BHP Iron Ore Pty Ltd

OREBODY 18

Consultative Environmental Review

BHP

July 1996

BHP Iron Ore Pty Ltd

OREBODY 18

CONSULTATIVE ENVIRONMENTAL REVIEW

BHP Iron Ore Pty Ltd
Mining of Orebody 18, ML 244SA

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 establish an iron ore mine at Orebody 18, Mineral Lease 244SA, 32 km 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 29 July 1996 closing on Monday 26 August 1996.

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 26 August 1996.**

Submissions should be addressed to:
Environmental Protection Authority
Westralia Square
141 St Georges Terrace
PERTH WA 6000
Attention: Mr Ian Harvey

BHP Iron Ore Pty Ltd (BHP Iron Ore) proposes to establish a mining operation at Orebody 18, a satellite orebody 32 km east of the larger Mt Whaleback mine at Newman. The project involves mining a 116 million tonne (Mt) iron ore reserve at up to 15 million dry tonnes per annum (Mtpa) for 12 - 15 years. Support infrastructure including an 8 km rail spur, crushing, screening and load out facilities will also be developed (Figure 2.1).

The proposed development will provide extra capacity to help meet BHP Iron Ore's current and mid-term requirements for iron ore. The operation will also add to the already substantial economic benefits generated by the Western Australian iron ore industry through export income and flow-ons to the community.

BHP Iron Ore is committed to achieving a high standard of environmental management at its Orebody 18 operation. This commitment requires the integration of all monitoring and management programmes to refine and continuously improve environmental management of the operation.

The development of Orebody 18 is subject to formal environmental impact assessment under Part IV of the *Environmental Protection Act 1986*. In addition, works approval and licencing under Part V of the Act are required. This Consultative Environmental Review (CER) describes the proposal, identifies potential environmental impacts and the means of managing those impacts.

Key environmental aspects of the proposal include:

- changes to the landform;
- surface and groundwater hydrology;
- flora and fauna;
- Aboriginal heritage;
- dust and noise control;
- waste products and hazardous materials;

- rehabilitation;
- planning for decommissioning and managing longer term environmental impacts; and
- development of an Environmental Management Programme.

These topics are briefly outlined below and summarised in Table ES-1 at the end of this section.

Changes to the Landform

Development of the pit and overburden storage areas will result in the permanent alteration of approximately 317 ha. Other infrastructure such as road and rail access corridors, borrow pits, stockpile areas, and crushing facilities will result in the modification of approximately 130 ha.

Overburden will be stored outside the pit, either on the plain (capacity 99 Mt) or in a gully (capacity 17 Mt). The overburden storage areas will be designed and rehabilitated to blend with the surrounding topography.

Surface Water

The proposed mine pit follows the line of an escarpment and will intercept approximately 10 drainage lines at the top of the catchment. The mine will reduce the catchment area for local drainage lines to the south, thereby potentially reducing surface runoff. However, there will be little impact on downstream vegetation as existing drainage flows infiltrate the porous scree deposits at the base of the slope and there is no phreatophytic vegetation (vegetation dependent on groundwater) in this area.

The overburden storage areas to the south-east of the pit will not disrupt surface flows as they occur at the head of the catchment. The overburden storage areas in the gully to the north-west of the pit will alter surface flows within that drainage channel.

Significant surface water flows which leave the mine area will be managed by the use of settling ponds. There may be some local increase in turbidity downstream of the pit, however it is expected to be filtered out in the scree before reaching the major drainage lines.

Groundwater

Dewatering activities will be required in the later stages of mine development to access mineable ore reserves up to 43 m below the water table. Approximately 8 ha of the 163 ha pit will require dewatering. Due to the limited hydraulic connection between the orebody aquifer and other local aquifers, the dewatering activities will have a negligible impact on other aquifers.

Monitoring will be undertaken to assess the degree of drawdown associated with the dewatering.

Comparison of annual pit inflow from groundwater with annual evaporation indicates that a waterbody with a surface area of approximately 8 ha will form in the decommissioned pit. The waterbody will become saline in time. However, due to the low permeability of the underlying shales there is not likely to be any movement of water from the pit to the adjacent aquifer systems.

