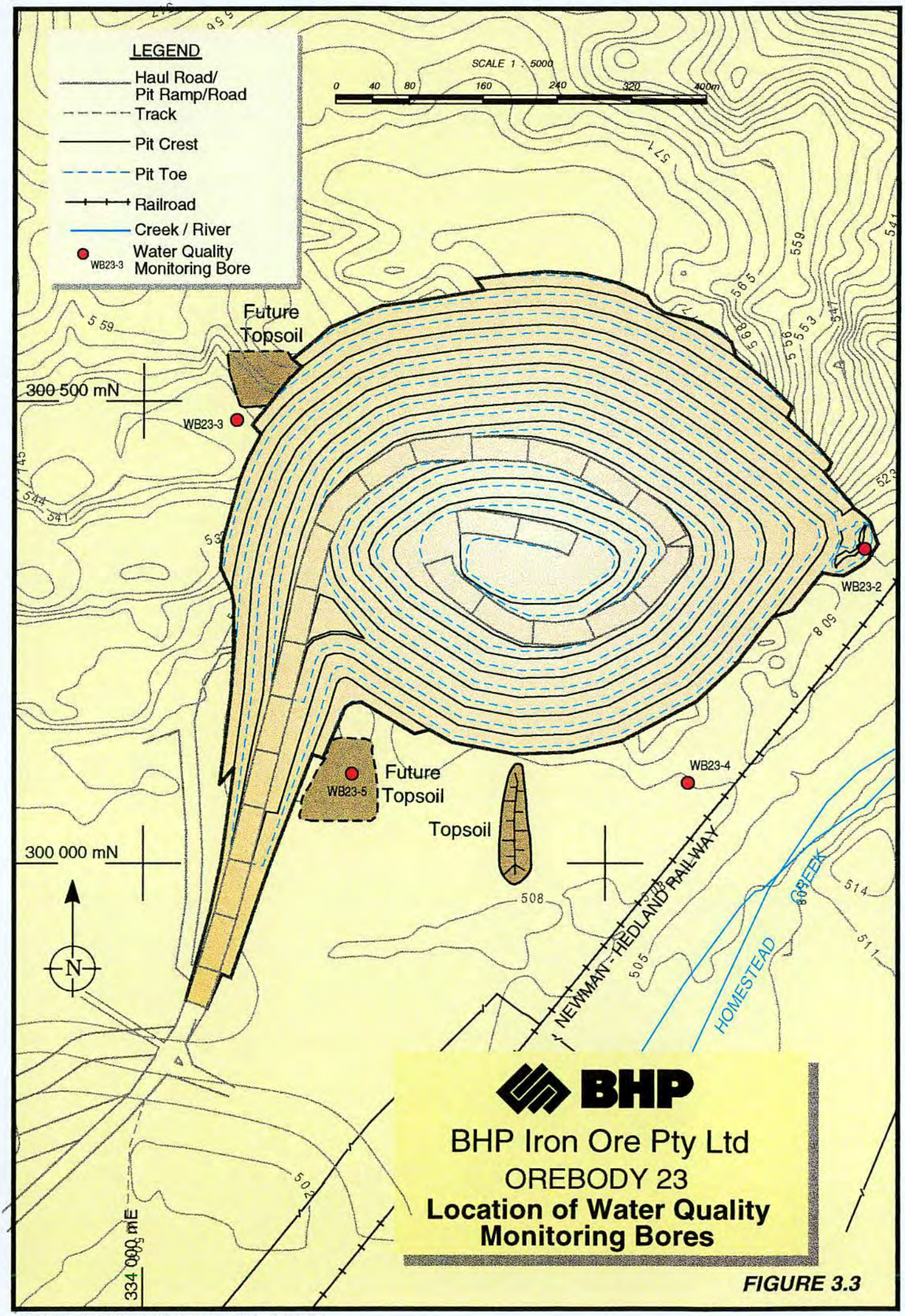

LEGEND
Haul Road/ Pit Ramp/Road
Track
Pit Crest
Pit Toe
Railroad
Creek / River
WB23-3 Water Quality Monitoring Bore
SCALE 1 : 5000
0 40 80 160 240 320 400m
Future Topsoil
300 500 mN
WB23-3
WB23-2
WB23-4
WB23-5
Future Topsoil
Topsoil
300 000 mN
N
NEWMAN - HEDLAND RAILWAY
HOMESTEAD CREEK
334 000 mE
BHP
BHP Iron Ore Pty Ltd
OREBODY 23
Location of Water Quality Monitoring Bores
FIGURE 3.3
DRWG No D:\DGN\OB23\6260MS50.DGN DATE 25-8-97

TABLE 3-2

HYDROCHEMISTRY OF OREBODY 23 AQUIFER

Site	A	A	B	B	D	E
Units (mg/L, or as shown)	Bore WB2 6/6/97	Bore WB2 8/6/97	Bore WB3 2/6/97	Bore WB3 4/6/97	Bore WB5 16/6/97	Bore WB4 12/6/97
pH (pH units)	7.5	7.5	7.5	7.4	7.4	6.6
conductivity (µS/cm)	1600	1700	1200	1200	1700	1000
total dissolved solids	920	1000	780	690	970	540
total suspended solids	-	<5	-	<5	<5	50
sodium (Na)	-	170	-	110	130	72
potassium (K)	-	10	-	13	11	5.3
calcium (Ca)	-	79	-	64	87	61
magnesium (Mg)	-	90	-	67	96	65
iron (Fe)	-	<0.1	-	<0.1	<0.05	<0.05
chloride (Cl)	-	220	-	130	220	120
carbonate (CO_1)	-	nil	-	nil	nil	nil
bicarbonate (HCO_1)	-	480	-	430	520	405
sulphate (SO_4)	-	160	-	100	150	61
nitrate-nitrogen (NO_3-N)	-	5.2	-	3.7	1.7	0.9
aluminium (Al)	-	<0.1	-	<0.1	<0.1	<0.1
cadmium (Cd)	-	<0.001	-	<0.001	<0.001	<0.001
lead (Pb)	-	<0.005	-	<0.005	<0.005	<0.005
arsenic (As)	-	<0.001	-	<0.001	<0.001	<0.001
mercury (Hg)	0	<0.0005	-	<0.0005	<0.0005	<0.0005
selenium (Se)	0	<0.002	-	<0.002	<0.002	<0.002
barium (Ba)	-	0.06	-	0.08	0.13	0.13
chromium (Cr)	0	<0.01	-	<0.1	<0.01	<0.01
copper (Cu)	-	0.01	-	0.02	<0.01	<0.01
manganese (Mn)	-	0.01	-	0.02	<0.01	<0.01
nickel (Ni)	-	0.01	-	<0.01	<0.01	<0.01
zinc (Zn)	-	<0.01	-	<0.01	<0.01	<0.01

Analysis for potability indicated that, based on the *Australian Drinking Water Guidelines* (National Health and Medical Research Council and Agriculture and Resource Management Council of Australia and New Zealand, 1996), the water is potable. However, there is some natural variation of water quality throughout the Ethel Gorge Aquifer where salinity currently exceeds 1,500 mg/L TDS.

3.6.2 Potential Impacts

Mine Dewatering

The mining plan for Orebody 23 involves the extraction of the ore in approximately four years. Dewatering of the Orebody 23 pit will be required for the four year mine life to allow the recovery of ore below the current watertable. This operation will lower the watertable in the pit to maintain dry conditions for mining to a planned depth of 140 m. Dewatering bores will be installed and operated prior to the commencement of mining below the watertable. Shallow bores (<100 m) will intercept flows in the alluvium south of the pit. Deep bores (~250 m) on the eastern and western sides of the pit will dewater the orebody aquifer.

A dewatering strategy has been developed using the numerical model that was developed with data from both the dewatering trial and previous investigations.

The estimated dewatering schedule is shown in Table 3-3.

TABLE 3-3

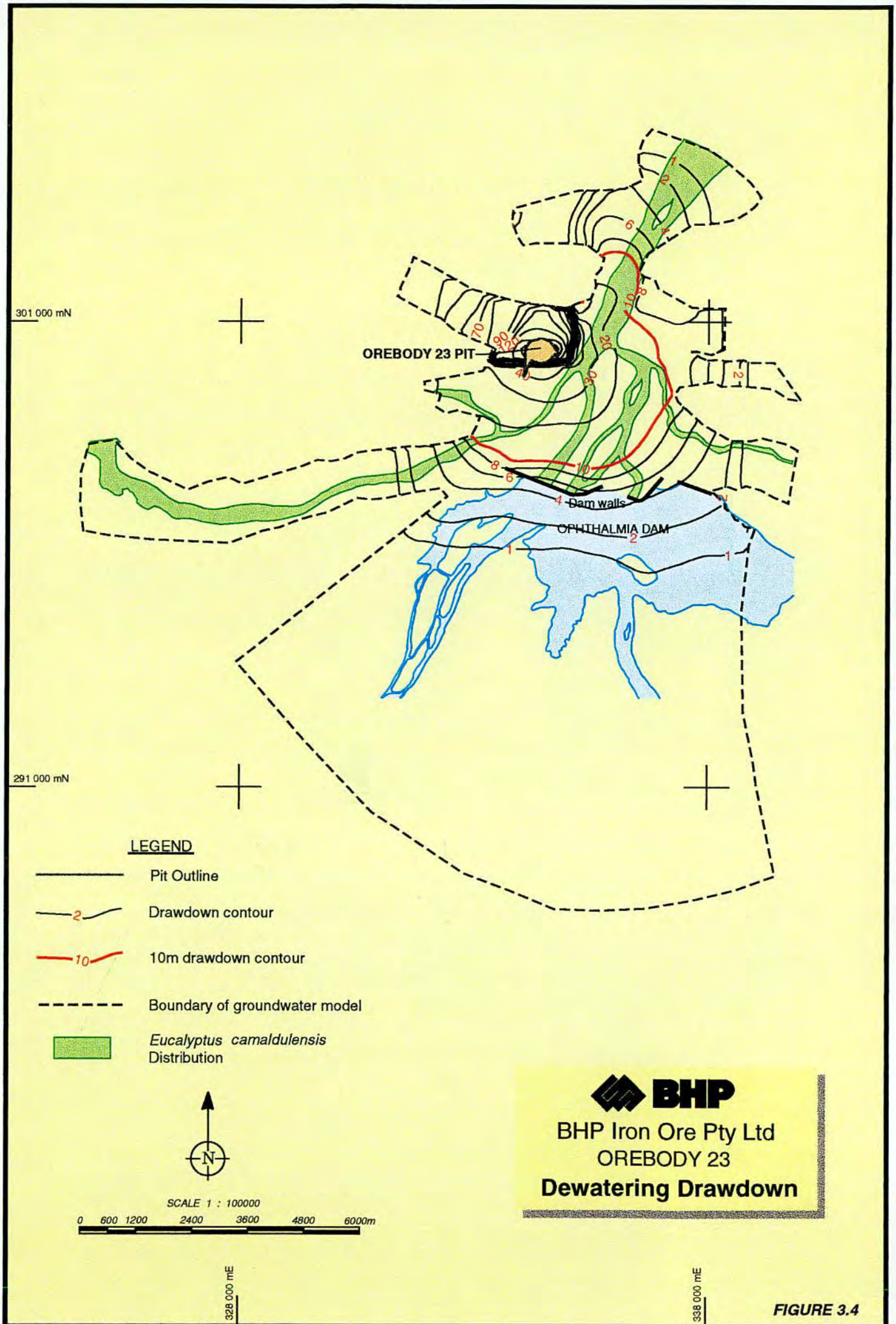
DEWATERING SYSTEM DEVELOPMENT SCHEDULE

Dewatering Period (Years)	Predicted Pit Inflow at the end of the Period (ML/d)
1	33
2	37
3	38
4	38

Impact on the Groundwater Regime

Groundwater modelling indicates that significant drawdowns will occur in the palaeovalley alluvium as a result of dewatering Orebody 23 (Rust PPK, 1996 and AGC Woodward-Clyde, 1997). The predicted drawdown in the alluvium, after four years of dewatering, is presented in Figure 3.4.

Outflow of groundwater from Ethel Gorge to the north will effectively be stopped except during and immediately after periods of heavy rainfall when some shallow groundwater flow may occur in river channel sediments. However, this is not a major component of the water balance for the downstream areas. Several estimates of natural (i.e. pre-mine, pre-wellfield development) outflow to the north have been made including some recent estimates as part of the BHP Iron Ore modelling study. These indicate that natural outflow would likely range from 1,000 to 2,000 kL/day.



BHP Iron Ore Pty Ltd
OREBODY 23
Dewatering Drawdown

FIGURE 3.4

DRWG No D:\DGN\OB23\6260MS27.DGN DATE 5-6-97

However, the natural outflow has been altered with the development of the Ethel Gorge and Homestead Creek Wellfields. Estimates of the aquifer outflow to the north since the development of these Wellfields suggest that current outflows is in the order of 500-700 kL/day (AGC Woodward-Clyde, 1997).

Post Mining

Once the mining and dewatering has ceased at Orebody 23 it is predicted that ground water levels in the aquifer will return to near pre-dewatering levels within approximately 3 years (Figures 3.5 and 3.6). The pit will, therefore, contain an open water body. It is predicted that evaporative losses from the water body will increase the salinity of water contained in the pit. A salt mass balance model of the pit system has been developed (BHP Iron Ore Pty Ltd, 1996). This model indicates that the salinity of water (as measured by Total Dissolved Solids - TDS) in the pit may reach 1,800 mg/L over a 10 year period.

Groundwater modelling of the aquifer adjacent to the pit suggests that following the initial post-mining watertable recovery, water may flow out of the pit into the aquifer system. Therefore, it is possible that increases in pit water salinity may eventually impact upon the Ethel Gorge Aquifer immediately adjacent to and downstream of the pit.

Further mass balance and dilution modelling of the aquifer (BHP Iron Ore Pty Ltd, 1996) was undertaken to quantify this increase in salinity. In the first 10 years, after dewatering has stopped, it is estimated that salinity increases in the aquifer adjacent to the pit would be negligible (undetectable to taste) (Figure 3.7). Furthermore, it is estimated that it would take approximately 40 years for aquifer salinity adjacent to the pit to approach 1,500 mg/L.

Impacts on the overall Ethel Gorge Aquifer must be considered in terms of both current and future beneficial uses of the resource. This is also dependent on the water quality at various locations within the aquifer system as there is some natural variation. Current beneficial uses have been identified as:

- natural vegetation requirements;
- Newman town water supply; and
- Whaleback operation water supply.

Another likely beneficial use would be drinking water for livestock. *Western Australian Water Quality Guidelines for Fresh and Marine Waters* (Environmental Protection Authority, 1993) recommend TDS levels below 5,000 mg/L as suitable for sheep and cattle of all ages. No water quality criteria are provided for natural vegetation and mine water supplies. However, water quality below 2,000 mg/L is likely to be suitable to sustain natural vegetation in the area and for Whaleback operation water supply.

The Water Quality Guidelines also recommend that potable water does not exceed 1,000 mg/L TDS. The potable water supply for the Newman townsite is drawn from a branch of the aquifer along Homestead Creek approximately seven kilometres upstream of Orebody 23. Any likely migration of saline water will be generally downstream of the pit and, therefore, will not affect the Newman water supply.

3.6.3 Management

Mine Dewatering

It is estimated that the dewatering of Orebody 23 will result in the abstraction of up to 38,000 kL/day. Dewatering production will therefore exceed the daily water requirements for the Whaleback operation (@14,000 kL/day) by up to 24,000 kL/day.

Some of this water (approximately 1,000 kL/day) will be used for dust suppression at Orebodies 23 and 25. A further proportion of the excess water (predicted approximately 3,000 kL/day) may be pumped back into the Fortescue River valley to irrigate vegetation that might be at threat from lowered watertable levels as a result of dewatering (refer to Section 3.7.3). The remainder of the excess water will be distributed between:

- discharge to the Ophthalmia Dam (approximately 14,000-19,000 kL/day); and
- infiltration through the Fortescue River channel downstream of the mining areas to maintain groundwater throughflow.

Discharge to the Fortescue River will be spread across areas of river bed sufficient to minimise surface ponding and any associated environmental impacts. Data from Tahal (1981), collected during the design of Ophthalmia Dam, suggest that infiltration rates are in the order of 0.3 m/d - 0.7 m/d. This suggests that, for example, 1,000 kL/day could be infiltrated over approximately 150 m of river bed without significant surface ponding.

The objectives of the dewatering and water management strategy are to:

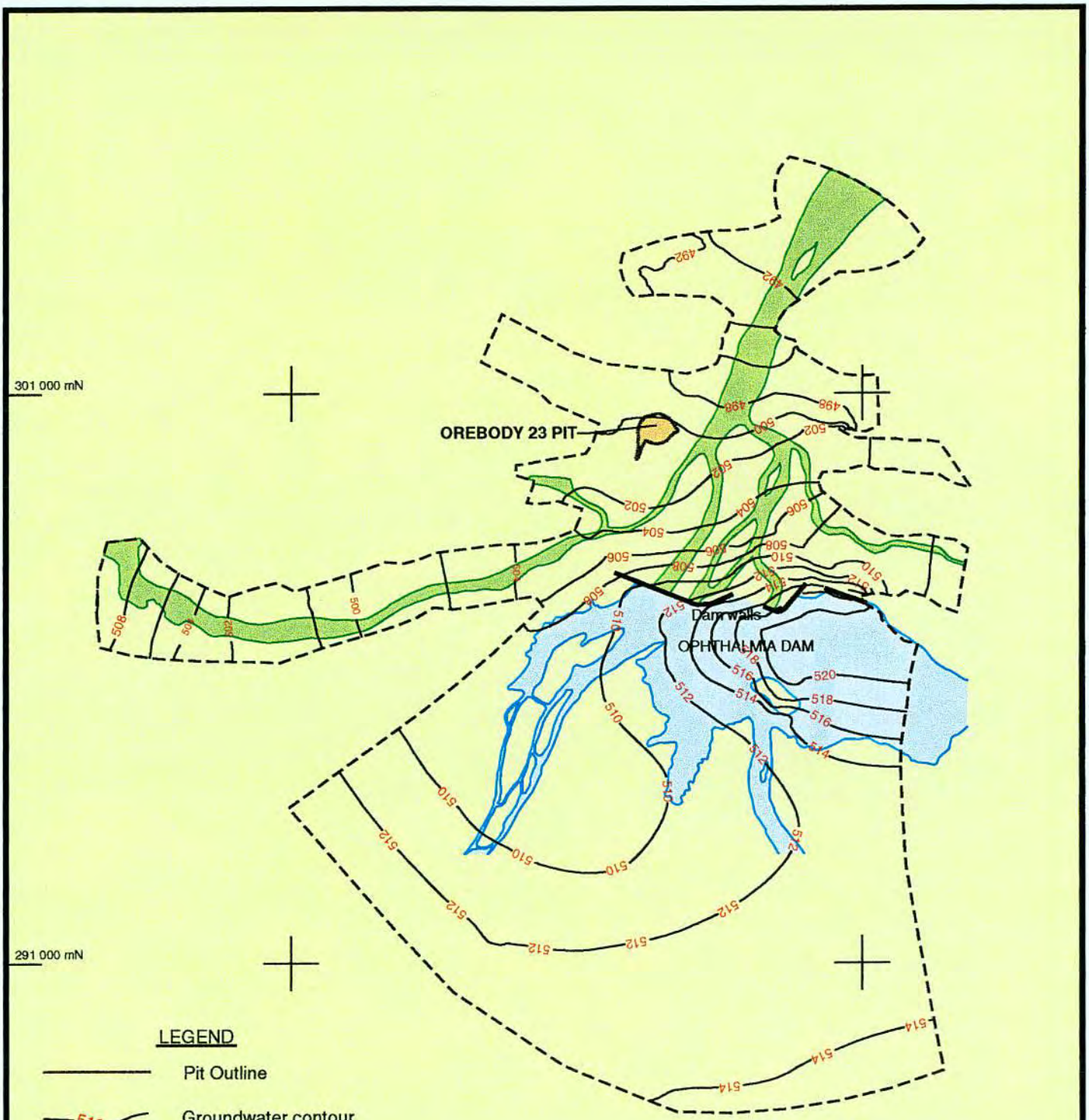
- dewater Orebody 23 to meet the four year mining schedule;
- sustain a 14,000 kL/day raw water supply to BHP Iron Ore's operation at Mt Whaleback; and
- prevent any significant adverse environmental impacts.

An outline water balance for the Orebody 23 dewatering operation is given in Table 3-4.

Post Mining

At the completion of mining, water abstraction from the area will be reduced to match the requirements of the Whaleback operation (approximately 14,000 kL/day @ current rates). This water will be sourced from a combination of some of the original water bores and some of the newly established dewatering bores.

BHP Iron Ore proposes to augment the already established groundwater monitoring system to measure watertable levels throughout the affected area of the Ethel Creek Wellfield system. Water quality will also be measured at various strategic locations throughout the system. A pit water monitoring programme will also be established following the post-mining watertable recovery. Comprehensive monitoring of both the borefield network and pit will be continued throughout the dewatering and post-mining periods to assess the medium and long-term changes in water quality. An action level for salinity (as measured by TDS) of 1,500 mg/L in selected monitoring bores adjacent to the pit is proposed to trigger investigations into means of limiting further increases.