A borefield located along a 2-4 km east-west line immediately south of the site will supply water for the operation. Groundwater in the supply water borefield is 36m below the natural ground surface and does not support phreatophytic vegetation. Therefore vegetation is unlikely to be affected by any drawdown at the water supply site. There are also no pastoral bores in the vicinity of the proposed borefield.

Flora and Fauna

No Declared Rare Flora have been located within the Project boundary. Three populations of the Priority 2 flora species, *Triumfetta maconochieana* ms., were located in the Project area and a further 9 populations were located in the greater Newman area. Three sites containing 84 plants (out of a total of 424 identified) will be disturbed by the mining operations.

Management of vegetation disturbance will be closely supervised to ensure that the minimum area required for construction of the mine infrastructure is cleared. Plans will be prepared and checked in advance of clearing.

Disturbed surfaces will be rehabilitated to a self sustaining condition with vegetation consistent with the natural surroundings. Rehabilitation Criteria are proposed in Table 3-2.

Fauna species of conservation significance identified in the project area include the Western Pebble-mound Mouse, while the Grey Falcon and Grey Honeyeater are likely to occur but have not been identified. Eleven active pebble mounds will be removed as a result of the project.

The proposed mining operation will result in some displacement of fauna in the Orebody 18 area. Once disturbance ends, it is expected that the rehabilitated areas will be recolonised from surrounding areas.

Management of habitat disturbance will be achieved by close supervision of the construction contractor to ensure that the minimum area is disturbed. The contractor will not be permitted to leave the site until any such disturbance is rehabilitated. Re-creation of faunal habitats will coincide with re-vegetation of disturbed areas.

Aboriginal Heritage

Ten Aboriginal archaeological sites have been identified in the region of the Orebody 18 mine site and a further two sites were identified in the vicinity of the proposed rail alignment. None of these sites were reported to be significant by the archaeological consultants (Quartermaine, 1995).

Approval to disturb seven of the known sites in the vicinity of the Orebody 18 deposit has previously been obtained under Section 18 of the *Aboriginal Heritage Act 1972-1980*. Ministerial approvals will be sought in accordance with the Act for all sites which will be disturbed by the project.

Dust and Noise

The nearest residence is Sylvania Homestead, located 30 km to the south. It is not likely to be affected by dust or noise generated by the project.

The Orebody 18 mine and infrastructure will cause a localised increase in dust levels.

Occupational and ambient dust levels will be controlled at source by fitting dust suppression systems where required in the processing plant and applying water to areas which have the potential to generate fugitive dust (e.g. haul roads).

Operation of the mining plant and the ore processing plant will increase ambient noise levels at the site. Noise from these sources will not approach statutory limits at the nearest residence. Some increased noise will also be associated with the ore train movements along the spur line.

Waste Products and Hazardous Materials

The proposed operation at Orebody 18 will generate waste materials including scrap metal, tyres, wood, paper and domestic solid and liquid waste. While not hazardous, these materials will be treated as necessary and disposed of properly.

A range of products termed 'hazardous materials' will also be used. These materials include fuels, lubricants, detergents, explosives and paints. A procedure for the handling, storage and disposal of hazardous and other waste materials will be developed as part of the Draft Environmental Management Programme (Attachment A) for the Orebody 18 operation.

There is no asbestiform material known from the proposed mining area.

Decommissioning and Management of Long-term Impacts

Operations at Orebody 18 will continue for approximately 12 - 15 years. Residual impacts at the completion of mining will include the mine pit and overburden storage areas. Evapo-concentration of salts will occur over time in the waterbody.

All infrastructure will be removed. Rehabilitation will continue after mine closure to stabilise and revegetate overburden storage areas. Monitoring following decommissioning will consist of periodic site visits to assess the progress of revegetation. Sites requiring remedial work will be repaired. Water quality will be monitored in the pit and surrounding aquifers. Environmental monitoring and ongoing research studies to be undertaken through the life of the mining operation at Orebody 18, and at other BHP Iron Ore mining operations, will assist in refining environmental management practices to minimise longer-term impacts.

Environmental Management Programme (EMP)

An EMP is being developed by BHP Iron Ore in consultation with the Department of Environmental Protection (DEP) to provide a structured approach to managing the environmental issues associated with all activities at Orebody 18.

A draft EMP which identifies the management and monitoring objectives, responsibilities and reporting requirements is attached to this CER (Attachment A). The EMP will be periodically revised by BHP Iron Ore and submitted to the DEP for review. This will facilitate an effective environmental management system which is able to modify practices in response to monitoring programmes, results and operational changes.

TABLE ES-1

SUMMARY OF TOPICS CONTAINED IN THE ENVIRONMENTAL PROTECTION AUTHORITY GUIDELINES FOR THE PROJECT

TOPIC	EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL FOR IMPACT	PROPOSED MANAGEMENT	OUTCOME
Flora	Protect rare and priority species.	One priority 2 listed species, *Triumfetta maconochieana* ms, but no Declared Rare Flora are found within the Project area.	Moderate locally - Three populations of a Priority 2 flora species will be removed by the mine pit and overburden storage areas.	Surveys have located 9 additional populations of the Priority 2 species in the vicinity which will not be disturbed.	The species occurs elsewhere and is considered secure in Rudall River National Park
Fauna	Protect rare and priority species.	91 mounds of the Western Pebble-mound Mouse were found in the proposed Project area, of which 16 were active. The species is widespread in the Pilbara including in National Parks(CALM, pers. comm.).	Moderate locally, Minor regionally - Clearing of the mine site will remove eleven active Pebble-mounds in the vicinity of the mine.	Mice from the eleven mounds will be relocated or included in research programmes, in consultation with CALM.	Local and regional populations of the Pebble-mound Mouse will remain viable. Species considered secure in National Parks.
Local and Regional Environment	Minimise loss of locally and/or regionally significant vegetation associations and habitats.	The landforms and vegetation associations in the Project area are widespread throughout the Pilbara and are well represented within conservation areas.	Minor - Clearing of the mine site and rail spur will affect vegetation communities and fauna habitats in the immediate vicinity of the mine. This will have a minor effect on the populations in the area.	The progressive revegetation of disturbed sites in the project area will re-establish plant communities and fauna habitats similar to the existing associations.	Plant and animal communities disturbed during mining will eventually return to a state consistent with the surroundings, except for communities removed over the pit.

TOPIC	EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL FOR IMPACT	PROPOSED MANAGEMENT	OUTCOME
Surface Water	Minimise impacts on the quality and quantity of surface water.	Surface water in the Project area consists of ephemeral stream flow which fans out at the base of the slopes, infiltrating the scree deposits. There are many similar ephemeral drainage lines in the Opthalmia Range area.	Pit development will intercept 10 ephemeral drainage lines. This will have little impact on the surrounding vegetation because water infiltrates deep into the scree and does not support phreatophytic vegetation. Potential for increased turbidity in drainage lines below the pit will be negligible due to natural infiltration into the scree before entering major streams.	Diversion works will be constructed to minimise the impacts on existing drainage.	There will be moderate impacts on ephemeral drainage systems in the vicinity of the pit and overburden storage area. No significant effect on vegetation or major water courses downstream of the pit.

TOPIC	EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL FOR IMPACT	PROPOSED MANAGEMENT	OUTCOME
Groundwater	Minimise short and long-term effects caused by groundwater use.	Groundwater occurs in five units associated with the basement rock, scree and alluvial deposits. The pit aquifer has limited hydraulic connection to the other four aquifers. The depth to groundwater at the supply water borefield site is around 36m. Salinity of the orebody aquifer is fresh (570-580 mg/L) while salinity of the water supply aquifer is brackish (1,200-1,400 mg/L).	There will be few impacts associated with dewatering activities outside the pit due to the limited connection between aquifers. There will be limited drawdown at the supply site borefield. As there is no phreatophytic vegetation in this area, there will be no effect on vegetation caused by the drawdown. A waterbody will be formed up to 43 m deep and with a surface area of approximately 8 ha in the deepest part of the pit.	Water recovered from dewatering activities will be used for process water and dust suppression activities. Borefield abstraction will be monitored.	The local groundwater system will not be significantly affected by the mining operation. No vegetation will be affected by drawdown at the minesite or water supply site.