BHP Iron Ore Pty Ltd

OREBODY 23

Groundwater Prior to Dewatering

FIGURE 3.5

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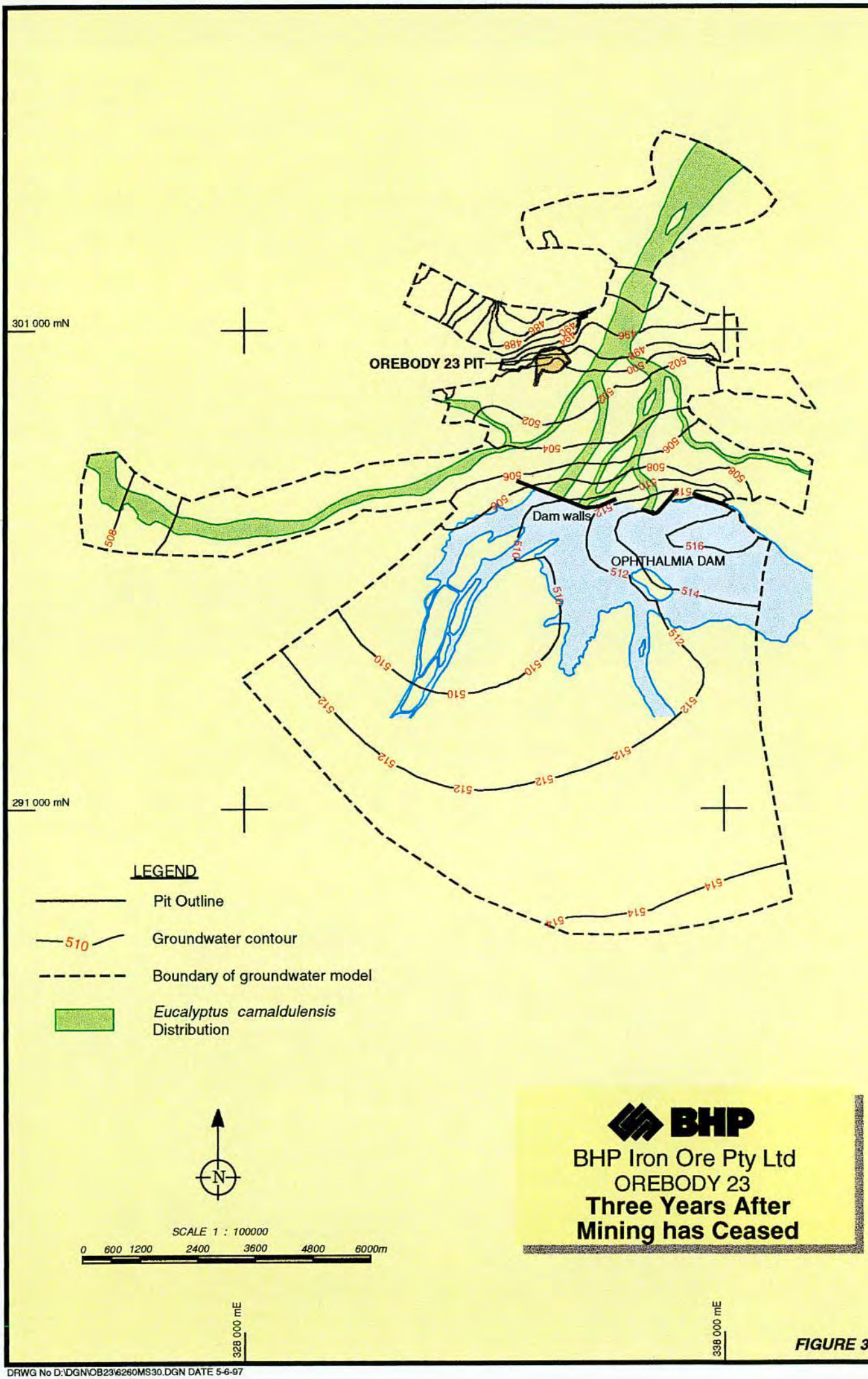

BHP Iron Ore Pty Ltd

OREBODY 23

Three Years After Mining has Ceased

FIGURE 3.6

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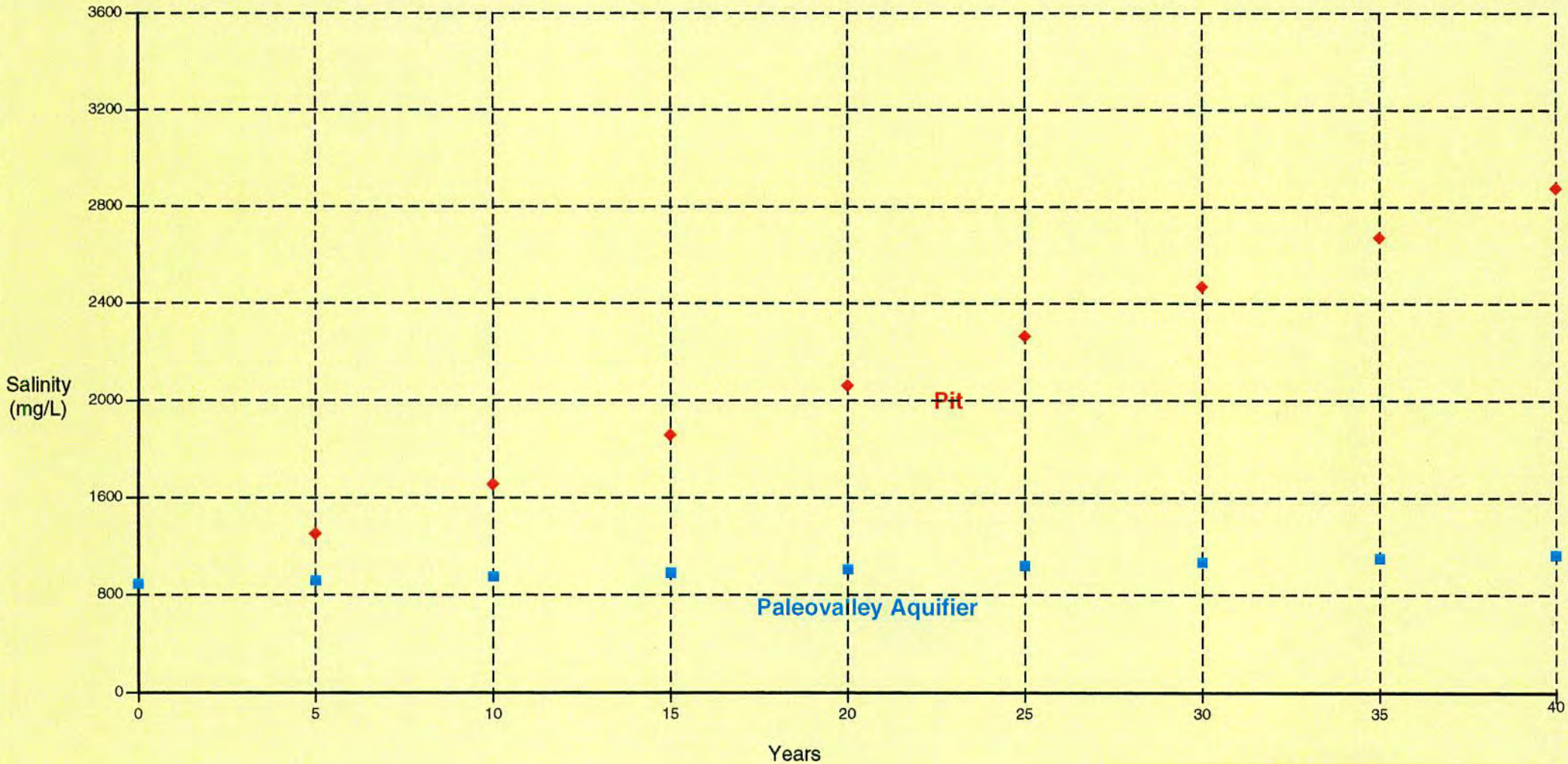

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OREBODY 23

Calculated Pit and Palaeovalley Salinity Versus Time

FIGURE 3.7

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Monitoring will continue to determine the rate of increase so that suitable techniques are developed and implemented at the point where aquifer salinity levels of 2,000 mg/L or more are recorded in the selected bores over a twelve month monitoring period.

TABLE 3-4

OREBODY 23 DEWATERING OPERATION WATER BALANCE

Water Source/Allocation	Estimated Volume/Year (kL/day)					
	Pre-Mining	Year 1	Year 2	Year 3	Year 4	Post-Mining
Supply/Throughflow:						
• Mine Dewatering	0	33,000	37,000	38,000	38,000	0
• Existing Raw Water Bores	14,000[1]	0	0	0	0	14,000
• Groundwater Throughflow	500-700	670	460	120	0	500-700
Allocation:						
• Raw Water for Whaleback	14,000[1]	14,000	14,000	14,000	14,000	14,000
• Dust Suppression at Orebody 23	0	1,000	1,000	1,000	1,000	0
• Tree Watering	0	3,000[2]	3,000[2]	3,000[2]	3,000[2]	0
Excess:						
• Discharge to Ophthalmia Dam	0	14,000	18,000	19,000	19,000	0
• Throughflow Support	0	1,000	1,000	1,000	1,000	0

[1] Current supply from Ethel Creek Wellfield.
[2] Indicative Tree-watering distribution and rate depends on monitoring results.

These action levels have been derived on the basis of existing aquifer water quality and with respect to identified beneficial uses including natural vegetation requirements, Newman town water supply, Whaleback operation water supply and livestock drinking water (refer Section 3.6.2). These levels have been chosen to provide an indication of incremental changes in the aquifer immediately adjacent to the pit so that management measures can be implemented to minimise adverse impacts and preserve beneficial uses of the overall water resource.

Based on the above groundwater modelling predictions, salinity level increases to the above action levels may not occur for 40 years or so. The understanding of environmental effects and practical experience in managing exposed groundwater in open pits will have progressed considerably during this time. Leaving the Orebody 23 pit open will provide an opportunity to comprehensively investigate changes in water quality and potential salinity migration from the pit over the medium to long-term. This will provide greater certainty for assessing, planning and managing future projects involving mining below the watertable in the Pilbara. Data from these investigations would be used to develop future management techniques. It is, however, important that the beneficial uses of the aquifer water resource be periodically reviewed with the State Government in order to set ultimate target objectives for maintaining water quality.

Commitment 2: Water Monitoring

BHP Iron Ore will supplement the existing water monitoring system to measure watertable levels throughout the Ethel Creek Wellfield. Additionally, the quality of the water will be measured at various strategic locations throughout the system. Monitoring will take place during the mining/dewatering phase and after cessation of mining for the period of time until the aquifer has reached near pre-mining levels.

Commitment 3: Pit Waterbody Monitoring

BHP Iron Ore will monitor the quality of water in the pit and the adjacent aquifer following the completion of mining at Orebody 23. Appropriate monitoring bores, representing aquifer water quality adjacent to the pit, will be selected with the agreement of the Department of Environmental Protection.

Commitment 4: Pit Waterbody Management

If the results from the aquifer monitoring indicate salinity levels (as measured by Total Dissolved Solids) in the selected bores have increased to 1,500 mg/L or more, BHP Iron Ore will investigate means of limiting further increases. Where sustained levels in excess of 2,000 mg/L are recorded in the selected bores for more than a 12 month sampling period, BHP Iron Ore will implement suitable techniques to maintain water quality consistent with agreed beneficial uses, at that time.

3.7 VEGETATION AND FLORA

Orebody 23 is situated within the Eremaean Botanical Province, in the Fortescue Botanical District. The district is composed of eight sub-districts of which the Hamersley Plateau sub-district is relevant to this Project. The vegetation of the Project area is broadly mapped as a tree steppe with scattered *Eucalyptus leucophloia*, *Eucalyptus gamophylla* and *Corymbia opaca* over spinifex (*Triodia*) steppes. In general, there are few large shrubs present and a rich array of small shrubs and forbs.

3.7.1 Vegetation Associations

A biological survey of the Newman lease was carried out in 1984 (Maunsell & Partners, 1984). An additional flora survey of the Project Area (Figure 2.1) covering the proposed development and the existing borrow pits was completed in June 1997 (*ecologia* Environmental Consultants, 1997).

The following information is largely derived from these reports.

Minesite Vegetation

The vegetation survey identified a total of eight vegetation associations within the Project Area (Figure 3.8).

Association 1 — *Acacia aneura* groves over *Triodia pungens* and soft grasses. This association is divided into two sub-types:

(i) *Acacia aneura* groves over a moderately dense cover of *Triodia pungens* and soft grasses; and

(ii) Scattered stands of *Acacia aneura* shrubs over moderately dense soft grasses.

Association 2 — Creekline/drainage systems comprising dense tall shrublands over *Triodia pungens*, usually with an overstorey of *Corymbia opaca*. This vegetation type occurs both at the base of larger gullies at the edge of the ridgeline and in tributaries of Homestead Creek immediately south of Orebody 23.

Association 3 — Sandplains dominated by *Plectrachne pungens* with a sparse, unevenly distributed overstorey of *Eucalyptus gamophylla*. The vegetation association is restricted within the survey area to two small areas north of the Project ridgeline.

Association 4 — *Senna* shrublands over herbs which are restricted to a very small area north of the ridgeline on a stony plain.

Association 5 — Steep rocky slopes and knolls with scattered *Eucalyptus leucophloia* over sparse shrubs and *Triodia wiseana/Eriachne pulchella*. This association is widely distributed within the Project Area.

Association 6 — Moderately steep ridge slopes of *Triodia wiseana/T. pungens* with sparse emergents. This association is also widely distributed on the slopes of the ridgeline.

Association 7 — Ridge tops with sparse emergents over *Triodia basedowii*.

Association 8 — Base plains with *Eucalyptus gamophylla/E. leucophloia* over *Triodia basedowii*, *T. pungens* and *Eriachne pulchella*. This vegetation type is widespread both north and south of the Orebody 23 ridgeline.

The vegetation associations present in the proposed mining area are widely distributed in the Pilbara and, consequently, do not have conservation significance within a regional context.

Riverine Vegetation

The minor creeklines and drainage channels within the Project Area contain dense tall shrublands over *Triodia pungens*. All the drainage patterns are mapped as one unit, however some gradation of vegetation occurs along the channels. In general, as the drainage capacity increases, the number and height of trees increases such that in the larger tributaries of Homestead Creek, an open canopy of *Eucalyptus xerothermica*, *E. aspera*, *E. gamophylla*, *E. leucophloia* and *Corymbia opaca* is present, reducing to a scattered to sparse overstorey dominated by *Corymbia opaca* in minor channels.

The vegetation of the Fortescue River, Homestead and Shovelanna Creeks in the area of the predicted drawdown consists of River Red Gum (*Eucalyptus camaldulensis*) and Coolibah (*E. victrix*) Woodlands on the river banks and small islands between the river channels. No Cajeput trees (*Melaleuca argentea*) occur in this area.

Smaller shrubs of *Melaleuca glomerata* and various *Acacia* species are common along the river banks and islands.

3.7.2 Flora

The survey of the area in 1997 encompassed two separate study areas: the proposed mine site at the eastern end and the borrow pit about 8 km to the west of the orebody. Within these two areas, 23 sites were surveyed. A total of 304 taxa of vascular flora was collected from the Project Area, of these 269 were recorded from the proposed mine site and 157 from the borrow pit. The taxa belong to 47 families, 15 of which were represented by a single taxon. The most frequently represented families were:

- Poaceae (38 taxa);
- Mimosaceae (with 26 taxa recorded);
- Malvaceae (23 taxa); and
- Chenopodiaceae (20 taxa).

The genera represented by the greatest number of taxa were:

- *Acacia* (26 taxa);
- *Senna* (12 taxa);
- *Ptilotus* (11 taxa); and
- *Eremophila* (10 taxa).

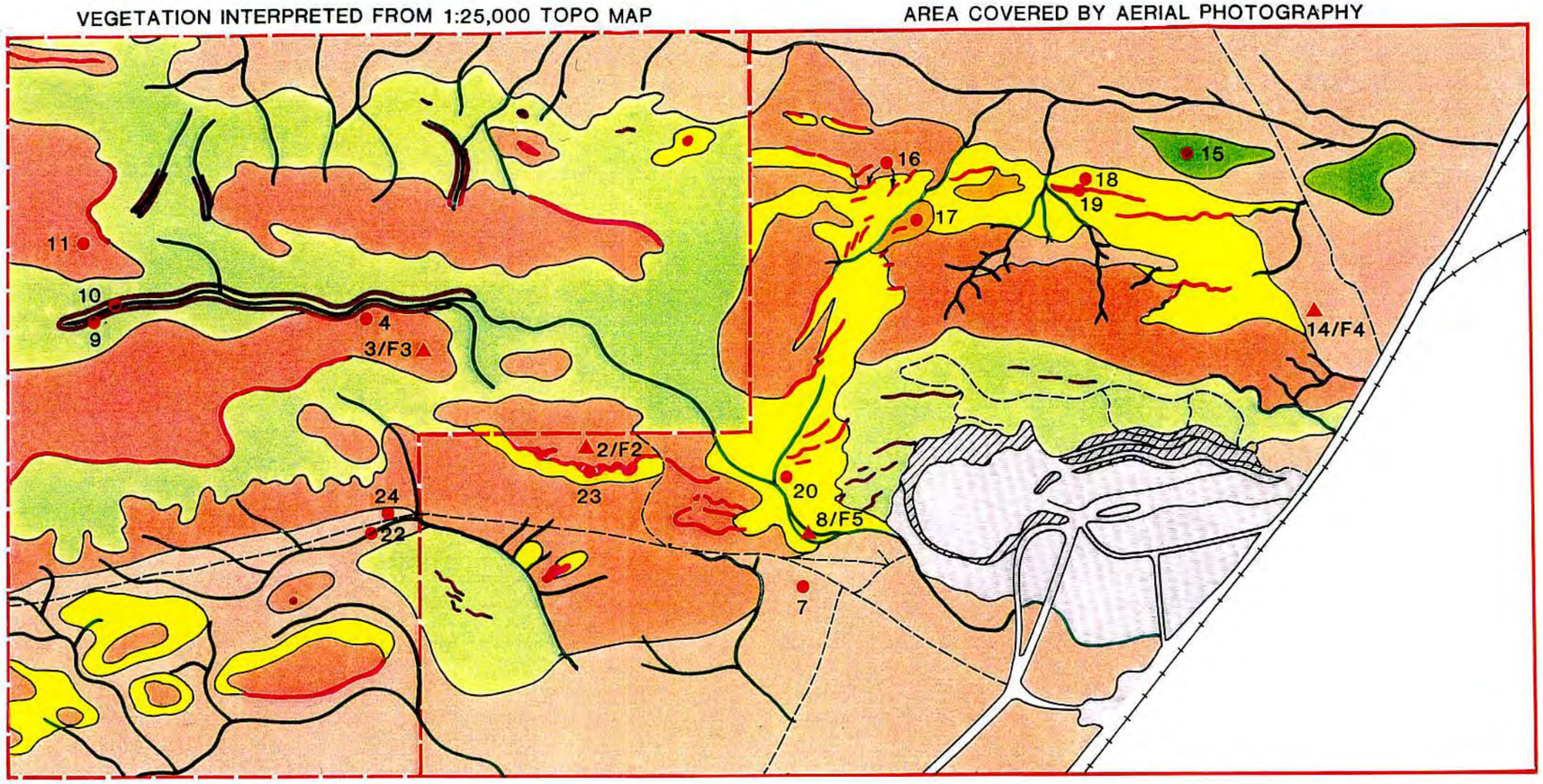
The most widely distributed taxa within the area surveyed were *Solanum lasiophyllum, Ptilotus obovatus, Eriachne pulchella, Ptilotus exaltatus* and *Triodia pungens*.

No Declared Rare Flora as listed in the CALM Rare Flora List (Atkins, 1996) were collected within the study area.

One Priority 2 taxon, *Scaevola acacioides*, was recorded within the study area. A Priority 2 species is designated as 'a taxon which is known from only a few populations, at least some of which are not believed to be under threat' (Department of Conservation and Land Management, 1995). Three individual plants of this species were recorded, two within a small drainage system and one on nearby rocky slopes immediately west of the existing overburden storage areas. This moderately sized shrub (1-3 m tall) is officially recorded at six locations within the Pilbara region of Western Australia (Chichester National Park, Tom Price, Paraburdoo and east and west of Karijini National Park). The population in the Project Area is approximately 120 km east of the nearest population and represents an extension of the species' known range.

VEGETATION INTERPRETED FROM 1:25,000 TOPO MAP

AREA COVERED BY AERIAL PHOTOGRAPHY



N

LEGEND

- Creekline/drainage channels; Dense tall shrublands over *Triodia pungens*, usually with an overstorey of *Corymbia opaca*.
- Sandplains dominated by *Plectrachne pungens*, with sparse unevenly distributed overstorey of *Eucalyptus gamophylla*.
- *Senna* shrubland over herbs
- Steep rocky slopes & knolls: Scattered *Eucalyptus leucophloia* over sparse shrubs and *Triodia wiseana/Eriachne pulchella*
- Moderate ridge slopes *Triodia wiseana/Triodia pungens* with *Ptilotus obovatus* and *Acacia bivenosa*.
- Ridge tops with sparse ermergents over *Triodia basedowii*.
- Base plains; Mixed *Eucalyptus gamophylla/Eucalyptus leucophloia* over *Triodia basedowii*, *T. pungens* and *Eriachne pulchella*.
- Mosaic of moderate ridge slopes; *Triodia wiseana/Triodia pungens* with *Ptilotus obovatus* and *Acacia bivenosa* and ridge tops with sparse ermergents over *Triodia basedowii*.
- Existing mine works: cleared areas
- Semi cleared areas with remnant vegetation or rehabilitation species.
- ● 7 Flora survey site
- ▲ 2/F2 Flora and fauna survey site
- Railway
- Track

0 500 1000m

Scale 1:15 000

BHP

BHP Iron Ore Pty Ltd

OREBODY 23

Vegetation of the Project Area

FIGURE 3.8

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Six introduced flora taxa were recorded from the Project Area of which the most widely distributed was *Rumex vesicaria*. This species is widespread especially within the disturbed areas of the survey area. Another species, *Cenchrus ciliaris,* is considered an environmental weed as it becomes a prolific colonizer of low lying areas, but is valued as a fodder plant on pastoral leases.

3.7.3 Potential Impacts

Minesite Vegetation

Mining and overburden placement will require the clearing of vegetation. However, the vegetation of the Project Area is not unique and is representative of similar hill systems in the surrounding region.

The population of the Priority 2 species, *Scaevola acacioides*, is located to the west of the existing overburden storage area within an area likely to be impacted by the proposed development. However, the habitat in which it was found is relatively common within the study area and specific searching for this species may reveal that it is more widespread within the Project Area.

The area affected by the mine expansion is small in comparison to the floristic units present in the region. Therefore, the impact of the Project on the vegetation of the area is considered to be low.

Riverine Vegetation

The impact of dewatering on the nearby riverine vegetation was assessed in the following manner:

- modelling the predicted drawdown of groundwater from dewatering;
- mapping the vegetation along the creek systems;
- establishing the relationship of the riverine vegetation to the groundwater levels; and
- predicting the impact of dewatering on the vegetation.

Groundwater Drawdown

Section 3.6.2 describes the extent of groundwater drawdown as a result of mine dewatering. The area of drawdown extends upstream approximately 11 km on Homestead Creek, 6.5 km on the Fortescue River and 5.7 km on Shovelanna Creek and 5 km downstream on the Fortescue River (Rust PPK, 1996 and Woodward-Clyde, 1997).

Vegetation - Groundwater Relationships

The relationship between groundwater and riverine vegetation in the eastern Pilbara has been examined previously by Muir Environmental (1995). In this report, Muir states that phreatophytes (ie. vegetation reliant at some time on groundwater moisture levels) such as River Red Gums could be expected to be intolerant to prolonged drought due to their dependence on water. However, in desert areas, these trees would occasionally experience drought conditions and could adapt quite well if the impacts were not too sudden or severe. In

severe dry periods where the watertable drops and soil moisture decreases below the adventitious root zone, the plants would probably exhibit stress as they would not be able to obtain sufficient water.

Muir Environmental (1995) classes the Coolibah as a vadophyte. Vadophytes are considered to be relatively drought tolerant, although would experience stress if the watertable fell to a point where the capillary fringe of the vadose layer were no longer accessible. A gradual decline of the watertable would probably not affect Coolibahs. However, the effects of a long-term decline in the groundwater level would depend on the adaptive ability of individuals and their dependence on the vadose zone.

The only true obligate phreatophytic trees in the Newman area are Cajeputs which do not occur in this immediate area.

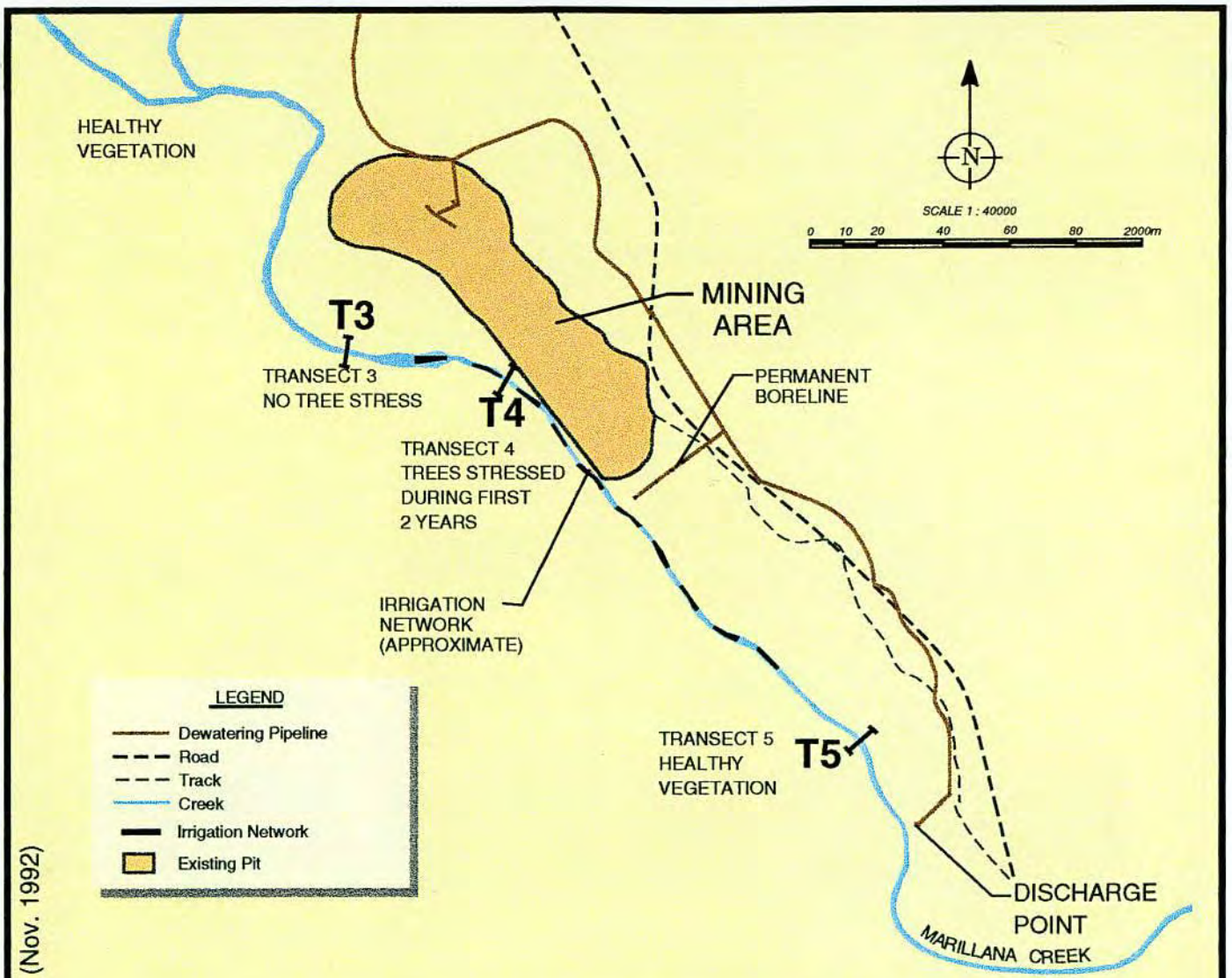
Based on Muir Environmental's (1995) description, the impact of drawdowns on River Red Gums in the area requires further consideration.

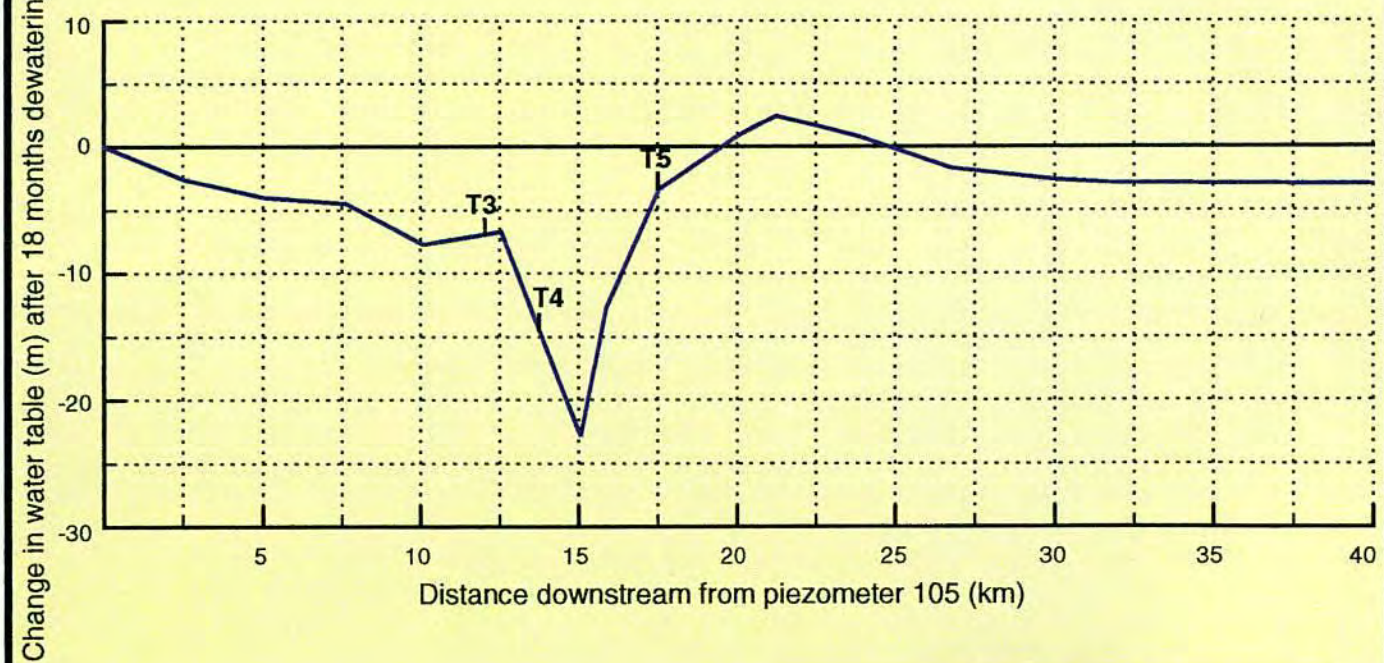
There have been no definitive studies on the direct relationship of River Red Gums to river hydrology and groundwater levels. Therefore, it is difficult to accurately predict the impact of watertable drawdowns on the River Red Gums.

The potential impact of drawdown on River Red Gums was assessed for this report in two ways. Firstly, an examination of bore hydrographs from the Fortescue River indicates that a fall in the watertable of up to 5-8 m over a period of four years has been observed in some bores adjacent to the river. Recent visual examination of these sites reveals that the River Red Gums and other native species do not appear to have been adversely affected as a result of the reduction in groundwater levels. While the lowering of the groundwater may have caused some stress at the time of drawdown, this is no longer evident and indicates that the riverine vegetation of this area can adapt to natural falls in the watertable of at least 5-8 m during drought periods.

The second method of assessing the relationship between the River Red Gums and the watertable was undertaken by analysing the Marillana Creek vegetation and hydrology monitoring data.

The riverine vegetation of Marillana Creek has been monitored since 1991 to determine any impacts of dewatering from the mining operation at Marillana Creek. Figure 3.9 shows the extent of groundwater drawdown in this period. Two transects (3 and 4) are located in a section of the Creek which has experienced significant drawdowns. The groundwater near transect 3 has been lowered by 8 m since 1991 with a fall of 4 m experienced in one 12 month period and have shown no measurable effect of the lowered watertable. These trees have not been artificially watered during this period. The groundwater at transect 4 has fallen 17 m over a four year period and the River Red Gum showed early signs of stress in the first two years where the watertable dropped 10 m. These trees were subsequently irrigated by means of a tree watering line until early 1995, but continue to show signs of stress, however, no tree deaths have been caused by groundwater drawdown in this area. It is difficult to predict what effect the tree watering has had in the absence of control trees.





BHP

BHP Iron Ore Pty Ltd

OREBODY 23

Marillana Creek Drawdown

FIGURE 3.9

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The conclusions that can be drawn from these assessments are that River Red Gums show the ability to adapt to a reduction in groundwater up to 10 m and, therefore, could survive drawdowns of this magnitude for a period of time without any artificial watering. A drawdown of greater than 10 m over a prolonged period may cause stress in River Red Gums which may or may not be reversible.

3.7.4 Management

A tree monitoring programme has been designed to measure the response of riverine trees to lowering groundwater levels and to understand the nature of any responses such that the appropriate corrective action can be applied, if necessary.

The monitoring programme will concentrate mainly on the tall riverine trees: River Red Gums, Coolabahs and possibly smaller trees such as *Melaleuca glomerata* and an *Acacia* species. The impact of dewatering in lowering the groundwater should only potentially affect phreatophytic vegetation. Therefore, non-phreatophytic vegetation such as small shrubs will not be monitored in this study.

The monitoring programme will include an assessment of the following components:

- tree health - creekbed monitoring sites;
- tree health - aerial survey;
- tree water use;
- groundwater levels - shallow and deep;
- streamflow;
- weather data; and
- tree irrigation rates.

Tree Health - Creekbed Monitoring Locations

Permanent tree monitoring sites will be established in areas within the creek system likely to be affected by drawdown (impact sites), unaffected by drawdown (control sites), and in areas which may be irrigated. Figure 3.10 shows the proposed location of tree monitoring sites.

At each site trees will be marked and a plan compiled showing individual tree locations so the same individual trees are reassessed for health in the future. Tree health will be assessed through photographs from a permanent marker and a visual health ranking.

The ranking system used to assess individual tree health is presented in Table 3-5.

TABLE 3-5

SUGGESTED HEALTH RANKING FOR INDIVIDUAL PLANT SAMPLES

Rank	Condition	Description
1	Healthy	No evidence of stress.
2	Obviously Stressed	Obvious loss of leaves, dieback of limbs or other signs of stress.
3	Very Stressed	Major stress with most leaves lost, death of major limbs and overall appearance of being close to death.
4	Dead	No apparent signs of life visible including no living bark above ground level.

Tree Health - Aerial Survey

To assess tree health on a broader scale, Digital Multi-Spectral Video (DMSV) imaging will be used.

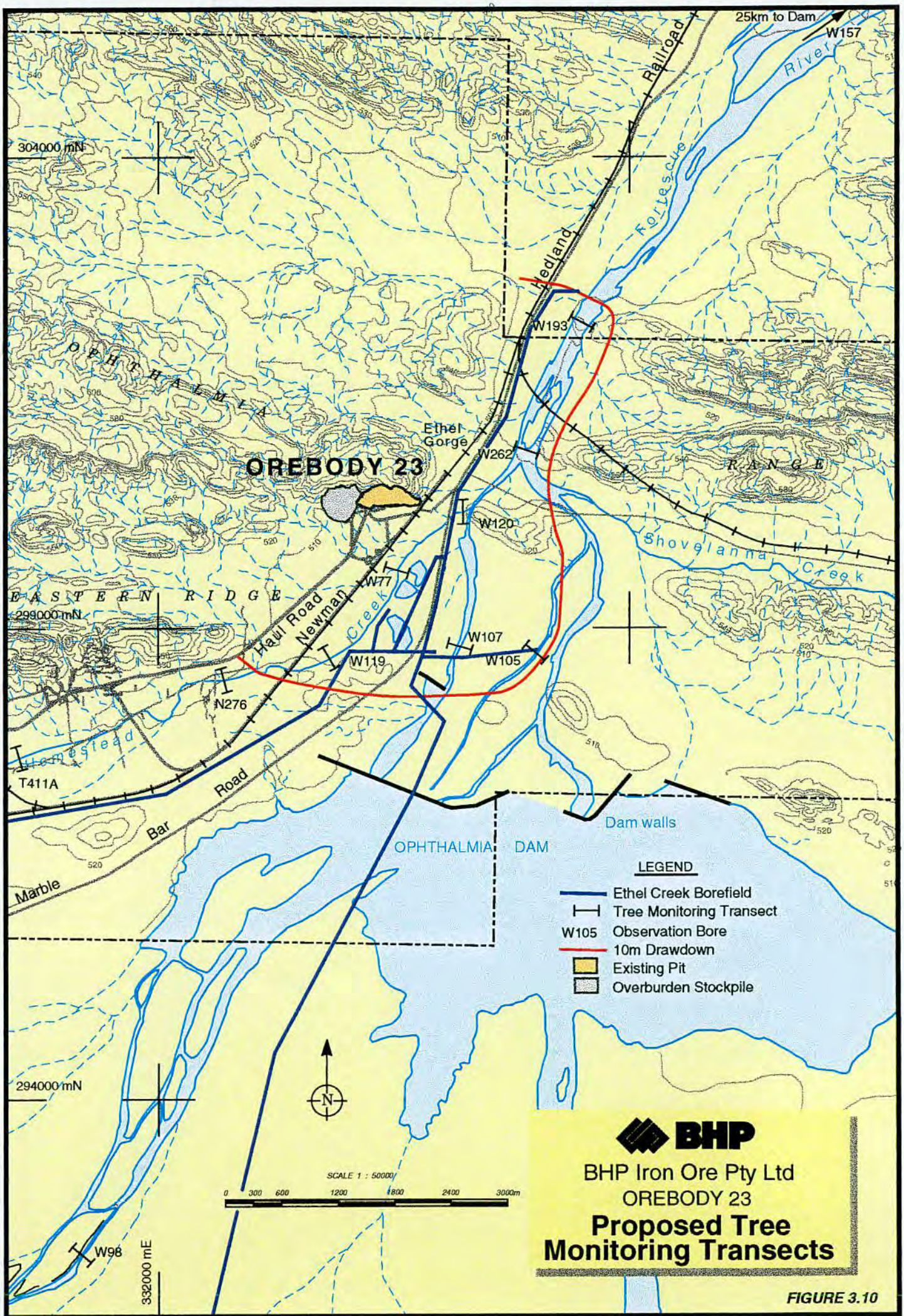
DMSV is a low level aerial photographic system which incorporates four cameras designed for the acquisition of digital images of terrain, vegetation, water bodies and coastal environments. Changes in the health of trees may be detected with the use of DMSV before they become apparent to the observer on the ground. The technique of DMSV has been trialed for Marillana Creek and shown to be useful in identifying general patterns of tree health.

On commencement of the monitoring programme the study area will be flown and a mosaic produced which shows baseline tree health information on a broad scale. The study area will be reflown on an annual basis to determine any changes to tree health. The area would be flown more frequently if changes in tree health were observed in the interim.

Tree Water Use

The amount of water used by riverine trees is an important variable to measure to understand whether any changes in tree health can be attributed to reduced moisture availability. Currently, there is no information available on the amount of water used by riverine trees in the Pilbara.

The heat pulse method is a modern technique which directly measures water use in trees. The heat pulse equipment measures sap velocity within a tree by inserting a heat probe and sensors into the trunk. The water use of an individual tree or stand of trees can be calculated accurately using the relationship between sap velocity and conducting wood area. The method has been successfully used in Western Australia on River Red Gums, Jarrahs, Tasmanian Blue Gums and a variety of other species.



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Three sample sites on Homestead Creek will be selected due to its proximity to Orebody 23 and to minimise the influence of Ophthalmia Dam. The monitoring sites in Homestead Creek will be:

- upstream, outside the drawdown area;
- at the predicted 10 m drawdown area; and
- at the area of maximum drawdown.

At each of the above sites two heat pulse units will be installed for a one year period. The continuing use of the heat pulse units will be reviewed after this initial period.

Information from these studies will be used in determining the actual watering requirements of trees in areas of watertable drawdown. This information will be beneficial for assessing the impacts of dewatering on creek/aquifer systems in other parts of the Pilbara.

Groundwater Levels

The creekbed tree monitoring sites will have shallow and deep piezometers installed to measure water levels. This will facilitate the comparison between tree health and soil moisture levels. Existing observation bores will be used, where appropriate, to monitor the deeper groundwater levels. Where existing deep bores are not present, a new deep monitor bore will be installed.

Up to three shallow piezometers will be installed at each site across the creek system. The shallow piezometers would be installed to an approximate depth of 10 m.

Monitoring of bores will be performed on a monthly basis or every 3 weeks to coincide with the heat pulse data logger downloading.

Streamflow

A stream flow gauging station is located on Homestead Creek. This station will be monitored to provide information on water flow into and through the Homestead Creek system. This information is an important component in the hydrological budget of the creek system.

Weather Data

Meteorological data is required for the heat pulse water use study to determine the relationship between climatic factors and tree water use. Information on rainfall and temperature will be obtained from the Newman meteorological station. Pan evaporation rates will be obtained from the Wittenoom meteorological station.

Tree Irrigation Rates

A tree watering system has been designed to irrigate the riverine vegetation, should the tree monitoring programme identify that dewatering is having an adverse impact on the health of the riverine trees. Watering would be achieved by discharging into the river channels at several locations and allowing the water to disperse along the channels and seep into the creekbed soils. Due to the potential for deep percolation of the irrigation water, several discharge points would be required to maintain water availability to the trees throughout the affected area.

The irrigation system has been designed to take advantage of the existing pipelines and headworks currently collecting water from the bores in Ethel Gorge. The irrigation system would be relatively automated, requiring a power supply and telemetry link at each outlet.