TOPIC	EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL FOR IMPACT	PROPOSED MANAGEMENT	OUTCOME
Overburden storage	Maximise return of overburden to pits and ensure stability.	Rocky slopes with low species diversity, widely represented in area. Gullies with locally higher plant species diversity, widely represented in area.	Mining will remove approximately 116 Mt of overburden. This material will be largely stored on the plains to the east and north-west of the open pit.	The overburden storage areas will be designed to blend with the surrounding topography and contoured, stabilised and revegetated during and after mining.	Objective not substantially attainable due to the need to access the final ore at bottom of pit. As mine plan proceeds this will be re-considered during reviews of the EMP. Overburden storage areas will be constructed and rehabilitated consistent with the surrounding topography.
Noise and dust impacts on nearest neighbours	Achieve compliance with noise regulations and guidelines for nuisance dust levels.	Nearest residence is 30 km away. Opthalmia Dam, a popular tourist area is about 15km away.	Noise and dust will be generated through normal mining activities.	Noise - noise will be managed through standard industry practice of suppression at source. Dust - dust generation will be controlled at source by the fitting of suppression systems and the use of water tankers on roads.	Dust and noise will be within the limits set in State regulations and limits.

TOPIC	EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL FOR IMPACT	PROPOSED MANAGEMENT	OUTCOME
Aboriginal Sites	Comply with the provisions of the *Aboriginal Heritage Act, 1970-1982.*	Twelve archaeological sites have been recorded in the vicinity of the Project area. They are not considered to be significant. No ethnographic sites present in the vicinity of the Project area.	Construction of the mine and associated infrastructure could remove nine of the archaeological sites.	Approval to disturb has already been granted for seven of the sites in the Project area. Approval under the Act will be sought if the newly recorded sites are to be disturbed.	Necessary approvals will ensure that the provisions of the *Aboriginal Heritage Act, 1970-1982* are complied with.
Environmental Management System	To ensure that the project is managed during all phases under an effective Environmental Management Programme.	All aspects.	Aspects to be affected by the mine include: landform, flora, fauna, water resources and Aboriginal Heritage.	An Environmental Management Programme will be prepared to the satisfaction of the relevant government agencies.	The environment will be monitored and managed in a manner agreed with the relevant agencies to ensure that impacts are not significant.
Rehabilitation of Project area	Define an acceptable end land use, rehabilitation criteria and mine closure strategy.	Plant associations in the area are widespread in the Pilbara. The Project area consists of ridges and gully landforms which are widespread in the area. The area is Vacant Crown Land and pastoral station owned by BHP.	Changes to topography and disturbance to vegetation. Modified local surface drainage.	Overburden storage areas will be contoured and rehabilitated. The pit will remain. End use to be landforms and vegetation similar to the surrounding area. Closure strategy as detailed in EMP (draft attached).	Rehabilitation will ensure disturbed surfaces are returned to a state consistent with the current land use as soon as practicable.

TOPIC	EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL FOR IMPACT	PROPOSED MANAGEMENT	OUTCOME
Cumulative environmental impacts from this mine	To minimise cumulative impact of mining on the regional environment.	Other mine developments exist within the Opthalmia Range at Mt Whaleback, Orebody 23/25 and Jimblebar over a 50km distance.	The Project requires infrastructure, services and transport routes. There will be an 8km increase in the rail length, and a short section of new access road.	Existing road and rail corridors will be used where available. The mining workforce will be accommodated in existing facilities in Newman.	There will be a minor increase in land disturbance, although not significant in a regional context. Dewatering will not have cumulative impacts with other operations.
Social issues	Minimise impacts on social surroundings.	The nearest community is Newman, 32 km to the east of the mine site. Adequate housing and services exist in Newman.	The activities of the construction and operation workforce may lead to demand on some existing infrastructure and services.	Opportunities to compete for contracts will be available to the local community.	Minor impacts on the services and facilities in Newman will be essentially positive, supporting the existing level of activities. The mining workforce will add to Newman community.