Estimates of total tree water needs have been estimated at 1,000 kL/day for winter and 3,000 kL/day for summer. These values will be more accurately determined with data from the heat pulse monitoring. The irrigation rates will be adjusted accordingly.

Currently it is proposed to have a total of 13 outlets to irrigate the riverine vegetation which is predicted to be the most affected by dewatering. Water would be discharged from a minimum of 4 - 6 outlets at one time to maintain outlet pipe velocities, over a determined time period.

The initial discharge of irrigation waters from the outlets would be observed to determine coverage and effectiveness.

Changes would be made to the discharge system as appropriate to ensure riverine trees are receiving adequate water supplies.

Commitment 5: Tree Monitoring

BHP Iron Ore will establish a comprehensive tree monitoring programme that will assess the impact of dewatering on the vegetation along the creek systems.

Commitment 6: Tree Watering

If the tree monitoring programmes (Commitment 5) indicates that dewatering is having an adverse impact on riverine vegetation, BHP Iron Ore will implement a tree watering system to sustain riverine vegetation in areas as determined by the monitoring. The watering system will operate during mining/dewatering and after the cessation of mining until the groundwater level, in identified areas, has returned to near pre-mining levels.

3.8 FAUNA

Butler and Butler (1976) conducted an assessment of the vertebrate fauna of several areas of the Newman lease. A further, more extensive, field survey of the Project Area (Figure 2.1) was conducted by *ecologia* Environmental Consultants (1997) in June 1997 covering the proposed development and the existing borrow pits. The field survey of fauna and fauna habitats recorded 62 species of bird, eight native and two introduced mammal species and 18 reptiles species. Literature searches and known habitat preferences suggest that the Project Area may support approximately 111 bird species, 32 native and four introduced mammal species, 98 reptile species and 3 amphibian species.

The following information is drawn from this report.

3.8.1 Fauna Habitats

Four main fauna habitats were recognised within the Project Area:

- Detrital Slopes with Spinifex Steppe;
- Gully with dense *Acacia* thickets;
- Ridgetop with small cliff faces; and
- Riverine.

Spinifex Steppe comprised the majority of habitat within the Project Area. This habitat has the greatest species richness with a total of 56 species comprising seven mammals, 39 birds and 10 reptiles. The Riverine habitat was restricted to a minor creek line in the extreme eastern margin of the borrow pit study area. It has an overstorey of River Red Gums (*E. camaldulensis*) and is considered an important habitat of avifauna and bats. The Riverine habitat had the second highest species diversity with 49 species due mainly to its diverse avifauna (40 species). The Gully habitat comprised 37 species (two mammals, 26 birds and 9 reptiles) and the Ridgetop habitat comprised 28 species (three mammals, 18 bird and seven reptiles).

Fauna habitats are closely aligned with landform and vegetation associations. The gully habitat provides an array of ecological niches for exploitation by invertebrate and vertebrate fauna. The litter layer is rich in ground dwelling insects which in turn support a diverse reptile and insectivorous bird fauna.

3.8.2 Avifauna

Sixty-two bird species have been recorded in the Project Area. Using known habitat preferences and species distribution, a further 49 species could potentially occur in the area. The Project Area is unlikely to support the full complement of species at any one time as many species are transitory visitors. Many of the species likely to be encountered in the area have broad distributions, occurring over much of Western Australia.

Two species listed on the CALM Rare and Endangered Fauna Schedule (Schedule 1 and 4) were recorded in the Project Area. A further three species could potentially occur.

- Schedule 1. Species that have experienced a significant range contraction since European settlement, have highly restricted known distributions or are species which are poorly known, but are presumed to be under threat;

  - Grey Honeyeater (*Conopophila whitei*) - recorded;

  - Grey Falcon (*Falco hypoleucos*) - potential to occur; and

  - Night Parrot (*Pezoporus occidentalis*) - potential to occur.

- Schedule 4. Species that are generally common, probably declining in settled regions, still well established in remote areas;

  - Peregrine Falcon (*Falco perengrinus*) - recorded in area; and

  - Major Mitchell's Cockatoo (*Cacatua leadbeateri*) - potential to occur.

The Grey Honeyeater was recorded on two occasions . This site was to the east of the borrow pits, adjacent to a minor drainage line with a dense stand of Mulga in flower. The birds observed were foraging in the Mulga trees and are probably transitory in the Project Area.

Two bird species listed under the China-Australia Migratory Bird Agreement (CAMBA) may also potentially occur in the Project area, but were not recorded during the survey. These species are the Rainbow Bee-eater (*Merops ornatus*) and the Fork-tailed Swift (*Apus pacificus*).

The Rainbow Bee-eater is an aerial forager exploiting the upper strata of the tree canopy for flying insects. They construct their nests by tunnelling into a sand bank or sloping sandy soil. In the Pilbara this is usually along drainage lines (Slater *et al.*, 1989).

3.8.3 Reptiles and Amphibians

Opportunistic collecting and trapping within the Project area recorded 18 reptile species from five families including a Schedule 1 species, the Pilbara Olive Python (*Morelia olivacea barroni*). Based on known species distributions and habitat preferences up to 98 reptile and three amphibian species may occur in the Project Area. The limited survey duration and low temperatures experienced during the survey account for the relatively low number recorded.

Some species (e.g. *Diplodactylus wellingtonae*) are at the northern most part of their range, while others are occurring at the southern extreme of their range (e.g. *Carlia munda*). Several species have small distributions in the northern/central Pilbara area, encompassing the Project area (e.g. *Varanus pilbarensis, Ctenotus rutilans, Lerista chalybura, Lerista neander, Liasis olivaceus barroni*).

3.8.4 Mammals

Ten mammal species were recorded in the Project Area comprising two dasyurid, one macropod, two bat, three rodent and two introduced species (including the Dingo). The presence of the Western Pebble-mound Mouse (*Pseudomys chapmani*), Euro (*Macropus robustus*) and the Feral Cat (*Felis catus*) were inferred from indirect evidence.

Two active Pebble-mound Mouse mounds were found on the ridge, 3 km west of the orebody.

The area has the potential to support the Echidna, a further six dasyurid, two macropod, 13 bat, two rodent and two introduced species. Four species are of particular conservation significance, being listed on the Rare and Endangered Fauna Schedule and the *Commonwealth Endangered Species Protection Act*. These are:

- Schedule 1 Western Pebble-mound Mouse (*Pseudomys chapmani*) - indirect evidence;
  Orange Leaf-nosed Bat (*Rhinonicteris aurantius*) - potential to occur;
- Schedule 2 Lesser Stick Nest Rat (*Leporillus apicalis*) - potential to occur;
- Vulnerable Ghost Bat (*Macroderma gigas*) - potential to occur.

3.8.5 Scheduled Fauna

Three species having conservation significance were recorded within the Project Area. A further nine species have to potential to occur within the area. These are presented on Table 3-6.

TABLE 3-6

SIGNIFICANT SPECIES WITHIN THE PROJECT AREA

Schedule	Species	Recorded/Potential	Range/Habitat	Comment
Schedule 1	Grey Honeyeater (Conopophila whitei).	Recorded during 1997 survey in Mulga habitat in drainage line.	Transitory.	Habitat in minor drainage line.
	Grey Falcon (Falco hypoleucos).	Potential to occur.	Nomad or semi-deserts, grassy and tree scattered plains and timbered water courses of central Australia.	Wide ranging species, not dependent on any habitat in the area to be disturbed.
	Night Parrot (Pezoporus occidentalis).	Potential to occur.	Nomadic species occurring on inland plains and breakaways.	Thinly distributed wide ranging species.
	Pilbara Olive Python (Morelia olivacea).	Potential to occur.	Range restricted to the Pilbara region along major drainage systems, especially those associated with rock outcrops.	Absence of primary habitat, low probability of occurrence.
	Western Pebble-mound Mouse (Pseudomys chapmani).	Indirect evidence of presence (two active mounds in area).	Species inhabits Triodia hummock grassland with mounds common on spurs and lower slopes of ridges in iron ore formations and dolomite and calcrete outcrops.	Schedule 1 status currently under review.
	Orange Leaf-nosed Bat (Rhinonicteris aurantius).	Potential to occur.	Humid caves preferred roosting and foraging sites, although will probably occur in a wide range of habitats.	No roosting sites, possible foraging in area.
Schedule 2	Lesser Stick Nest Rat (Leporillus apicalis).	Potential to occur.	Formerly ranged over much of central Australia nesting in small caves and break aways.	Habitat present in area. No recent sitings or evidence of presence.
Schedule 4	Peregrine Falcon (Falco peregrinus).	Recorded during 1997 survey in gully habitat.	Nomadic or sedentary, prefers coastal or inland cliffs and gorges, timbered water courses, plains and open woodlands.	Wide ranging species, not dependent on any habitat in the area to be disturbed.
	Major Mitchell's Cockatoo (Cacatua leadbeateri).	Potential to occur.	Nomadic and widespread across Australia.	Wide ranging species, not dependent on any habitat in the area to be disturbed.
'Vulnerable'[1]	Ghost Bat (Macroderma gigas).	Potential to occur.	Humid caves preferred roosting sites.	No roosting sites.
Migratory[2]	Rainbow Bee-eater (Merops ornatus).	Potential to occur.	Aerial forager in tree canopy. Nests in sand banks or sloping sandy soil occurring along drainage lines.	No suitable habitat in Project Area except transitory foraging.
	Fork-tailed Swift (Apus pacificus).	Potential to occur.	Aerial species rarely landing.	Species rarely lands, therefore Project Area habitats not provided.

[1] Vulnerable' as listed on the *Commonwealth Endangered Species Protection Act* as species believed likely to move into the 'Endangered' category in the near future as causal factors continue to operate.

[2] Listed under China-Australia Migratory Bird Agreement (CAMBA) for the protection of migratory birds and birds in danger of extinction and also for the management and protection of their environments.

Source: *ecologia* Environmental Consultants, 1997.

On the basis of apparent scarcity and a contracting range, the Western Pebble Mound Mouse was gazetted in 1987 as Schedule 1 on the CALM Rare and Endangered Fauna Schedule. Species within this category include those that have experienced a significant range contraction since European settlement, have highly restricted known distributions or are species which are poorly known, but are presumed to be under threat. This status is currently under review.

The Australian and New Zealand Conservation Council (ANZECC) has placed the species on the List Of Endangered Vertebrate Fauna April 1991 as 'vulnerable'. These are species believed likely to move into the 'Endangered' category in the near future if the causal factors continue to operate.

3.8.6 Potential Impacts

The mining operations will have local impacts on fauna mainly as a result of the overburden storage areas. The larger mobile fauna species found in the Project Area will move to other areas, however the less mobile species occupying sites of disturbance will be impacted.

The Mulga habitat occurring within a minor drainage line to the east of the existing borrow pits will not be disturbed by the Project.

The Project is unlikely to have a significant impact on the fauna with conservation significance as the Project Area does not present suitable habitats for the majority of these species.

Two active Pebble-mound Mouse mounds were found in the area, but due to their distance from the mining operation will not be disturbed by the Project.

3.8.7 Management

To minimise the impact on fauna from habitat loss, the Proponent is committed to a policy of minimum disturbance with rehabilitation to occur as soon as practicable following mining.

Management of habitat disturbance will be achieved by the close supervision of the contractor to ensure that the minimum area required for the Project is disturbed.

3.9 ABORIGINAL HERITAGE

3.9.1 Existing Conditions

BHP Iron Ore has commissioned archaeological and ethnographic surveys of the areas which will be affected by the proposed mine expansion. Initial heritage surveys over the Newman area, including Orebody 23, were commissioned by the former Mt Newman Mining Company and undertaken by the former Department of Aboriginal Sites, Western Australian Museum (Palmer, 1975 and Troilett and Clarke, 1981).

Only one Aboriginal site , P0203 (recorded by Palmer, 1975), was recorded within the proposed mining area. This site (Palmer's field site 7) is recorded as an artefact scatter comprising four pieces of flaked stone. Approval to use the land upon which site P0203 was located was granted under Section 18 of the *Aboriginal Heritage Act 1972-1980* in February 1985 by the Minister for Aboriginal Affairs.

Ethnographic and archaeological survey work undertaken for the development of the Newman Dam included coverage of the land proposed for Orebody 23 dewatering and monitoring locations (Clarke and Smith, 1979). A number of sites were recorded as a result of this work which are in close proximity to both Orebody 23 and the dewatering and monitoring locations. These are mythological site P2051 and archaeological sites P2045, P2049, P2052 and P2057.

3.9.2 Impacts and Management

Mythological site P2051 is located over 1 km to the north of Orebody 23 between the Newman-Nullagine road and the Newman to Hedland railway and will not be impacted by the current proposal. This site has been fenced and appropriate signs erected to ensure its protection and management.

Approval to use the land upon which archaeological site P2045 was located had previously been granted under Section 18 of the Aboriginal Heritage Act in 1985. This site was located at the eastern end of Ophthalmia Range, approximately 200 m to the east of the current proposal and was impacted a number of years ago.

The other previously recorded sites P2049, P2052 and P2057 are recorded along the banks of the Fortescue River. None of these sites will be impacted by the proposed dewatering, monitoring locations and associated access tracks.

Further archaeological and ethnographic heritage surveys were conducted by BHP Iron Ore in 1997 over the proposed extensions to Orebody 23. One site, an artefact scatter, was recorded as a result of this work. The developments, as currently proposed, will not impact upon this site as it has been fenced and marked as a management measure. Should, in the future, the land upon which this site is located be required for the purposes of mining then BHP Iron Ore will abide by the provisions of the *Aboriginal Heritage Act 1972-1980* and make a formal application under Section 18 of this Act.

To avoid any disturbance or damage to this site and others in the vicinity of Orebody 23, all BHP Iron Ore employees and contractors visiting and or employed at the proposed Orebody 23 area will undergo a compulsory induction where they will be advised of their responsibilities under the Act and of the management measures undertaken for the newly recorded site and those previously recorded sites in close proximity.

To further ensure compliance with provisions of the Act BHP Iron Ore will also address the identified Aboriginal heritage considerations for Orebody 23 as part of the Life of Project Environmental Management Plan.

3.10 STATE OF WESTERN AUSTRALIA

3.10.1 Socio-economic Setting

The development of the iron ore industry in the Pilbara since the 1960s has contributed significantly to both the region's economy and population growth. The population of the Pilbara region in the 1996 census was 44,798 with a majority living in coastal towns such as Port Hedland, Karratha, Exmouth and mining towns such as Newman, Tom Price, Panawonica and Paraburdoo.

Approximately 9,021 people lived in the East Pilbara Shire during 1996. The population of the Town of Newman for the year of 1996 was estimated to be 5,505.

Population figures for the Town of Newman and the East Pilbara Shire for the last six years are provided in Table 3-7.

TABLE 3-7

POPULATION CHANGES FOR THE EAST PILBARA SHIRE AND TOWN OF NEWMAN

Year	Town of Newman	East Pilbara Shire
1990	5,500	9,500
1991	5,627	10,200
1992	5,400	10,000
1993	5,200	9,300
1994	3,500	9,300
1995	4,000	9,500
1996	5,505	9,021

Source: pers. comm. East Pilbara Council 1996 and 1997.

The economy of the Pilbara is dominated by the recovery of minerals (such as iron ore) and petroleum products. Revenue from tourism in the Pilbara is largely derived from tourists passing through the region on their way to other areas. The Market Equity study of the Pilbara (Market Equity, 1995) identified the potential to promote the Pilbara as a destination in itself. The number of tourists passing through Newman in 1995 was estimated at nearly 40,000 (Shire Clerk, Town of East Pilbara 1995, pers. comm.) Furthermore, over 165,000 visitors stay in paid accommodation every year at various tourist locations in the Pilbara regions (Market Equity, 1995). The development of infrastructure such as roads to service mining companies has provided a vital form of access for tourists which might otherwise not have been available. The major regional tourist attractions in the southern Pilbara area include the gorges of the Karijini National Park and the springs/pools around the Newman area.

The pastoral industry also operates extensively throughout the Pilbara rangelands.

3.10.2 Potential Impacts

The Project will have a positive impact on the economy of the State of Western Australia. Around 60 people will have permanent employment from this development together with the nearby Orebody 25 operation. Employees will all be sourced from Western Australia, where possible. A variety of specialist consultants will also be employed during the life of the mine who will also be sourced from Western Australia, where possible.

All facilities required for the commencement of the Project are present on site, however, materials for the maintenance and upgrade of equipment throughout the life of the Project will be sourced from Western Australia providing they are price, service and delivery competitive.

The development of the Orebody 23 mining operation will result in economic benefits for the community through:

- the State Government receiving additional revenue in the form of royalties, payroll tax and other charges;
- increased income flow to the Federal Government through tax revenue (personal income tax and corporate tax);
- demand for goods and services which will generate income and create opportunities for other Australian business sectors; and
- returns to shareholders.

3.11 DUST

3.11.1 Existing Conditions

Elevated ambient dust levels are often present in the Pilbara during periods of strong winds. At present, Western Australia does not have any State-wide uniform regulatory ambient standards for particulates (dust).

3.11.2 Potential Impacts

The generation of dust from open-cut iron ore mining can occur when large volumes of dry materials are moved. No processing of ore occurs at Orebody 23 so the activities with the potential to generate dust include:

- drilling and blasting;
- ore and overburden mining and loading operations;
- ore and overburden hauling;
- road haulage; and
- truck unloading (tipping).

The overburden storage areas and ore stockpiles may occasionally contribute to elevated dust levels. Dust may be generated both from the process of forming the storage area and stockpiles and from older, as yet unconsolidated, storage area surfaces.

The township of Newman is the closest residence to Orebody 23, which is located 13 km to the south-west of the mine. It is, therefore, unlikely to be affected by any dust generated by the Project activities. The production of dust from the proposed mine is not expected to have a significant additional nuisance impact to that which is naturally generated in high wind conditions.

Dust suppression will be by means of watering by water tankers to control fugitive dust generated from blasts, roads and loading/unloading activities.

3.11.3 Management

The management objective for the control of dust is to comply with the guidelines for nuisance dust levels, that is to maintain dust levels below 1,000 $\mu g/m^3$ (15 minute sample) (Environmental Protection Authority, 1992) at neighbouring residential properties. Since the nearest residences are located 13 km away in Newman, nuisance dust will not be an issue.

Occupational dust levels will be controlled in accordance with the *Mine Safety and Inspection Regulations 1995*.

Dust suppression equipment used at the mine will be maintained in efficient operating condition in accordance with the relevant regulations.

With respect to dust generated from blasting activities, mine regulations require all personnel to be cleared from the area during blasting and that re-entry is not permitted until safe work conditions exist.

All employees and contractors will be informed of the importance of controlling ambient dust levels.

3.12 NOISE

3.12.1 Existing Conditions

Noise has been generated at Orebody 23 during previous periods of mining. This has not created any problem in the past as the site is isolated, being approximately 13 km form the nearest residence in Newman.

3.12.2 Potential Impacts

Noise will be generated by blasting, the operation of mine machinery and movement of light vehicles. This noise will have little to no impact on the local community as the mine site is approximately 13 km from Newman, the nearest population centre.

3.12.3 Management

Noise impacts from blasting will be minimised by detonating at specific times during daylight hours, that is, between 7.00 am and 6.00 pm Monday to Saturday. The size of the blast will be appropriate to the area and will take account of the atmospheric conditions at the time of blasting.

Since noise impacts associated with the proposed mine will be more than 13 km from the Newman township, noise emissions (including blasting) will comply with the *Noise Abatement (Neighbourhood Annoyance) Regulations 1979*. The requirements of the *Mine Safety and Inspection Regulations 1995* for the protection of workers will also be complied with.

The *Mine Safety and Inspection Regulations 1995* sets an action level for noise exposure of 85 dB(A) over an eight hour period in relation to occupational health and safety. The regulations require that noise levels above the action level associated with the construction and operation of the mine must be reduced as much as practicable by engineering noise controls.

Based on the requirements of these regulations, the following measures will be implemented to reduce noise levels:

- the use of low-noise equipment;
- the use of silencers, where necessary; and
- the use of exhaust mufflers.

3.13 WASTE PRODUCTS AND HAZARDOUS MATERIALS

3.13.1 Potential Impacts

The Orebody 23 operations will require the use of products which are classified as dangerous goods (fuels, lubricants, detergents and explosives). The site will also generate non-toxic waste including scrap metal, tyres, wood, paper and domestic solids.

3.13.2 Management

All waste products resulting from the operation will be disposed of in accordance with local and State Regulations. Oily wastes will be collected by a registered agent for disposal. Non-toxic solid wastes will be disposed of off-site in the local Shire landfill as is the practice with the existing operations.

Bulk fuel will be stored in above ground tanks in impermeable bunded enclosures. Explosives will be stored in a magazine remote from operational activities and above flood level.

3.14 GREENHOUSE GASES

3.14.1 Potential Impacts

The mining operation at Orebody 23 will generate greenhouses gases through the use of equipment and fuels.

3.14.2 Management

BHP Iron Ore is a member of the Greenhouse Challenge, a voluntary programme to reduce emissions of greenhouses gases relative to production. The Company will minimise the emission of these gases though the implementation of action plans to increase energy efficiency in the areas of mobile equipment efficiency, fuel selection, the use of electricity and the methods of product transportation selected.