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1.1 INTRODUCTION

BHP Iron Ore Pty Ltd (BHP Iron Ore) proposes to establish a mining operation at Orebody 18 (the Project), a satellite orebody 32 km from Newman. The Project involves mining 116 million tonnes (Mt) of ore at a rate of up to 15 million dry tonnes per annum (Mtpa) for a mine life of 12 - 15 years. Support infrastructure includes an 8 km rail spur and crushing, screening and load out facilities.

This document describes the proposed mining operations, assesses potential environmental impacts and describes management measures for the proposed mining operation. Preliminary details of the Project were referred to the Environmental Protection Authority (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.

1.2 PROPONENT

The Proponent is BHP Iron Ore Pty Ltd, which is the manager for the Mount Newman Joint Venturers - the owners of the Project. These Joint Venturers are:

- BHP Minerals Pty Ltd (85%);
- Mitsui-Itochu Iron Pty Ltd (10%); and
- 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 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 currently

operates a number of other iron ore mines in the Pilbara including the Yarrie, Yandi, Orebody 29, Orebody 23/25 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

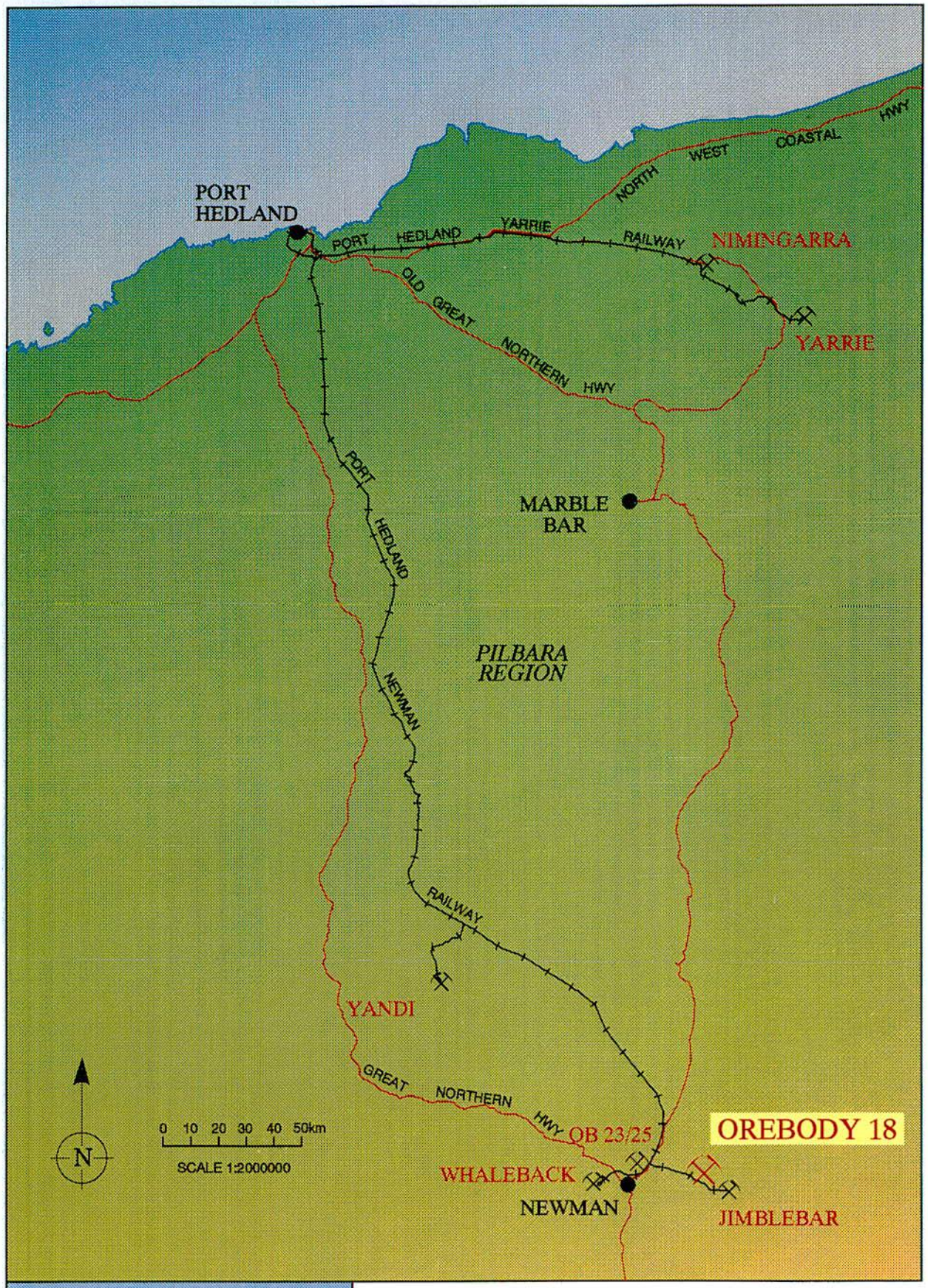
Orebody 18 is located 32 km east of the township of Newman in the Shire of East Pilbara on Mineral Lease 244SA. The orebody is situated at the eastern end of the Ophthalmia Range. Along with Orebody 18, a number of other satellite orebodies have been identified on ML 244SA in the Newman area (refer to Figures 1.1 and 1.2).