3.15 TRANSPORT

Transport associated with the current Orebody 23 operation is mostly confined to private roads controlled and maintained by BHP Iron Ore. BHP Iron Ore use of public roads is mainly confined to deliveries of fuel, equipment, and other supplies to the Orebody 25 site for use at Orebody 23 and occasional use by personnel commuting to and from Newman.

3.15.1 Potential Impacts

The proposed expansion to the Orebody 23 operation will not significantly increase the traffic volumes using the public roads in the area.

3.15.2 Management

Where practicable, traffic associated with the mining operation will be restricted to the private roads controlled by BHP Iron Ore. Vehicles using the public road will comply with the safety requirements of Main Roads Western Australia and any relevant statutory requirements, Australian Standards and/or codes of practice.

3.16 VISUAL AMENITY

The current Orebody 23 pit and overburden storage area are visible from the Newman-Marble Bar Road.

3.16.1 Potential Impacts

Visual impacts associated with the proposed expansion to the Orebody 23 operation will result from an increase in the size of the overburden storage areas. The majority of the expanded pit will be below ground level, therefore, the impacts associated with this will be no greater than those from the existing pit.

3.16.2 Management

Following the completion of mining, all disturbed surfaces outside the pit and accessible pit benches will be rehabilitated to a stable condition with vegetation and flora approaching that which occurred in the area prior to mining. Overburden storage areas will be constructed to be consistent with the surrounding landforms and to meet rehabilitation objectives.

3.17 COMPLETION OF MINING

3.17.1 Potential Impacts

Operations at Orebody 23 will continue for approximately four years. Residual longer-term impacts at the completion of mining operations at Orebody 23 will be mainly associated with the stabilisation of post-mining landforms and hydrological impacts as discussed in previous sections of this CER.

3.17.2 Management

Following the completion of mining, all infrastructure will be removed and disturbed areas rehabilitated using techniques standard at the time of decommissioning.

BHP Iron Ore has developed rehabilitation procedures through its experience in the Pilbara region. The overall objective of the rehabilitation programme is to return disturbed surfaces to a stable condition with flora and fauna approaching that which occurred in the area prior to mining.

Where practicable, topsoil and vegetation on areas to be disturbed will be stripped and stored for later use in rehabilitation. At the end of mining, areas will be contoured, as necessary, topsoiled and the surface treated by ripping or other techniques to promote water harvesting. Where necessary, areas will be seeded with a mixture of native species.

The monitoring of rehabilitated areas will be undertaken by environmental staff at Newman and will be similar to that presently being carried out at other BHP Iron Ore operations.

BHP Iron Ore has recently adopted the approach for satellite orebody development in the Newman area whereby environmental management practices are described in specific Life of Project Environmental Management Plans. This involves submitting a draft of the EMP to the EPA for assessment with the Project approval documentation. Following approval, the EMP will be periodically revised by BHP Iron Ore and submitted to the DEP for review as part of an effective environmental management system where practices are modified in response to the results of monitoring programmes and any operational changes.

This approach is proposed for Orebody 23 and a general commitment is made to prepare and implement such an EMP. The draft Life of Project Environmental Management Plan is provided in Appendix B.

The following commitment is made by BHP Iron Ore for the Orebody 23 operation.

Commitment 7: Development of a Life of Project Environmental Management Plan

BHP Iron Ore will prepare, to a timetable agreed with the Department of Environmental Protection, and implement a Life of Project Environmental Management Plan (EMP) for the Orebody 23 Project to the satisfaction of the Environmental Protection Authority, on advice from the Department of Environmental Protection and the Department of Minerals and Energy.

The EMP will be developed in accordance with statutory conditions applied to the approved operations. The EMP will be reviewed and updated as required.

The EMP will address and BHP Iron Ore will commit to practice guidelines to manage the following environmental factors:

- surrounding environment;
- vegetation and topsoil management;
- overburden storage;
- surface water;
- groundwater;
- flora;
- fauna;
- Aboriginal heritage;
- noise;
- dust;
- waste and hazardous materials;
- rehabilitation;
- decommissioning;
- contracting; and
- continuous improvement.

The proposal to extend the mining operation at Orebody 23 below the watertable, as described in this document, provides BHP Iron Ore with the ability to meet current and mid-term demands for iron ore. The operation will also add to the already substantial economic benefits derived from the Western Australian iron ore industry through generating export income and flow-ons to the community.

BHP Iron Ore makes the commitments, summarised in Table 5-1, for the management of environmental impacts at Orebody 23.

TABLE 5-1

SUMMARY OF PROPONENT'S COMMITMENTS

Commitment	Objective	Action	Timing	Whose Advice	Measurement/Compliance Criteria
Commitment 1: Pyritic Shales					
BHP Iron Ore will ensure that potentially reactive pyritic shales are managed within the overburden storage areas to prevent acid generating processes occurring. Pyritic materials exposed in the pit walls will be sealed to prevent exposure to air.	To ensure that potentially reactive material is managed to prevent the generation of acid rock drainage.	Pyritic material will be stored above the groundwater table in dedicated cells within the overburden storage area.	During mining.	DME	Pyritic materials stored in dedicated cells within the overburden storage areas.
Commitment 2: Water Monitoring					
BHP Iron Ore will supplement the existing water monitoring system to measure watertable levels throughout the Ethel Creek Wellfield. Additionally, the quality of the water will be measured at various strategic locations throughout the system. Monitoring will take place during the mining/dewatering phase and after cessation of mining for the period of time until the aquifer has reached near pre-mining levels.	To minimise the short and long-term effects caused by groundwater use. To monitor for changes in groundwater level and quality both during mining and for an indefinite period following the completion of mining to ensure that the beneficial use of the resource is protected.	An ongoing groundwater monitoring programme will be developed and implemented to meet the requirements of the DEP.	During mining and dewatering and post-mining.	WRC DEP	Groundwater monitoring programme developed and implemented.
Commitment 3: Pit Waterbody Monitoring					
BHP Iron Ore will monitor the quality of water in the pit and the adjacent aquifer following the completion of mining at Orebody 23. Appropriate monitoring bores, representing aquifer water quality adjacent to the pit, will be selected with the agreement of the Department of Environmental Protection.	To monitor for changes in groundwater level and quality both during mining and for an indefinite period following the completion of mining to ensure that the beneficial use of the resource is protected.	An ongoing groundwater monitoring programme will be developed and implemented to meet the requirements of the DEP.	During and post-mining.	DEP.	Monitoring programme in operation.

Commitment	Objective	Action	Timing	Whose Advice	Measurement/Compliance Criteria
Commitment 4: Pit Waterbody Management					
If the results from the aquifer monitoring indicate salinity levels (as measured by Total Dissolved Solids) in the selected bores have increased to 1,500 mg/L or more, BHP Iron Ore will investigate means of limiting further increases. Where sustained levels in excess of 2,000 mg/L are recorded in the selected bores for more than a 12 month sampling period, BHP Iron Ore will implement suitable techniques to maintain water quality consistent with agreed beneficial uses, at that time.	To minimise the short and long-term effects caused by groundwater use.	Investigate and, if required, implement techniques to maintain water quality consistent with agreed beneficial uses.	During and post-mining.	DEP	Investigations undertaken, if required, into techniques to maintain water quality. Implement, if required, techniques to maintain water quality.
Commitment 5: Tree Monitoring					
BHP Iron Ore will establish a comprehensive tree monitoring programme that will assess the impact of dewatering on the vegetation along the creek systems.	To detect potential impacts of groundwater drawdown on the phreatophytic vegetation of the area.	Develop and implement a tree monitoring programme which meets the requirements of the DEP and CALM.	Before dewatering starts.	DEP CALM	Tree monitoring programme developed and implemented.
Commitment 6: Tree Watering					
If the tree monitoring programmes (Commitment 4) indicates that dewatering is having an adverse impact on riverine vegetation, BHP Iron Ore will implement a tree watering system to sustain riverine vegetation in areas as determined by the monitoring. The watering system will operate during mining/dewatering and after the cessation of mining until the groundwater level, in identified areas, has returned to near pre-mining levels.	To minimise the impacts of groundwater drawdown on the phreatophytic vegetation of the area.	Develop and implement a tree watering programme, if required, which meets the requirements of the DEP and CALM.	If indicated is required by tree monitoring programme in Commitment 5.	DEP CALM	Commencement of the tree watering programme, if required.

Commitment	Objective	Action	Timing	Whose Advice	Measurement/Compliance Criteria
Commitment 7: Development of a Life of Project Environmental Management Plan					
BHP Iron Ore will prepare, to a timetable agreed with the Department of Environmental Protection, and implement a Life of Project Environmental Management Plan (EMP) for the Orebody 23 Project to the satisfaction of the Environmental Protection Authority, on advice from the Department of Environmental Protection and the Department of Minerals and Energy. The EMP will be developed in accordance with statutory conditions applied to the approved operations. The EMP will be reviewed and updated as required. The EMP will address and BHP Iron Ore will commit to practice guidelines to manage the following environmental factors: • surrounding environment; • vegetation and topsoil management; • overburden storage; • surface water; • groundwater; • flora; • fauna; • Aboriginal heritage; • noise; • dust; • waste and hazardous materials; • rehabilitation; • decommissioning; • contracting; and • continuous improvement	To manage the environmental impact of the Project.	Develop and implement a Life of Project Environmental Management Plan to meet the requirements of the DEP and DME.	Prior to the commencement of mining.	DEP DME	Life of Project Environmental Management Plan developed.

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ANFO	ammonium nitrate fuel oil
ANZECC	Australian and New Zealand Conservation Council
BHP Iron Ore	BHP Iron Ore Pty Ltd
BIF	banded iron formation
°C	degrees Celsius
CALM	Department of Conservation and Land Management
CAMBA	China-Australia Migratory Bird Treaty
dB(A)	A-weighted decibels
DEP	Department of Environmental Protection
DME	Department of Minerals and Energy
DMSV	Digital Multi-Spectral Video
EMP	Life of Project Environmental Management Plan
EPA	Environmental Protection Authority
ha	hectares
kL	kilolitres
kL/day	kilolitres per day
km	kilometres
m	metres
m^3	cubic metres
m^2/d	square metres per day
mg/L	milligrams per litre
mm	millimetres
ML	megalitres
ML/d	megalitres per day
Mt	million tonne
Mtpa	million tonnes per annum
RL	relative level
t	tonne
TDS	Total Dissolved Solids
$\mu g/m^3$	micrograms per cubic metre

Environmental Protection Authority Guidelines

APPENDIX A

Environmental Protection Authority
Guidelines

NEWMAN SATELLITE DEVELOPMENT - MINING OF OREBODY 23 BELOW WATERTABLE

(Assessment Number 1142)

Part A	Specific Guidelines for the preparation of the Consultative Environmental Review
Part B	Generic Guidelines for the preparation of an environmental review document

Attachment 1	Example of the invitation to make a submission
Attachment 2	Advertising the environmental review
Attachment 3	Location of Orebody 23
Attachment 4	Regional Hydrology

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.

Part A: Specific Guidelines for the preparation of the Consultative Environmental Review

1. The proposal

BHP Iron Ore Pty Ltd (the proponent) is proposing to extend bedrock mining at the current Orebody 23 operation to below the water table level. The minesite is located on the southern side of the Ophthalmia Range approximately 13 kilometres northeast of Newman (see Attachment 3). This area is adjacent to where the Fortescue River cuts the range at Ethel Gorge (Attachment 4).

Mining of scree ore commenced at Orebody 23 in July 1992, and mining of bedrock commenced in May 1993, pursuant to a commitment to restrict mining to above the watertable. The proponent has since undertaken an assessment of the environmental impacts of mining below the watertable, and now wishes to mine below the watertable.

Ore is currently hauled to the Orebody 25 plant for processing and trainloading. It is proposed that ore from Orebody 23, mined from below the watertable, will continue to be hauled by off-highway trucks approximately 6 kilometres to the existing Orebody 25 crusher location which is adjacent to the rail siding. No additional infrastructure is required.

To date, 6 Mt of ore has been recovered and the remaining ore reserve of 10.7 Mt occurs below the watertable. It is proposed that the remaining ore will be mined over a four year period at a rate of between 2 and 4 Mt per year.

Orebody 23 lies in the Fortescue River aquifer at the junction of Homestead Creed and the Fortescue River at Ethel Gorge. The remaining ore reserve lies below the 505 m RL watertable level and it is proposed that dewatering will be necessary for its recovery. It is estimated that dewatering of Orebody 23 will result in the abstraction of up to 22 000 kilolitres per day.

2. Environmental factors relevant to this proposal

At this preliminary stage, the Environmental Protection Authority (EPA) believes the relevant environmental factors, objectives and work required is as detailed in the table below:

CONTENT	SCOPE OF WORK	
Factor	**EPA objective**	**Work required for the environmental review**
BIOPHYSICAL		
Vegetation communities	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.	Baseline studies to identify existing vegetation communities. Assessment of potential impacts (direct and indirect) on vegetation communities as a result of mining and associated activities, including dewatering and dewatering discharge. Proposed measures to manage impacts.
Declared Rare and Priority Flora	Protect Declared Rare and Priority Flora, consistent with the provisions of the Wildlife Conservation Act 1950.	Baseline studies to identify any Declared Rare and/or Priority Flora. Assessment of potential impacts (direct and indirect) on Declared Rare and Priority Flora as a result of mining and associated activities. Proposed measures to manage impacts.
Terrestrial Fauna	Maintain the abundance, species diversity and geographical distribution of terrestrial fauna.	Baseline studies to identify existing terrestrial fauna in the project area. Assessment of potential impacts (direct and indirect) on terrestrial fauna as a result of mining and associated activities. Proposed measures to manage impacts.
Specially Protected (Threatened) Fauna	Protect Threatened Fauna and Priority Fauna species and their habitats, consistent with the provisions of the Wildlife Conservation Act 1950.	Baseline studies to identify existing threatened fauna in the project area. Assessment of potential impacts (direct and indirect) on threatened fauna as a result of mining and associated activities. Proposed measures to manage impacts.

CONTENT	SCOPE OF WORK	
Factor	**EPA objective**	**Work required for the environmental review**
Watercourses	Maintain the integrity, functions and environmental values of watercourses. Ensure that the quantity and seasonal variation in flow of surface and groundwater is maintained, throughout the life of the mine and after decommissioning. Ensure that alterations to surface water drainage do not adversely impact indigenous vegetation.	Assessment of the potential impacts (direct and indirect) on watercourses. Assessment of impact on Homestead Creek during and subsequent to dewatering. Proposed measures to manage impacts.
Groundwater quantity	Maintain the quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.	Detail of water requirements for any on-site processing and mine operations. Assessment of the implication(s) this may have on regional groundwater and phreatophytic vegetation. Proposed measures to manage impacts.
Landform	Establish stable, sustainable landform consistent with surroundings.	Assessment of potential impacts of the proposal on existing landforms. Detail of management of the final void, ie. backfilled or partially backfilled. If only partial, to what level. Detail of measures proposed to rehabilitate the impacted area, including removal of infrastructure, clean-up of any contaminated areas and how ongoing environmental management of the site will not be required.

CONTENT	SCOPE OF WORK	
Factor	**EPA objective**	**Work required for the environmental review**
POLLUTION MANAGEMENT		
Greenhouse gases	Ensure that greenhouse gas emissions meet acceptable standards and requirements of Section 51 of the Environmental Protection Act 1986 (all reasonable and practicable measures are taken to minimise greenhouse gas discharge).	Detail of potential source(s) of greenhouse gas emissions.
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.	Baseline studies to identify existing sources of dust. Assessment of potential increases in dust resulting from the construction and operation of the mine and associated activities. Assessment of potential impacts of increased dust on the amenity of surrounding land users from the construction and operation of the mine and associated activities. Discussion should be given to the possibility of asbestos dust emissions occurring. Proposed measures to manage impacts.
Groundwater quality	Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993) [and the NHMRC / ARMCANZ Australian Drinking Water Guidelines - National Water Quality Management Strategy].	Detail of water requirements for any on-site processing and mine operations. Detail of drainage and fate of water used in any on-site processing and mine operations. Detail of potential salinisation and the possibility of acid mine drainage occurring, and potential impacts on the surrounding environment. Assessment of the implication(s) this may have on regional groundwater quality. Proposed measures to manage impacts.
Surface water quality	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993) [and the NHMRC / ARMCANZ Australian Drinking Water Guidelines - National Water Quality Management Strategy].	Detail of water requirements for any on-site processing and mine operations. Detail of drainage and fate of water used in any on-site processing and mine operations, including dewatering. Detail of the possibility of acid mine drainage occurring, and potential impacts on the surrounding environment. Assessment of the implication(s) this may have on regional groundwater quality. Proposed measures to manage impacts.

CONTENT	SCOPE OF WORK	
Factor	**EPA objective**	**Work required for the environmental review**
Noise	Protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring that noise levels meet statutory requirements and acceptable standards.	Baseline studies to identify existing sources of noise. Assessment of potential increases in noise resulting from the construction and operation of the mine and associated activities. Assessment of potential impacts of increased noise on the amenity of surrounding land users from the construction and operation of the mine and associated activities. Proposed measures to manage impacts.
SOCIAL SURROUNDINGS		
Public health and safety - transport	Ensure that roads are maintained or improved and road traffic managed to meet an adequate standard of level of service and safety and MRWA requirements.	Detail of transport requirements for the proposal. Assessment of potential impacts from any transport works that result from the proposal. Proposed measures to manage impacts.
Visual amenity	Visual amenity of the area adjacent to the project should not be unduly affected by the proposal.	Assessment of potential impacts on visual amenity of the project area and surrounds from the proposal. Proposed measures to manage impacts.
Aboriginal culture and heritage	Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972; and Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Identify Aboriginal cultural and heritage sites of significance through archaeological and ethnographical surveys of the project area and through consultation with local Aboriginal groups and the Department of Aboriginal Affairs. Identify potential impacts on any identified sites. Proposed measures to manage impacts.

The above factors should be addressed within the environmental review document for the public to consider and make comment to the EPA. The EPA anticipates addressing these factors in its report to the Minister for the Environment.

The 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.

3. Availability of the environmental review

3.1 Copies for distribution free of charge

Supplied to DEP:

- Library/Information Centre.....9
- EPA members.....6
- Officers of the DEP (Perth & Regional)..... 10

Distributed by the proponent to:

Government departments

- Department of Resources Development.....1
- Department of Minerals and Energy.....1
- Department of Land Administration.....1
- Water and Rivers Commission 1
- Department of Conservation and Land Management.....1
- Department of Aboriginal Affairs.....1

Local government authorities

- Shire of East Pilbara 1

Libraries

- J S Battye Library 3
- The Environment Centre.....2

Other

- Conservation Council of WA.....1

3.2 Available for public viewing

- J S Battye Library; and
- Department of Environmental Protection Library.

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 Environmental Protection Authority (EPA) to help the proponent to improve the proposal so the environment is protected. The DEP will co-ordinate, on behalf of the 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 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. 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.

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 programme, 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), so that the EPA can obtain informed public comment to assist in providing advice to government.

3. Environmental management

The EPA expects the proponent to develop and implement an Environmental Management System appropriate to the proposal consistent with the principles outlined in the AS/NZS ISO 14000 series, including provisions for accountability review and a commitment to continuous improvement.

The key components which should be included in environmental review documentation, depending on the scale of the proposal, are environmental management:

- policy;
- resources budget;
- programme;
- plan(s);
- training programme;
- monitoring programme;
- contingency plan(s); and
- improvement plan(s).

Documentation on the relevant components should be proportional with the scale of the proposal and the potential environmental impacts. If appropriate, the documentation can be incorporated into a formal environmental management system and provision made for periodic performance review. Public accountability is a principle that should be incorporated into the approach on environmental management.

The environmental management programme is the key document that should be appropriately defined in an environmental review. The environmental management programme should provide plans to manage the relevant environmental factors, define the performance objectives, 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

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.

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 could be presented in the form of a table as follows:

Table 1: Key characteristics (example only)

Element	Description
Life of project (mine production)	55 months
Size of ore body	682 000 tonnes
Area of disturbance	100 hectares
Ore mining rate • maximum • average	 • 200 000 tonnes per year • 160 000 tonnes per year
Background gamma radiation levels • maximum • average	 • 0.52 µGrey per hour • 0.16 m 0.08 µGrey per hour
Water supply • source • maximum hourly requirement • maximum annual requirement	 • Yarloop borefield, shallow aquifer • 180 cubic metres • 1 000 000 cubic metres
Heavy mineral concentrate transport • truck movements (maximum)	 • 75 return truck loads per week

[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.

The key characteristics table should be supplemented with figures to ensure that the proposal is clearly explained. 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.

All figures should include a north arrow, a scale bar, a legend, grid co-ordinates, the source of the data, a title and (where applicable) the date of aerial photo.

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 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 EPA, DEP and other relevant agencies is recommended. The DEP can advise the proponent on the recommended 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 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 EPA's objective as defined above;
- if not, environmental management proposed to ensure the EPA's objective is met;
- 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)

Environmental Factor	EPA Objective	Existing environment	Potential impact	Environmental 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 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 EPA's objective can be met

5.3 Environmental management commitments

The implementation of the proposal and all 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 key 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 key 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 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 a commitment to good general management of the project. Such commitments would not normally be included in the list appended to the statement. The EPA expects that the proponent will audit these commitments by internal processes. Though the DEP would not subject the less significant environmental commitments to routine audit, it may periodically request that compliance with these commitments be demonstrated, so as to verify satisfactory environmental performance in the proponent's implementation of the proposal.

With the implementation of continuous improvement, the procedures to implement the commitments may need to be changed. These changes can be made in updates to the environmental management plan, whilst ensuring the objective is still achieved.

Once the proposal is approved, changes to the commitments constitute a change to the proposal and should be referred to the DEP.

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

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

Commitment (Who/What)	Objective (Why)	Action (How/Where)	Timing (When)	Whose advice	Measurement/ Compliance criteria
1. XYZ Mining will develop a rehabilitation plan	to protect the abundance, species diversity, geographic distribution and productivity of the vegetation community types 3b and 20b	by limiting construction to a small area (10 ha) of Reserve 34587 and rehabilitating the area	before construction	CALM, NPNCA	fences built; species distribution and density consistent with vegetation community types 3b and 20b
2. XYZ Mining will minimise dust generation	to maintain the amenity of nearby land owners	by preparing and implementing a Dust Control Plan which meets EPA Dust Control criteria	before the start of construction phase	preparation: DEP; implementation: Shire	Letter from Shire submitted with Performance and Compliance Report.

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

Draft commitments which are not in a format that can be audited will not be accepted by project 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 EPA process can be noted and referenced.

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 (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 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 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 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 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;
- 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: **[Project Officer name]**

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 PROGRAMME

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

SCM Chemicals Ltd is planning to extend the company's existing residue disposal programme 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

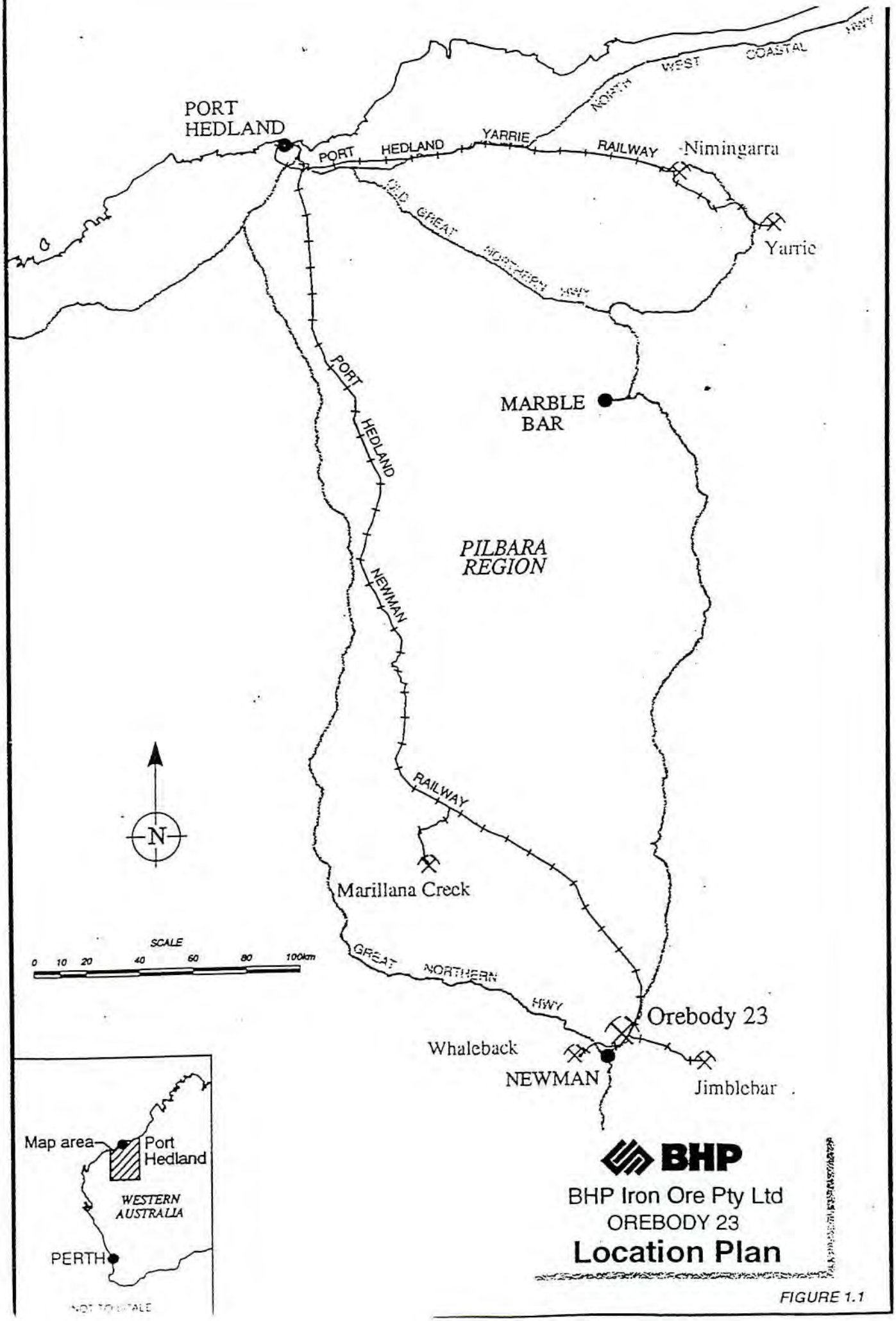
Copies of the complete Consultative Environmental Review will be available for examination at:

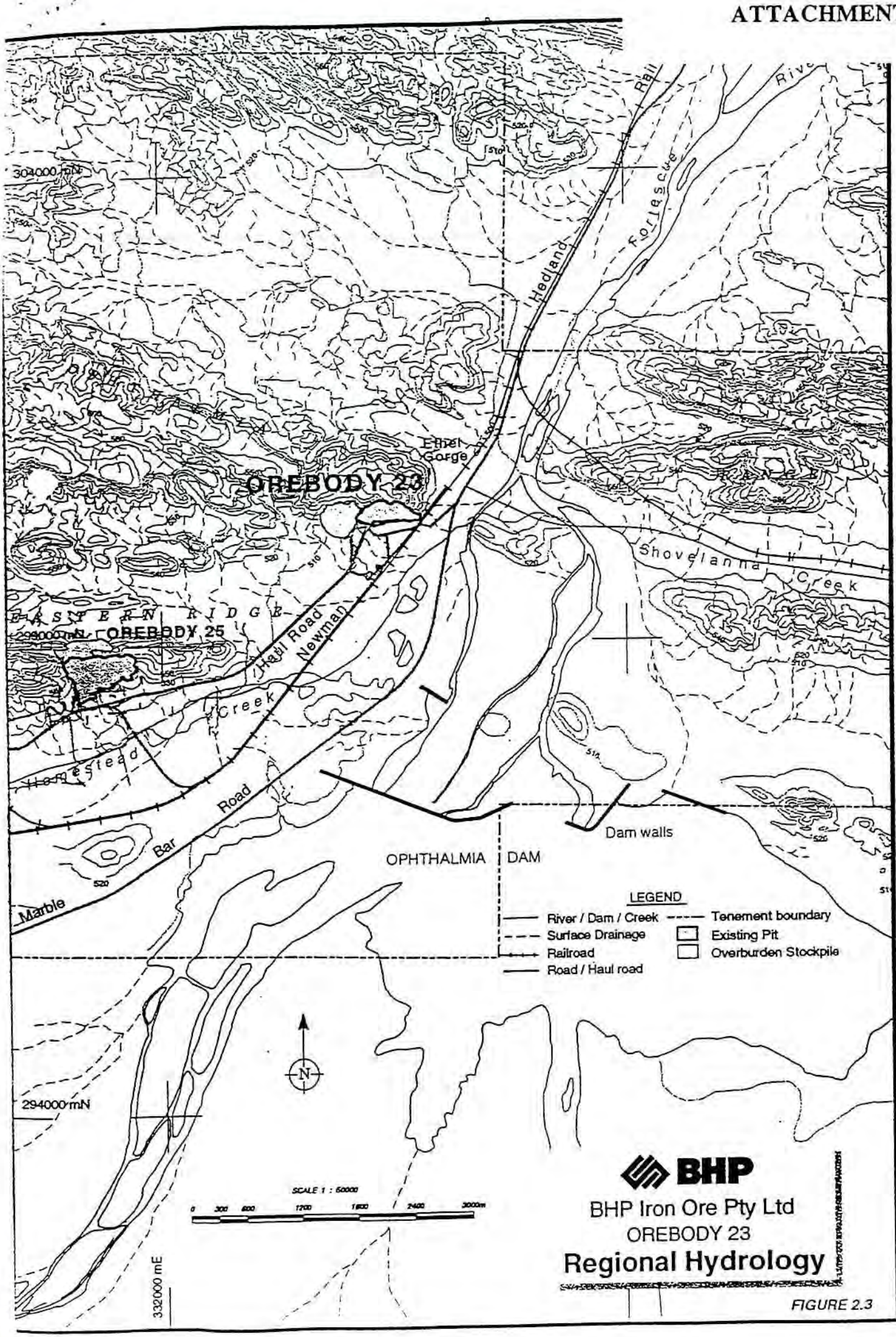
- Environmental Protection Authority
  Library Information Centre
  8th Floor, Westralia Square
  38 Mounts Bay Road
  PERTH WA 6000
- Environmental Protection Authority
  65 Wittenoom Street
  BUNBURY WA 6230
- City of Bunbury public libraries
- Shire of Capel libraries
- Shire of Harvey library (Australind)
- 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
38 Mounts Bay Road
PERTH WA 6000
Attention: **[Project Officer name]**

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


PORT HEDLAND
PORT HEDLAND YARRIE RAILWAY
Nimingarra
Yarrie
NORTH WEST COASTAL HWY
OLD GREAT NORTHERN HWY
PORT HEDLAND
MARBLE BAR
PILBARA REGION
NEWMAN
RAILWAY
Marillana Creek
N
SCALE
0 10 20 40 60 80 100km
GREAT NORTHERN HWY
Orebody 23
Whaleback
NEWMAN
Jimblebar
Map area
Port Hedland
WESTERN AUSTRALIA
PERTH
NOT TO SCALE
BHP
BHP Iron Ore Pty Ltd
OREBODY 23
Location Plan
FIGURE 1.1


304000 mN
Hedland
Fortescue
Rail
Ethel Gorge
OREBODY 23
OREBODY 25
EASTERN RIDGE
Shovelanna Creek
Newman
Haul Road
Creek
Homestead
Bar
Road
Marble
Dam walls
OPHTHALMIA DAM
LEGEND
River / Dam / Creek
Surface Drainage
Railroad
Road / Haul road
Tenement boundary
Existing Pit
Overburden Stockpile
N
294000 mN
SCALE 1 : 60000
0 300 600 1200 1800 2400 3000m
332000 mE
BHP
BHP Iron Ore Pty Ltd
OREBODY 23
Regional Hydrology
FIGURE 2.3

Life of Project Environmental Management Plan

APPENDIX B

NEWMAN SATELLITE DEVELOPMENT MINING OF OREBODY 23 BELOW THE WATERTABLE

LIFE OF PROJECT ENVIRONMENTAL MANAGEMENT PLAN

September 1997

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Tables

Attachments

1.1 BACKGROUND

The Orebody 23 minesite is located approximately 13 km north-east of the Newman township on the Ophthalmia Range in the vicinity of the Fortescue River.

The remaining ore reserve in the pit totals 12 million tonnes (Mt) and will be extracted over a four year period at a rate of between 2 Mt to 4 Mt per year. The ore will be trucked to the existing Orebody 25 plant where it will be crushed and transported by rail to Port Hedland.

BHP Iron Ore is adopting the approach for this development of submitting a draft of the Project specific Life of Project Environmental Management Plan (EMP) to the Environmental Protection Authority (EPA) for assessment as an appendix to the Project approval documentation. Following Project implementation, the EMP will be periodically revised by BHP Iron Ore and submitted to the DEP for review as part of BHP Iron Ore's environmental management system (EMS).

With this approach, the commitment is made to prepare and implement the EMP.

1.2 EXISTING BHP ENVIRONMENTAL PROGRAMMES IN THE PILBARA AREA

BHP Iron Ore is committed to achieving a high standard of environmental management in its mining activities and adhering to all environmental obligations relevant to its activities. This requires the integration of all monitoring and management programmes to refine and continuously improve environmental management practices.

BHP Iron Ore is committed to regional conservation and land management through the implementation of research and management programmes, including:

- Western Pebble-Mound Mouse Management Strategies at Jimblebar, Yarrie and Marillana Creek, in consultation with the Department of Conservation and Land Management (CALM);
- survey work for the Priority 3 plant species *Ptilotus aphyllus*, in consultation with CALM;
- rehabilitation of 16,000 ha of degraded pastoral stations and mining areas;
- decommissioning and rehabilitation of the Goldsworthy, Shay Gap and Koolan Island iron ore operations, including their associated towns;
- initiation of an environmental management plan for the Weeli Wolli Springs area;

- ongoing Marillana Creek hydrological and hydrogeological studies; and
- initiating and maintaining a herbarium of Pilbara plant species.

2.1 ENVIRONMENTAL POLICY

The BHP Environmental Policy was formally promulgated by the Managing Director in July 1991 and applies throughout the BHP organisation. This EMP incorporates and is consistent with the Policy, as reproduced in Attachment A.

This policy applies to all aspects of BHP's operations including contractors and suppliers of goods and services.

2.2 ENVIRONMENTAL MANAGEMENT SYSTEM

BHP Iron Ore has developed a common framework for the Environmental Management System (EMS) developed for each site or operating business.

BHP Iron Ore's EMS is designed to be consistent with ISO 14001.

The Orebody 23 EMS will:

1. comply with government licence conditions;
2. incorporate DEP/EPA compliance audits;
3. incorporate annual internal audit by qualified personnel from the BHP site;
4. incorporate triennial audit by qualified BHP personnel from an independent site;
5. develop an Environmental Performance Improvement Programme to rectify deficiencies identified by the audits;
6. identify, evaluate and rank in significance the environmental effects resulting from existing and proposed operations;
7. identify and evaluate effects of incidents, accidents and potential or real emergencies;
8. identify relevant legislative and regulatory requirements;
9. assist in establishing priorities and setting environmental objectives and targets;
10. document the environmental requirements, procedures and time frames to meet objectives and targets;
11. facilitate activities to ensure that BHP Iron Ore conforms to the BHP Environmental Policy and that the policy remains relevant; and
12. evolve to meet changing needs.

Following the formal assessment of the CER for the extension to mining at Orebody 23, the State Minister for the Environment will issue a statement under Section 45 of the Environmental Protection Act, 1986, stating the environmental management and protection conditions to be applied to the Project. A Pollution Prevention Licence to operate under Part V of the *Environmental Protection Act 1986* will also be sought.

In addition to obtaining a Pollution Prevention Licence, the Proponent must also comply with relevant legislation and regulations administered by other State and Federal Government agencies. These Acts, their application to Orebody 23 and the responsible Government department are listed in Table 3-1.

TABLE 3-1

ENVIRONMENTAL LEGISLATION AND ITS APPLICATION

Act	Application	Responsible Department
Environmental Protection Act 1986	Works Approvals, Pollution Prevention Licences	Dept. Environmental Protection.
Wildlife Conservation Act 1950	Rare Flora and Fauna Protection	Dept. Conservation and Land Management.
Conservation and Land Management Act 1984	Management of Flora and Fauna and Reserves	Dept. Conservation and Land Management.
Rights in Water and Irrigation Act 1914	Water Use, Pollution of Water Resources	Water and Rivers Commission.
Water Authority Act 1984	Licensing of Groundwater Abstraction	Water and Rivers Commission.
Bush Fires Act 1954	Management of Fire Safety	Bush Fires Board.
Agriculture and Related Resources Protection Act 1976	Management of Weeds and Pests	Agriculture WA.
Soil and Land Conservation Act 1945	Controls Land Degradation and Clearing of Land	Agriculture WA.
Land Act 1933	Classification of Land Tenure	Dept. Land Administration.
Mines Safety and Inspection Act 1995	Occupational Health and Safety Issues	Dept Minerals and Energy.
Mining Act 1978	Controls Licensing of Extractive Industries	Dept Minerals and Energy.
Explosives and Dangerous Goods Act 1961	Specifies Storage, Handling and Blasting Requirements	Dept Minerals and Energy.
Aboriginal Heritage Act 1972-1980 (in particular Section 18)	Controls Aboriginal Sites, Particularly Disturbance	Dept. Aboriginal Affairs
Australian Heritage Commission Act 1975	Lists Areas of National Heritage Significance	Australian Heritage Commission.
Native Title Act 1993	Deals with Aboriginal Claims for Land Ownership	Dept. Premier and Cabinet.
Health Act 1911 - 1979	Sewage Disposal Facilities	Dept. Health.
Iron Ore (Mount Newman) Agreement Act 1964	Controls Mining Developments by the Joint Venturers	Dept. Resources Development.

4.1 COMMITMENT

BHP Iron Ore has made the following commitment to develop a Life of Project Environmental Management Plan.

BHP Iron Ore will prepare, to a timetable agreed with the Department of Environmental Protection, and implement a Life of Project Environmental Management Plan (EMP) for the Orebody 23 Project to the satisfaction of the Environmental Protection Authority, on advice from the Department of Environmental Protection and the Department of Minerals and Energy.

The EMP will be developed in accordance with statutory conditions applied to the approved operations. The EMP will be reviewed and updated as required.

The EMP will address and BHP Iron Ore will commit to practice guidelines to manage the following environmental factors:

- *surrounding environment;*
- *vegetation and topsoil management;*
- *overburden storage;*
- *surface water;*
- *groundwater;*
- *flora;*
- *fauna;*
- *Aboriginal heritage;*
- *noise;*
- *dust;*
- *waste and hazardous materials;*
- *rehabilitation;*
- *decommissioning;*
- *contracting; and*
- *continuous improvement.*

4.2 PURPOSE OF THE LIFE OF PROJECT ENVIRONMENTAL MANAGEMENT PLAN

The life of Project Environmental Management Plan (EMP) provides information on the management objectives and performance indicators for each issue, the management practices to achieve the specified objectives, the responsibilities for actions and a review of the critical dates.

The EMP is not intended to provide details of the daily activities and procedures to be implemented at the site (e.g. seed and fertiliser rates).

4.3 RESPONSIBILITY

Overall environmental management at the site will be the responsibility of the BHP Iron Ore's Site Manager. The responsibilities of the Site Manager will be to:

- implement the BHP Environmental Policy and Mission on the site;
- understand environmental requirements and ensure compliance;
- set environmental objectives and targets;
- assign an individual responsible for environmental management who has direct access to the Site Manager;
- direct the activities of company employees, contractors and subcontractors on site to ensure that environmental requirements are met;
- obtain goods and services that conform with relevant legal, permit and contract requirements, accepted standards and BHP specifications.

The Contractors' Manager for the contracting company undertaking the mining operation at Orebody 23 will have the following responsibilities:

- ensuring compliance with all environmental requirements as specified in the contract;
- maintaining routine contact with the Site Manager to ensure the integration of environmental objectives with the mining operation; and
- providing monthly reports to site management on environmental issues and to conduct regular inspections, audits and to initiate follow-up actions.

IMPACT Deepening of the Orebody 23 pit and the extension to the existing overburden storage area will result in the alteration of an additional 100 ha. The total area altered at Orebody 23 will be approximately 137 ha.

EMP OBJECTIVES The objectives of the EMP are outlined below.

- To minimise the environmental effects of land disturbance;
- To plan for rehabilitation of the earliest possible time; and
- To control the impact of mine operations on the surrounding environment (i.e. flora and fauna habitats, landform and drainage systems) by adopting a minimum disturbance policy. Where disturbance is necessary, it will be undertaken in a manner which limits the area cleared to the minimum necessary, reduces the potential for erosion and promotes the natural return of vegetation and fauna.

MANAGEMENT PRACTICES BHP Iron Ore has a policy of minimum environmental disturbance. This practice will be applied to mining at Orebody 23. The following measures will be undertaken.

- Prior to the commencement of operations, a Closure Plan will be developed identifying post-disturbance land uses.
- Clearing works (greater than one hectare) will be approved by the Site Manager before clearing occurs.
- No unauthorised clearing is to occur, in accordance with contractual obligations (see Section 19.0). The importance of these obligations shall be communicated to all employees and contractors through an induction process.
- The overburden storage areas outside the pit will be constructed to be stable and form shapes consistent with the surrounding landforms. Prior to the development of the overburden storage areas:
  - vegetation, where practicable, will be removed and used immediately or stored for use in rehabilitation; and
  - topsoil will be removed and used immediately or stored for later use in rehabilitation.
- The overburden storage area will be progressively rehabilitated with the remaining areas rehabilitated at the completion of mining at Orebody 23 in accordance with Section 17.0 - Rehabilitation.

- Areas of disturbance will be progressively rehabilitated and demarcated as they become available. Further disturbance to these areas will not be permitted without approval of the Site Manager.
- A plan will be kept indicating areas of disturbance and type of disturbance. This plan will also indicate rehabilitated areas and will be updated periodically.