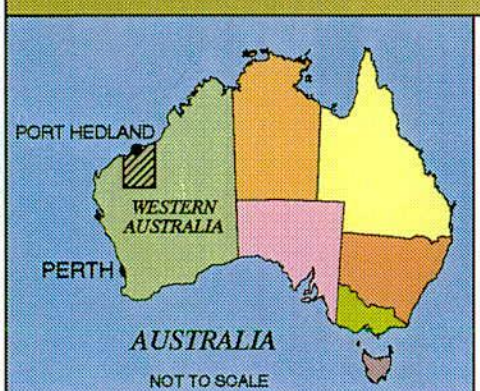
The Orebody 18 pit is covered by a granted mining lease. The rail extension, rail loop and infrastructure are located on Sylvania Pastoral Station which is owned by BHP Iron Ore.

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 proposal. In addition, works approval and licencing 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 18 are listed in Table 1-1.





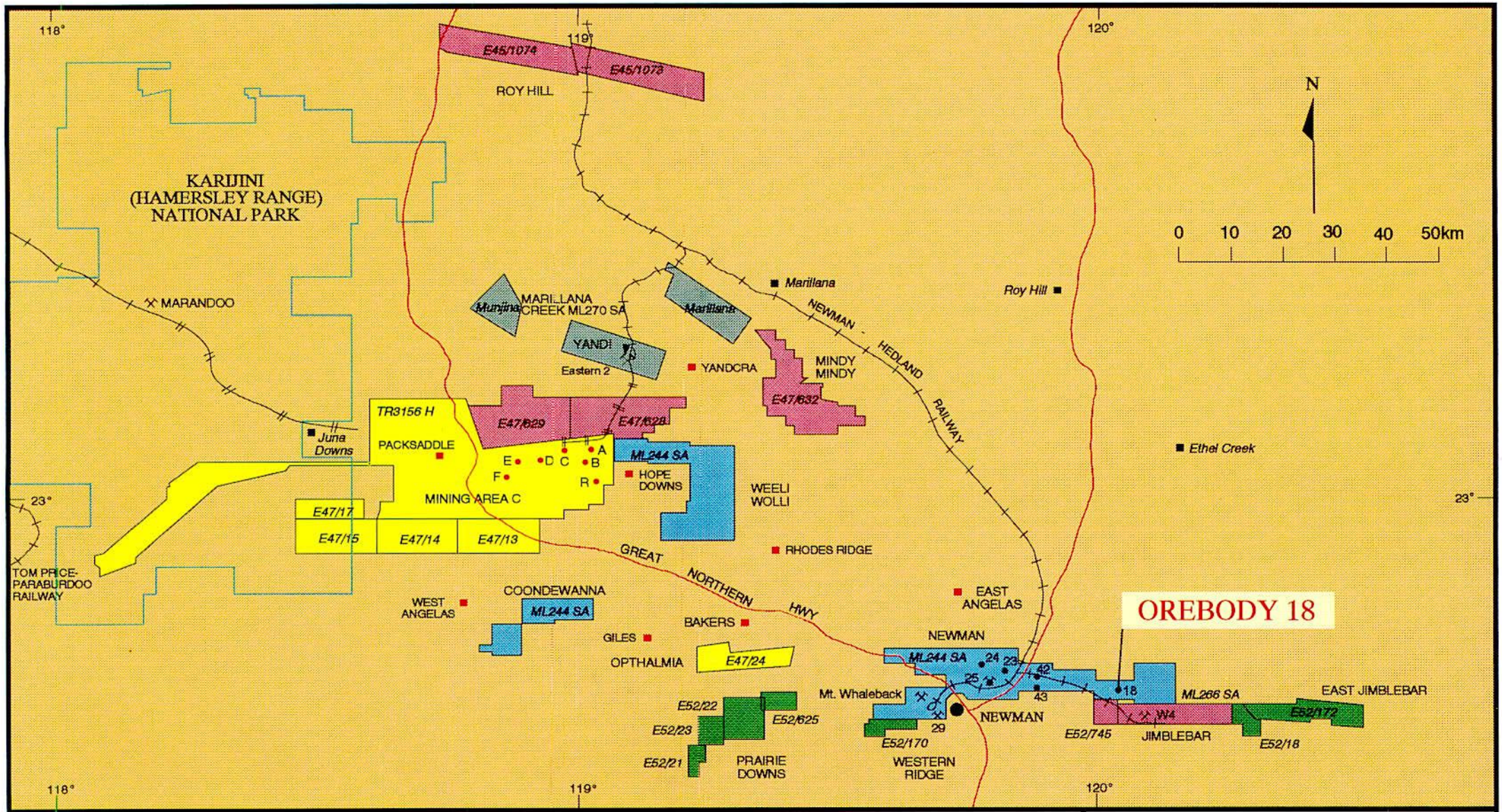
BHP Iron Ore Pty Ltd A.C.N. 008 700 981

OREBODY 18

Location Plan

FIGURE 1.1

DRAWING No	DATE	REV
N212-585-038	April 1996	



BHP Minerals Pty Ltd (BHP 100% - includes Jimblebar)

Mt Goldsworthy
Mt Newman JV
Yandi JV
} BHP Iron Ore Pty Ltd tenements (BHP 85%)

BHP Australia Coal/Renison tenements allocated after Iron Ore (McCameys Monster) Authorisation Amendment Bill 1986 (BHP 50%)