Mining contractors will be supervised by BHP Iron Ore to ensure conformity with these procedures. A condition which prohibits unauthorised clearing will be included in all contracts.

MONITORING

The BHP Iron Ore Site Manager will be responsible for monitoring of rehabilitated areas to assess the progress of the rehabilitation programme.

PERFORMANCE INDICATORS

General Commitments

- BHP Iron Ore will comply with the requirements of the DEP, CALM, Department of Minerals and Energy (DME) and other relevant decision making authorities as contained in the appropriate regulations, codes of practice and legislation.
- Clearing will comply with site approved plans.

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES

Prior to the commencement of mining, a plan will be prepared outlining the areas to be cleared. This plan will periodically be updated during the life of the mine. If additional areas are required to be disturbed, approval will be sought prior to the commencement of any clearing activities.

IMPACT

Vegetation and topsoil, where practicable, will be removed from all areas associated with the expansion of the Orebody 23 pit and overburden storage area and stockpiled for later use or used immediately for rehabilitation.

EMP OBJECTIVE

The EMP objective is to conserve and reuse the vegetation and topsoil which contains seeds, nutrients, organic matter and micro-organisms required for establishing vegetation on rehabilitated areas.

MANAGEMENT PRACTICES

A plan will be prepared showing all major (greater than one hectare) areas requiring topsoil removal before stripping occurs.

Vegetation will be removed and stored for later reuse.

Topsoil will be stripped prior to land disturbance, wherever it is present and safely accessible.

Wherever possible, topsoil will be applied immediately to areas being rehabilitated. Where this is not possible, topsoil will be stored in stockpiles for later use.

Topsoil and vegetation stockpiles will be no higher than 2 m.

Stockpiles shall be clearly marked in the field and identified on a site plan. Plans indicating the location and volume of topsoil stockpiles will be updated periodically.

MONITORING

Regular inspections will be undertaken to ensure that vegetation and topsoil is being removed and stockpiled in the appropriate locations and plans are updated.

PERFORMANCE INDICATORS

General Commitments

- BHP Iron Ore will comply with the requirements from the DEP, DME and other relevant decision making authorities contained in the appropriate regulations, codes of practices and legislation.
- Topsoil movement will comply with site-approved plans.

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES

Prior to the commencement of construction, a plan will be prepared indicating major areas where topsoil is to be recovered and stored. This plan will periodically be updated during the life of the mine.

IMPACT

The storage of approximately 50 Mt of additional overburden outside the Orebody 23 pit area will result in the alteration of an additional 80 ha in the immediate mine area.

The small quantity of pyritic black shale (1.5-2 Mt) will need to be removed from the pit to allow recovery of high grade iron ore. This material will be selectively handled and stored in dedicated cells within the overburden storage area. There will be no significant impact on the surrounding environment from the mining and disposal of the pyritic material.

EMP OBJECTIVE

The EMP objectives are:

- characterise the chemical and physical nature of overburden material;
- to ensure the area of overburden storage is minimised;
- to ensure overburden storage areas are stable;
- to ensure overburden storage areas are consistent with the surrounding landforms; and
- to ensure potentially reactive pyritic material is managed to prevent the generation of acid rock drainage.

MANAGEMENT PRACTICES

BHP Iron Ore has a policy of minimum environmental disturbance. This will apply to overburden storage at Orebody 23.

To reduce the environmental impact of the storage of overburden material, the following measures will be undertaken.

- Geochemical characterisation of overburden material will be undertaken.
- An overburden storage plan will be produced before mining commences and approved by the Site Manager. All overburden placement will be in accordance with this plan.
- The overburden storage plan will be reviewed periodically and alternative placement options considered. Where significant modifications are required, the DEP will be advised via the annual reporting process.
- Overburden storage areas will be constructed to be consistent with the surrounding landforms and to meet rehabilitation objectives.

- Procedures developed by BHP Iron Ore over many years and used successfully at Newman and on a large scale at the decommissioned operations at Mount Goldsworthy and Shay Gap-Nimingarra will be employed in the rehabilitation of the overburden storage areas (refer Section 17.0 Rehabilitation).
- Exposed faces of overburden storage areas will be battered to an angle of 20° or less. Landform stability techniques will be applied and the areas progressively rehabilitated.
- The overburden storage areas will be managed to minimise the effect on surface water quality consistent with regulatory requirements.

Pyritic material removed from Orebody 23 will stored above the groundwater table in dedicated cells within the overburden storage area. The handling of material will involve the following sequence:

- construction of a pad of non-reactive material within the overburden storage area to ensure the base of the cells are above the ground watertable;
- the creation of cells within the storage area with non-reactive overburden material;
- selective removal of potentially reactive shale during the mining operation;
- placement of potentially reactive material in layers within the cells, as it is mined, followed by regular covering with at least 200 mm of overburden to reduce the period of exposure; and
- at the completion of mining, capping of potentially reactive shale with at least 2 m of non-reactive material.

Surface water will be diverted around the overburden storage areas to minimise the potential for infiltration.

These works will be carried out in accordance with the rehabilitation programme developed in consultation with the DEP, the DME and other relevant authorities.

MONITORING

Regular monthly inspection will be undertaken of overburden storage areas to assess conformity with the approved placement plan.

Surface runoff will be periodically monitored for acid rock drainage.

PERFORMANCE INDICATORS

CER Commitment 1: Pyritic Shales

BHP Iron Ore will ensure that potentially reactive pyritic shales are managed within the overburden storage areas to prevent acid generating processes occurring. Pyritic materials exposed in the pit walls will be sealed to prevent exposure to air.

General Commitments

- BHP Iron Ore will comply with the requirements of the DEP, DME and other relevant decision making authorities as contained in the appropriate regulations, codes of practices and legislation.
- Overburden storage will conform with a site-approved plan.

RESPONSIBILITY

The Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES

Prior to the commencement of mining, an overburden storage plan will be developed.

Annual reporting by site management.

IMPACT

The Orebody 23 mine expansion will have a limited impact on the surface water resources in the area. However, the pit and overburden storage areas will intercept minor surface flows in the immediate mine area.

EMP OBJECTIVE

EMP objectives are:

- to minimise impacts on the quality of surface water and contain any contaminated water on site; and
- to ensure that the quality of water returned to local and regional surface water resources will not result in significant deterioration of those resources.

MANAGEMENT PRACTICES

BHP Iron Ore will design, install and maintain silt traps, as required, on major water courses downstream of disturbed areas and stockpiles.

Water quality monitoring and data collection will be undertaken prior to the commencement of extended mining operations. The data will be reviewed regularly to ensure water quality standards and reporting requirements are being met.

Wherever possible, water will be diverted around disturbed areas.

Water released from the site will, as necessary, be discharged via settling ponds to ensure that the water finally released meets the criteria specified in licence conditions.

Licences will be applied for under Part V of the*Environmental Protection Act 1986* for all water discharges.

Long-term drainage systems will be established in a sustainable manner by making them as similar as possible to pre-existing drainage systems.

Wherever practicable, the use of water will be minimised and recycling will be undertaken.

MONITORING

Water samples will be collected from Homestead Creek prior to the commencement of operations to determine background water quality.

Water samples will be collected from permanent discharge points to ensure compliance with Licence requirements. The location and frequency of this programme will be consistent with the drainage management plan. It will be reviewed routinely following commencement of mining operations.

Data required by the DEP/EPA will be submitted in an Annual Report.

PERFORMANCE INDICATORS

General Commitments

BHP Iron Ore will comply with the conditions of the Pollution Prevention Licence issued under the *Environmental Protection Act 1986* in relation to the quality of discharge water.

(Note: The performance indicators will be updated with the requirements from the DEP operating Pollution Prevention Licence issued to BHP following the review of the Proposal.)

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES

Prior to the commencement of operations, an application will be made for a Pollution Prevention Licence under Part V of the *Environmental Protection Act 1986* for all water discharges.

Prior to the commencement of mining, a drainage management plan will be prepared, showing the inputs, outputs and control structures needed for surface water flow. Following the commencement of mining, the monitoring programme for surface water will be reviewed and reported annually.

IMPACT

Groundwater levels in the vicinity of the Orebody 23 will be lowered by up to 140 m as a result of the dewatering operation at the mine which is predicted to peak at 38,000 kL/day during the last two years of mining. Approximately 14,000 kL/day is currently extracted from the Ethel Creek Wellfield for the Mt Whaleback raw water supply. The aquifer storage is mainly replenished through seepage from Ophthalmia Dam in the order of 24,000 kL/day. It is also estimated that approximately 10,000 kL/day is lost through evapotranspiration.

Outflow of groundwater in Ethel Gorge to the north will progressively decline during the first three years and will effectively be stopped during the final years of mining. However, this is not a major component of the water balance for the downstream areas. Estimates of current outflow rates to the north, with the operation of the Ethel Creek Wellfield, are in the order of 500-700 kL/day.

Once the mining and dewatering has ceased at Orebody 23 it is predicted that ground water levels in the aquifer will return to near pre-dewatering levels within approximately 3 years. The pit will, therefore, contain an open water body. It is predicted that evaporative losses from the water body may gradually increase the salinity of water contained in the pit.

Groundwater modelling of the aquifer adjacent to the pit suggests that following the initial post-mining watertable recovery, water may flow out of the pit into the aquifer system. Therefore, it is possible that increases in pit water salinity may eventually impact upon the Ethel Gorge Aquifer.

In the first 10 years after dewatering has stopped, it is estimated that salinity increases in the aquifer adjacent to the pit would be negligible (undetectable to taste). Furthermore, it is estimated that it would take approximately 40 years for aquifer salinity to approach 1,500 mg/L.

EMP OBJECTIVE

The EMP objectives are:

- to minimise the short and long-term effects caused by groundwater use;
- to minimise the short and long-term effects of watertable drawdown caused by the dewatering operation;
- to sustain a 14,000 kL/day raw water supply for BHP Iron Ore's operation at Mt Whaleback.
- to ensure the maximum volume of water abstracted for mining operations is in accordance with the Water and Rivers Commission licences; and

- to monitor for changes in groundwater level and quality both during mining and for an indefinite period following the completion of mining to ensure that the beneficial use of the resource is protected.

MANAGEMENT PRACTICES

It is estimated that the dewatering of Orebody 23 will result in the abstraction of up to 38,000 kL/day. Dewatering production will therefore exceed the daily water requirements for the Whaleback operation (@14,000 kL/day) by up to 24,000 kL/day.

Some of this water (approximately 1,000 kL/day) will be used for dust suppression at Orebodies 23 and 25. A further proportion of the excess water (predicted approximately 3,000 kL/day) may be pumped back into the Fortescue River valley to irrigate vegetation (refer to Section 10). The remainder of the excess water will be distributed between:

- discharge to the Ophthalmia Dam (approximately 14,000-19,000 kL/day); and
- infiltration through the Fortescue River channel downstream of the mining areas to maintaingroundwater outflow to the north (approximately 1,000 kL/day).

Discharge to the Fortescue River will be spread across areas of river bed sufficient to minimise surfaceponding and any associated environmental impacts.

At the completion of mining, water abstraction from the area will be reduced to match the requirements of the Whaleback operation (approximately 14,000 kL/day @ current rates). This water will be sourced from a combination of some of the original water bores and some of the newly establisheddewatering bores.

Licences will be applied for under the*Rights in Water and Irrigation Act 1914* and Part V of the *Environmental Protection Act 1986* for water extraction and all water discharges.

Discharge waters will comply with appropriate licence conditions.

Additional measures to maintain the quality of thegroundwater resource include:

- potentially hazardous wastes will be properly handled until removed from the site;
- on-site solid waste disposal will be minimised and properly managed;
- emergency procedures will be established for managing incidents involving toxic substances; and

- other potentially polluting substances (e.g. fuels and ammonium nitrate) will be stored in properlybunded sites to prevent discharge.

MONITORING BHP Iron Ore has maintained a comprehensive monitoring programme on the Ethel Gorge Creek aquifer. This programme will be augmented to include theOrebody 23 development and the quality of the water in the pit waterbody. Careful monitoring will be conducted during dewatering and post-mining periods.

The water quality of the pit waterbody and adjacent borefield network will be monitored to assess medium and long-term changes in water quality. Appropriate monitoring bores, representing aquifer water quality adjacent to the pit, will be selected for ongoing monitoring. When the salinity (as measured as Total Dissolved Solids - TDS) in the selected bores reaches 1,500 mg/L, investigations will commence into means of limiting further increases. Monitoring will continue to determine the rate of salinity increase.

When a level of 2,000 mg/L is maintained in the selected bores for a twelve month period, management techniques will be implemented. The beneficial use of the aquifer will be determined with the State Government and target objectives established for maintaining water quality.

Monitoring will be in compliance with the conditions of DEP/Water and Rivers Commission licences and will include pumping rates, groundwater levels and water quality. Monitoring will include:

- the sampling of monitoring bores at a frequency determined by the Pollution Prevention Licence conditions;
- water samples will be analysed for the specific anolytes specified in the Pollution Prevention Licence;
- monthly recording of output volumes of production bores; and
- monthly monitoring of water levels in specified monitoring bores.

Samples of discharged bore waters will be routinely submitted to NATA-registered laboratories for analyses detailed in the relevant licences.

Data required by the DEP/EPA/Water and Rivers Commission will be regularly submitted.

PERFORMANCE INDICATORS

Proponent Commitment: 2 Water Monitoring

BHP Iron Ore will supplement the existing water monitoring system to measure watertable levels throughout the Ethel Creek Wellfield. Additionally, the quality of the water will be measured at various strategic locations throughout the system. Monitoring will take place during the mining/dewatering phase and after the cessation of mining for the period of time until the aquifer has reached near pre-mining levels.

Commitment 3: Pit Waterbody Monitoring

BHP Iron Ore will monitor the quality of water in the pit and the adjacent aquifer following the completion of mining at Orebody 23. Appropriate monitoring bores, representing aquifer water quality adjacent to pit, will be selected with the agreement of the Department of Environmental Protection.

Commitment 4: Pit Waterbody Management

If the results from the aquifer monitoring indicate salinity levels (as measured by Total Dissolved Solids) in the selected bores have increased to 1,500 mg/L or more, BHP Iron Ore will investigate means of limiting further increases. Where sustained levels in excess of 2,000 mg/L are recorded in the selected bores for more than a 12 month sampling period, BHP Iron Ore will implement suitable techniques to maintain water quality consistent with agreed beneficial use objectives, at that time.

(This Section to be updated pending confirmation of expected licence conditions from DEP Pollution Prevention Division and Water and Rivers Commission.)

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES

Prior to the commencement of operations:

- an application will be made for a licence to abstract water under the *Rights in Water and Irrigation Act 1914*; and
- a monitoring programme will be developed for water resources adjacent to the site.

Prior to the commencement of dewatering, a monitoring programme will be developed to assess possible watertable drawdown and quality outside the pit area.

IMPACT

The expansion of the Orebody 23 iron ore mine will result in the loss of an area of vegetation through clearing activities. In a regional context, the operations area is not considered to be a significant impact.

One Schedule 2 species, *Scaevola acacioides*, was found during the flora survey (*ecologia* Environmental Consultants, 1997). The three individuals from the surveyed population will be impacted by the overburden storage areas.

There is the potential for drawdown associated with the dewatering activities at Orebody 23 to impact on the phreatophytic vegetation in the creek systems affected by the mine dewatering. The area of drawdown is predicted to extend upstream approximately 6 km on Homestead Creek, 5.5 km on the Fortescue River, 6 km on Shovelanna Creek and 5 km downstream on the Fortescue River.

EMP OBJECTIVE

The EMP objectives are:

- to ensure the conservation status of all flora species is not threatened; and
- to minimise the impacts of groundwater drawdown on phreatophytic vegetation in the area.

MANAGEMENT PRACTICES

Minesite Flora and Vegetation

All clearing operations will be kept to a minimum to reduce the impact on surrounding ecosystems. Clearing Plans will be prepared prior to clearing and monitored regularly to ensure adherence to the plan. A condition prohibiting unauthorised clearing will be included in all contracts.

Further survey work will be undertaken to determine the extent of the distribution of *Scaevola acacioides* within the Project Area.

Riverine Vegetation

A comprehensive tree monitoring programme will be implemented to measure the response of riverine trees to lowering groundwater levels and to understand the nature of any responses such that the appropriate corrective action can be applied, if necessary.

A tree watering system has been designed and will be implemented to irrigate the riverine vegetation, should the tree monitoring programme identify thatdewatering is having an adverse impact on the health of the riverine trees. Watering would be achieved by discharging into the river channels at several locations and allowing the water to disperse along the channels and seep into the creekbed soils. Due to the potential for deep percolation of the irrigation water, several discharge points would be required to maintain water availability to the trees throughout the affected area.

The irrigation system has been designed to take advantage of the existing pipelines andheadworks currently collecting water from the bores in Ethel Gorge. The irrigation system would be partially automated, requiring a power supply and telemetry link at each outlet.

The total tree water needs have been estimated at 1,000 kL/day for winter and 3,000 kL/day for summer. These values will be more accurately determined with data from the tree monitoring programme and the irrigation rates adjusted accordingly.

Currently it is proposed to have a total of 13 outlets to irrigate the riverine vegetation which is predicted to be the most affected by dewatering. Water would be discharged from a minimum of 4 - 6 outlets at one time to maintain outlet pipe velocities, over a determined time period.

The initial discharge of irrigation waters from the outlets would be observed to determine coverage and effectiveness.

Changes would be made to the discharge system as appropriate to ensure riverine trees are receiving adequate water supplies.

MONITORING

Monitoring is an integral part of the management practices for phreatophytic vegetation.

The monitoring programme will concentrate mainly on the tall riverine trees: River Red Gums, Coolabahs and possibly smaller trees such as *Melaleuca glomerata* and *Acacia* species. The impact of dewatering in lowering the groundwater should only potentially affectphreatophytic vegetation. Therefore, non-phreatophytic vegetation such as small shrubs will not be monitored in this study.

The monitoring programme will include an assessment of the following components:

- Tree health - Creekbed monitoring sites;
- Tree health - Aerial survey;

- Tree water use;
- Groundwater levels - Shallow and deep;
- Streamflow;
- Weather data; and
- Tree irrigation rates.

Tree Health - Creekbed Monitoring Locations

Permanent tree monitoring sites will be established in areas within the creek system likely to be affected bydrawdown (impact sites), unaffected bydrawdown (control sites), and in areas which may be irrigated.

At each site, trees will be marked and a plan compiled showing individual tree locations so the same individual trees can be reassessed for health in the future. Tree health will be assessed through photographs from a permanent marker and a visual health ranking.

The ranking system used to assess individual tree health is presented in Table 10-1.

Tree Health - Aerial Survey

To assess tree health on a broader scale, Digital Multi-Spectral Video (DMSV) imaging will be used.

Changes in the health of trees may be detected with the use of DMSV before they become apparent to the observer on the ground.

On commencement of the monitoring programme the study area will be flown and a mosaic produced which shows baseline tree health information on a broad scale. The study area will be reflown on an annual basis to determine any changes to tree health. The area would be flown more frequently if changes in tree health were observed in the interim.

TABLE 10-1

SUGGESTED HEALTH RANKING FOR INDIVIDUAL PLANT SAMPLES

Rank	Condition	Description
1	Healthy	No evidence of stress.
2	Obviously Stressed	Obvious loss of leaves, dieback of limbs or other signs of stress.
3	Very Stressed	Major stress with most leaves lost, death of major limbs and overall appearance of being close to death.
4	Dead	No apparent signs of life visible including no living bark above ground level.

Tree Water Use

The amount of water used by riverine trees is an important variable to measure to understand whether any changes in tree health can be attributed to reduced moisture availability.

The heat pulse method will be used to directly measure water use in trees.

Three sample sites on Homestead Creek will be selected due to its proximity to Orebody 23 and to minimise the influence of Ophthalmia Dam. The monitoring sites in Homestead Creek will be:

- upstream, outside the drawdown area;
- at the predicted 10 m drawdown area; and
- at the area of maximum drawdown.

At each of the above sites two heat pulse units will be installed for a one year period. The continuing use of the heat pulse units will be reviewed after this initial period.

Information from these studies will be used in determining the actual watering requirements of trees in areas of watertable drawdown. This information will be beneficial for assessing the impacts of dewatering on creek/aquifer systems in other parts of the Pilbara.

Groundwater Levels

The creekbed tree monitoring sites will have shallow and deep piezometers installed to measure water levels. This will facilitate the comparison between tree health and soil moisture levels. Existing observation bores will be used, where appropriate, to monitor the deeper groundwater levels. Where existing deep bores are not present, a new deep monitor bore will be installed.

Up to three shallow piezometers will be installed at each site across the creek system. The shallow piezometers would be installed to an approximate depth of 10 m.

Monitoring of bores will be performed on a monthly basis or every 3 weeks to coincide with the heat pulse data logger downloading.

Streamflow

A stream flow gauging station is located on Homestead Creek. This station will be monitored to provide information on water flow into and through the Homestead Creek system. This information is an important component in the hydrological budget of the creek system.

Weather Data

Meteorological data is required for the heat pulse water use study to determine the relationship between climatic factors and tree water use. Information on rainfall and temperature will be obtained from the Newman meteorological station. Pan evaporation rates will be obtained from the Wittenoom meteorological station.

PERFORMANCE INDICATORS

Proponent Commitment 5: Tree Monitoring

BHP Iron Ore will establish a comprehensive tree monitoring programme that will assess the impact of dewatering on the vegetation along the creek systems.

Proponent Commitment 6: Tree Watering

If the tree monitoring programmes (Commitment 4) indicates that dewatering is having an adverse impact on riverine vegetation, BHP Iron Ore will implement a tree watering system to sustain riverine vegetation in areas as determined by the monitoring. The watering system will operate during mining/dewatering and after the cessation of mining until the groundwater level, in identified areas, has returned to near pre-mining levels.

General Commitments

BHP Iron Ore will comply with the provisions of the *Wildlife Conservation Act 1950.*

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

IMPACT

Three species of conservation significance were recorded in the Project Area (*ecologia* Environmental Consultants, 1997). A further nine species have the potential to occur. The Project is unlikely to have a significant impact on significant fauna.

The expansion of the Orebody 23 mining operation will result in the loss of a small area of fauna habitat. This will not result in a significant local or regional impact on the fauna of the area.

EMP OBJECTIVE

The EMP objective is to ensure the conservation status of all fauna species is not threatened.

MANAGEMENT PRACTICES

The impacts of the mine operation on fauna will be minimised by limiting clearing to that which is absolutely essential and limiting road and track development.

To limit habitat disturbance, the mining contractor will be instructed to ensure that only the minimum area required for the operation of the mine is disturbed. A condition will be included in contracts which prohibits unauthorised clearing. The contractor will not be permitted to leave the site until any such disturbance is rehabilitated.

Return of cleared vegetation (eg. spinifex clumps, tree limbs etc) on rehabilitated areas will promote the return of fauna species by providing habitat, shelter and food sources.

General workforce training will be undertaken to ensure that the workforce causes minimal accidental or intentional impacts on fauna. This will include the prohibition of:

- firearms on site;
- off-road use of recreational vehicles;
- pets on-site;
- the unnecessary disturbance of habitat; and
- capture of fauna.

MONITORING

Periodic monitoring of rehabilitated areas will be undertaken. Parameters to be monitored will include the establishment and development of fauna habitats and evidence of the return of fauna species.

PERFORMANCE INDICATORS

General Commitments

BHP Iron Ore will comply with the provisions of the *Wildlife Conservation Act 1950.*

Clearing will be minimised and consistent with approved clearing plans.

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES

Prior to the commencement of construction a clearing plan will be developed to minimise the disturbance of fauna habitats in the mining area.

Annual reports will be prepared as required under licence conditions.

IMPACT

One Aboriginal archaeological site has been identified in the area to be disturbed by the Orebody 23 operation.

EMP OBJECTIVE

EMP objectives are:

- to avoid disturbance to Aboriginal sites; and
- for sites that can not be avoided to ensure that the disturbance is properly approved consistent with the *Aboriginal Heritage Act 1972-1980.*

MANAGEMENT PRACTICES

There is a standing BHP Iron Ore requirement that all employees and contractors promptly report any potential Aboriginal sites discovered in the vicinity of operations to the Company. Where sites are identified in the future, they will be avoided, wherever practicable. For sites that can not be avoided, approval for disturbance will be sought under Section 18 of the *Aboriginal Heritage Act 1972-1980.*

To avoid damage to Aboriginal sites, all employees and contractors will undergo a compulsory induction into their responsibilities under the *Aboriginal Heritage Act 1972-1980.*

MONITORING

Periodic inspections will be undertaken to ensure compliance with the *Aboriginal Heritage Act 1972-1980.*

PERFORMANCE INDICATORS

General Commitment

BHP Iron Ore will comply with the provisions of the *Aboriginal Heritage Act 1972-1980.*

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES

Permission will be sought under the *Aboriginal Heritage Act 1972-1980* to disturb Aboriginal sites, as required.

IMPACT The expansion of the mine at Orebody 23 will not increase noise levels in the immediate vicinity as mining operations have been active at the site since 1993. Noise will be generated by mining plant and equipment, blasting and the movement of ore transport vehicles to the Orebody 25 site. The mine site is isolated, with the nearest population centre 13 km away. Therefore, noise generated by the mine operation will not result in neighbourhood annoyance and will cause little impact beyond the mine boundary.

EMP OBJECTIVE EMP objectives are:

- to take all reasonable and practicable measures to prevent or minimise the generation of noise from the mining, processing and rail operations;
- to comply with DEP Pollution Prevention Licence conditions; and
- to ensure that noise generated does not result in neighbourhood annoyance, consistent with noise regulations.

MANAGEMENT PRACTICES The *Mine Safety and Inspection Regulations 1995* set an action level for noise exposure of 85 dB(A) over an eight hour period in relation to occupational health and safety. The regulations require that noise levels above the action level associated with the construction and operation of the mine must be reduced as much as practicable by engineering noise controls.

Based on the requirements of these regulations, the following measures will be implemented to reduce noise levels:

- the use of low-noise equipment, where practicable;
- the use of silencers, where necessary; and
- the use of exhaust mufflers.

To minimise the noise impact caused by blasting activities, blasting will only be undertaken during daylight hours.

The Orebody 23 mine will be located 13 km from the nearest population centre, therefore, it will readily comply with the *Noise Abatement (Neighbourhood Annoyance) Regulations 1979.*

MONITORING

Noise monitoring for employee protection will be undertaken as required by the relevant regulations.

PERFORMANCE INDICATORS

General Commitments

BHP Iron Ore will comply with the provisions of the *Noise Abatement (Neighbourhood Annoyance) Regulations 1979*. Note that these regulations are expected to change in the future. The appropriate regulations will be kept under review and complied with.

For the protection of workers, the operation will comply with the requirements of the *Mine Safety and Inspection Regulations 1995*.

(Note: The performance indicators will be updated with the requirements from the DEP Pollution Prevention Licence issued to BHP Iron Ore following the review of the Project.)

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

IMPACT Mining at Orebody 23 will involve the movement of large volumes of dry material which can generate dust. There is, however, limited vegetation cover in the region generally resulting in the natural generation of dust in high wind conditions. The production of dust from the proposed mine is not expected to have significant additional environmental impact.

EMP OBJECTIVE EMP objectives are :

- to take all reasonable and practicable measures to prevent or minimise the generation of dust from all handling operations, stockpiles, open areas and transport activities;
- to comply with Pollution Prevention Licence conditions; and
- to ensure that nuisance dust levels and potential health hazards are not experienced by other land users.

MANAGEMENT PRACTICES The levels of ambient dust will be determined and sources of operational dust generation at Orebody 23 identified.

Occupational and ambient dust levels will be controlled by the use of:

- water tankers in areas which have the potential to generate dust, including unsealed roads and haul roads;
- the minimisation of exposed surfaces; and
- rehabilitation of disturbed areas as soon as practicable.

The performance of dust suppression equipment used at the mine will be monitored and maintained in efficient operating conditions in accordance with the relevant regulations.

Mine regulations require that the area be cleared of all personnel during blasting operations and that re-entry is not permitted until safe work conditions (which includes a safe breathing atmosphere) exist.

Routine maintenance and housekeeping practices shall be employed to ensure that waste materials in or around the premises do not accumulate and lead to the generation of unacceptable airborne dust.

Where occurrences of unacceptable airborne dust occur, further dust suppression controls will be implemented. This is dependent upon site factors such as soil moisture and wind speeds which have caused dust generation.

All employees and contractors will be informed of the importance of minimising ambient dust levels.

MONITORING

A dust monitoring programme will be implemented to quantify the significance of dust emissions and to determine the ambient dust conditions.

Dust control equipment will be checked regularly to ensure effective operation.

PERFORMANCE INDICATORS

General Commitments

BHP Iron Ore will take all reasonable and practicable measures to prevent or minimise the generation of dust from all materials handling operations, stockpiles, open areas and transport activities in accordance with the conditions of its Pollution Prevention Licence.

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES

Prior to the commencement of operation, a dust monitoring programme will be developed which will quantify the significance of dust emissions, determine the ambient dust conditions and initiate appropriate control practices.

IMPACT

The expansion to the operation of the Orebody 23 mine will generate waste materials. It will also require the use of a range of products termed 'hazardous'. These materials have the potential to cause atmospheric, soil or water contamination and could potentially pose risks to human health and the environment.

EMP OBJECTIVE

EMP objectives are:

- minimise the potential adverse effects, risk and liability associated with hazardous materials at BHP Iron Ore ' operations;
- to minimise the generation of waste and to dispose of this waste in an environmentally acceptable manner and in compliance with all regulatory and BHP Iron Ore requirements; and
- to ensure that the transport, handling and storage of hazardous materials is in accordance with the *Explosives and Dangerous Goods Act 1961*, the *Dangerous Goods Regulations 1992* and the associated applicable codes, guidelines and Australian Standards.

MANAGEMENT PRACTICES

The management of stormwater and dust suppression water on-site will involve an 'open' water system directing runoff water from rainfall events and dust suppression around areas where hazardous materials are stored or used.

Water samples will be collected from major discharge points of the open water system after significant rainfall events and analysed for sediment load, salinity, pH and selected elements.

All waste streams will be identified and hazardous wastes classified and labelled in accordance with regulatory requirements.

Where possible, waste generation will be minimised through the adoption of efficient designs, procedures and materials.

Oily substances which are accidentally spilled will be removed by the excavation and removal of the contaminated soil and treated accordingly.

All waste and hazardous materials will be handled at nearby Orebody 25 in a manner which complies with regulatory requirements.

Regular training will be undertaken for personnel involved in the management of hazardous wastes.

MONITORING

Regular inspections will be carried out to ensure that hazardous waste management systems are effective and in compliance with relevant regulations.

PERFORMANCE INDICATORS

General Commitments

All toxic or hazardous mining or process materials shall be stored within weatherproof enclosures, with impervious flooring and perimeter bunding designed to minimise the threat to the environment resulting from spillage, fire or extreme weather conditions.

All fuel storage tanks (exceeding 200 L capacity) including associated pipework, valving and fuelling installations shall be aboveground and contained within impervious bunding designed to fully contain, at a minimum, the contents of the largest tank in the event of equipment failure or accidental spillage.

BHP Iron Ore will ensure that all matter containing potentially polluting substances (e.g. metals, hydrocarbons) will be retained within impervious holding facilities such that there is no significant impairment of surface water or groundwater quality. Sewerage disposal facilities servicing the mine offices and amenities shall treat and dispose of wastes in accordance with the *Health Act 1911 - 1979* and to the satisfaction of the local authority.

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

IMPACT The expanded mining operation at Orebody 23 will generate minimal quantities of greenhouses gases.

EMP OBJECTIVE The objectives of the EMP are:

- to meet the requirements of the United Nations' Framework Convention on Climate Change; and
- to reduce emissions of greenhouse gases relative to production.

MANAGEMENT PRACTICES Wherever practicable, BHP Iron Ore will re-use, recycle and reduce the use of materials as part of its operations.

The efficient use of energy will be actively promoted in the following areas:

- mobile equipment efficiency;
- driving habits;
- fuel selection; and
- modes of product transport.

Energy-efficient designs for mining, process and equipment will be used at the operation.

MONITORING Regular inspections will be carried out to ensure that Greenhouse Gas management systems are effective and in compliance with relevant regulations.

PERFORMANCE INDICATORS ***BHP Iron Ore Commitment Under the Greenhouse Challenge Programme***

BHP Iron Ore will prepare regular emissions inventories, action plans and forecasts.

RESPONSIBILITY BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

IMPACT The expanded mining operations at Orebody 23 are estimated to have a four year life. Residual impacts at the completion of mining will require the stabilisation of post-mining landforms and the monitoring of vegetation and hydrology in the vicinity of the mine.

EMP OBJECTIVE EMP objectives are:

- to make effective use of topsoil, seeds, water and landform as well as capital and labour in returning disturbed areas to an agreed post-mining land use;
- to define an acceptable post-mining land use, rehabilitation criteria and mine closure strategy; and
- to monitor changes in vegetation and hydrology as a result of mining.

MANAGEMENT PRACTICES The primary goal of the rehabilitation programme will be:

- the re-establishment of a stable landform with land uses similar to those existing prior to mining; and
- to establish a self-sustaining system of native grass and scattered shrub species that are equivalent in diversity, density and cover to pre-mine conditions and consistent with ongoing land use objectives.

Rehabilitation processes will be consistent with the Closure Plan.

During the mining operation:

- vegetation and topsoil, where present, will be removed and stored for later use in rehabilitation;
- disturbed areas will be progressively rehabilitated throughout the mining of Orebody 23;
- overburden slopes will be progressively battered to an overall angle of 20° or less, spread with stored topsoil and vegetation (where available) and stabilised to prevent erosion and encourage vegetation establishment and fauna recolonisation;
- topsoil will be returned, wherever available;
- stabilisation techniques will be applied to the slopes which will promote water collection and aid in the harvesting of airborne seed;
- slopes will be seeded, where required, using a mixture of native species;

- completed pit berms that protrude above the plain level will be progressively rehabilitated by ripping and seeding with native species to improve visual effects; and
- compacted surfaces no longer required for the mining activity will be ripped to promote water penetration and the catchment of seed.

At the completion of mining:

- all infrastructure will be removed and concrete footings excavated and buried;
- remaining surfaces of borrow pits or overburden storage areas will be battered to an angle of 20° or less;
- topsoil and vegetation (where practicable) which were stripped and stored prior to the commencement of mining will be returned to the areas to be rehabilitated;
- stabilisation techniques will be applied to exposed surfaces and native seed applied, where necessary;
- safety bund walls will be constructed around the decommissioned pits and their design will comply with guidelines established by the Department of Minerals and Energy (1991);
- compacted surfaces resulting from the operation of the mine will be ripped to promote water penetration and the catchment of wind blown seed;
- to minimise erosion in ensuing years, pre-existing drainage networks will be re-established, where appropriate; and
- revegetation activities will continue beyond the mine closure to enable final overburden storage areas to be contoured and stabilised.

MONITORING

Regular inspections will be carried out during operations and following the completion of mining to assess the progress of rehabilitation.

PERFORMANCE INDICATORS

General Commitments

Table 17-1 presents the rehabilitation criteria which have been developed for the Orebody 23 development.

TABLE 17-1

REHABILITATION CRITERIA

Site Element	Final Landform	Final Vegetation
Overburden storage areas	Flat topped spurs, 20° outslopes, stabilised; rounded forms like existing hills.	Early successional species first, final objective is grasses with scattered shrubs.
Open pit	Open pit to DME safety standards, possibly with occasional open water.	Accessible internal benches and pit floors will be ripped and seeded, as necessary.
Road	Consistent with existing. All infrastructure removed.	Site topsoiled, ripped and seeded consistent with the vegetation on adjacent areas, as necessary, to achieve a grassland with scattered shrubs.
Borefield	Consistent with existing. All infrastructure removed.	Site topsoiled, ripped and seeded consistent with the vegetation on adjacent areas, as necessary, to achieve a grassland with scattered shrubs.

Preliminary completion criteria will be developed, in consultation with relevant government agencies, within one year of the commencement of mining operations.

RESPONSIBILITY

BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES

Following the commencement of rehabilitation activities:

- the rehabilitation programme is to be regularly reviewed (the review interval has yet to be decided); and
- any disturbance to rehabilitated land is to be immediately reported to the Site Manager and the Senior Environmental Officer and rectified.

At least 12 months prior to the cessation of mining, a final closure plan will be developed for review by the DEP and implemented.

IMPACT Mining operations at Orebody 23 will result in a permanent alteration of the landscape. Post-mining landforms will include the rehabilitated overburden storage area and the flooded open pit.

EMP OBJECTIVE To establish clear, site-specific decommissioning and closure requirements in a plan that is regularly updated.

MANAGEMENT PRACTICES A mine closure plan will be developed prior to the completion of operations at Orebody 23 giving careful consideration to fuel and waste disposal areas. The plan will contain details of:

- the ultimate landforms;
- the pit, including bunding, fencing and signage;
- overburden storage areas, taking into consideration future settling; and
- the removal of infrastructure.

The mine closure plan will include the estimation of closure costs, establish a financial accrual plan and a checklist of the key elements of the plan.

Land stabilisation and rehabilitation will be planned to meet the post-operational land use described in Section 17.0 Rehabilitation.

Prior to mine closure, a detailed engineering cost and design will be completed.

An external audit, conducted three years prior to closure, will emphasise the level of completeness of the plan.

The closure plan will also detail document requirements for the decommissioning phase, that is:

- description of closure activities;
- accurate maps showing locations of disposal sites;
- a photographic record; and
- summary of costs.

MONITORING Environmental monitoring will be implemented to meet the requirements of the Departments of Minerals and Energy and Environmental Protection.

PERFORMANCE INDICATORS The mine closure plan will meet the requirements of the Departments of Minerals and Energy and Environmental Protection.

RESPONSIBILITY BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES An external audit will be conducted three years prior to closure.

IMPACT Mining at Orebody 23 will be undertaken by a mining contractor managed by BHP Iron Ore.

EMP OBJECTIVE EMP objectives are:

- to ensure that the environment is protected by incorporating environmental responsibilities into written contracts which require contractors to comply with this EMP; and
- to ensure that BHP Iron Ore maintains appropriate information on the activities and environmental performance of contractors.

MANAGEMENT PRACTICES As part of BHP Iron Ore's commitment to ensure products removed from site are disposed of or recycled in an environmentally acceptable manner, all contractors are to provide a copy of relevant licences which should stipulate their authority to handle the material to be removed from site. This documentation will be kept on a file at the operation site and with the BHP Iron Ore Site Manager.

Internal and external suppliers will be required to check that the goods and services conform to legal requirements, accepted standards and BHP Iron Ore specifications. Environmental hazards associated with these goods and services must be clearly identified, document and communicated to BHP Iron Ore prior to delivery.

MONITORING The monitoring of contractors will be carried out to ensure compliance with issues raised during the audit process and conditions specified in contracts.

PERFORMANCE INDICATORS Contractor's performance will be measured against specific clauses in individual contracts for environmental management.

RESPONSIBILITY BHP Iron Ore's Site Manager is responsible for activities required to fulfil the EMP.

CRITICAL DATES The Mining Contract will be written to require that:

- environmental clauses are included;
- contractors must supply BHP Iron Ore with copies of their licences stipulating their authority to handle material to be removed from the site;

- contractors will liaise with site staff to ensure appropriate design of environmental management facilities; and
- procedures will be developed for the monitoring and reporting of contract compliance.

Periodic reviews of contractor environmental performance will be undertaken.

The BHP Environmental Management System philosophy embodies the concept of continuous improvement.

The *Australian/New Zealand Standard for Environmental Management Systems -AS/NZS ISO 14001* (Standards Australia/Standards New Zealand, 1995) identifies the continuous improvement process as:

- identifying areas of opportunity for the improvement of the environmental management system which leads to improved environmental performance;
- determining the root cause or causes of nonconformities or deficiencies;
- developing and implementing a plan of corrective and preventative action to address root causes;
- verifying the effectiveness of the corrective and preventative actions;
- documenting any changes in procedures resulting from process improvement; and
- making comparisons with objectives and targets.

The BHP Iron Ore EMS Handbook provides mechanisms to evaluate the practices, procedures and processes by which its various mining activities are managed. This EMP, as one component of the EMS, presents performance indicators against which the Orebody 23 mine environmental performance will be evaluated.

Performance Improvement Plans will be required to be developed as the means for continuously improving deficiencies identified periodically.

Through the process of staff training, audits, corrective actions and the inclusion of new initiatives in environmental management the EMP will be continuously reviewed and improved to ensure stated objectives and environmental management plans are achieved.

AWRC	Australian Water Resources Council
dB(A)	decibels (A-weighting)
BHP Iron Ore	BHP Iron Ore Pty Ltd
CALM	Department of Conservation and Land Management
DEP	Department of Environmental Protection
DME	Department of Minerals and Energy
DMSV	Digital Multi-Spectral Video
EMP	Life of Project Environmental Management Plan
EMS	Environmental Management System
EPA	Environmental Protection Authority
ha	hectares
km	kilometre
mg/L	milligrams per litre
Mt	million tonnes
NATA	National Association of Testing Authorities
NHMRC	National Health and Medical Research Committee
$\mu g/m^3$	micrograms per meter cubed

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BHP Iron Ore Pty Ltd
Environmental Policy

ATTACHMENT A

BHP

BHP Iron Ore

ENVIRONMENTAL POLICY

It is BHP's policy to achieve a high standard of environmental care in conducting its business as a resources and industrial company contributing to society's material needs. BHP's approach to environmental management seeks continuous improvement in performance by taking account of evolving scientific knowledge and community expectations.

Specifically, it is BHP's policy to:

- comply with all applicable laws, regulations and standards; uphold the spirit of the law; and where laws do not adequately protect the environment, apply standards that minimise any adverse environmental impacts resulting from its operations, products or services;
- communicate openly with government and the community on environmental issues, and contribute to the development of policies, legislation and regulations that may affect BHP;
- ensure that its employees and suppliers of goods and services are informed about this policy and aware of their environmental responsibilities in relation to BHP business;
- ensure that it has management systems to identify, control and monitor environmental risks arising from its operations;
- conduct research and establish programs to conserve resources, minimize wastes, improve processes and protect the environment.

G. L. Wedlock
Group General Manager
BHP Iron Ore
1 March 1996