F • Major Satellite Orebodies
•18

Exploration Project

Homestead

Town

Mine

Potential railroad

Existing railroad

Note: E47/16 (Rocklea) not shown

BHP Iron Ore Pty Ltd A.C.N. 008 700 981

OREBODY 18

South East Pilbara Iron Ore Tenements

FIGURE 1.2

DRAWING No	DATE	REV
N212-585-039	April 1996	

TABLE 1-1

ENVIRONMENTAL LEGISLATION AND ITS APPLICATION

Act	Application
Environmental Protection Act 1986 (Part V)	CER, Works Approvals, Pollution Control Licences
Wildlife Conservation Act 1950	Rare Flora and Fauna Protection
Conservation and Land Management Act 1984	Management of Flora and Fauna and Reserves
Rights in Water and Irrigation Act 1914	Water Use, Pollution of Water Resources
Water Authority Act 1984	Licencing of Groundwater Abstraction
Bush Fires Act 1954	Management of Fire Safety
Agriculture and Related Resources Protection Act 1976	Management of Weeds and Pests
Soil and Land Conservation Act 1945	Controls Land Degradation and Clearing of Land
Land Act 1933	Classification of Land Tenure
Mines Safety and Inspection Act 1995	Occupational Health and Safety Issues
Mining Act 1978	Controls Licencing of Extractive Industries, Mines
Explosives and Dangerous Goods Act 1961	Specifies Storage, Handling and Blasting Requirements
Aboriginal Heritage Act 1972-1980 (in particular Section 18)	Controls Aboriginal Sites, particularly disturbance
Australian Heritage Commission Act 1975	Lists Areas of National Heritage Significance
Native Title Act 1993	Deals with Aboriginal Claims for Land Ownership
Iron Ore (Mount Newman) Agreement Act 1964	Controls Mining Developments by the Joint Venturers

1.5 PROJECT JUSTIFICATION

1.5.1 National and State Benefits

The development of the Orebody 18 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.

The on-site construction workforce during the 50 week construction period is expected to peak at 300 people. The permanent workforce at the full production rate of 12 to 15 Mtpa will be approximately 100 people.

To the maximum practical extent, both the construction and permanent workforces will be sourced from Western Australia and live in Newman.

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 1994, Western Australia exported 119.6 Mt of iron ore at an estimated value of over $2,700M, of which over 90% came from the Pilbara region (Australian Bureau of Statistics, 1995). Approximately half of this iron ore came from BHP Iron Ore mines at Mt Whaleback, Jimblebar, Goldsworthy and Yandi 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.

- Initiating 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 are all located to the east of Newman and comprise:

- Orebody 18;
- Orebody 24; and
- the deposits at Jimblebar.

Orebody 18 is the preferred immediate development option due to the quality and quantity of ore available. These aspects justify development of the ore load out facility and other infrastructure proposed.

In the longer-term it is anticipated that all the identified ore reserves will be developed.

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 proposed development with the following:

- East Pilbara Shire;
- Members of Parliament;
- Aboriginal people who speak for the area;
- local pastoralists;
- Chambers of Commerce at Newman and Port Hedland;
- interested members of the public; and
- BHP Iron Ore employees.

2.1 INTRODUCTION

This section outlines the proposal to mine the 116 million tonne known ore reserve at Orebody 18. Additional ore may be identified during mining. The proposed operation will be serviced by an 8 km rail spur from the existing Jimblebar line. Crushing, screening and train loading facilities will be developed at the Project site.

Figure 2.1 shows the route of the rail loop and plan of the mineral deposit.

The orebody is positioned in the Dales Gorge Member of the Brockman Iron Formation. The overburden to ore ratio is 1:1 and the life of the mine is estimated to be approximately 12 - 15 years. The ore will be crushed and screened on-site before being loaded onto trains and hauled to Port Hedland. At the port, the ore will undergo further processing and will be blended as necessary with other material mined from the Mt Whaleback mine and other Newman satellite orebodies prior to shipment to customers. Ore from Orebody 18 will not be sold as a separate product. The ore processing facilities will be established to process up to 15 Mtpa (dry). A summary of the main elements of the proposed development are presented in Table 2-1.

2.1.1 Access and Service Corridor

An access and service corridor will be established following the alignment of the existing and proposed rail spur (Figure 2.1). The corridor will contain a rail spur, power line and access road for light vehicles. The main factor determining the location of the transport corridor is the alignment of the rail spur which is subject to the most significant constraints in terms of landscape.

A description of the proposed rail spur is included in Section 2.6 - Ore Transport.

TABLE 2-1

SUMMARY OF PROPOSAL

Issue	Description*
Mining Rate (maximum).	15 Mtpa (dry).
Total Production (projected).	116 Mt.
Time Period.	12 - 15 yrs.
Average Stripping Ratio.	1:1.
Area Pit+.	154 ha.
Maximum Depth of Pit.	120 m.
Area Ore Stockpiles.	56 ha.
Area of Overburden Storage.	154 ha.
Total Overburden (projected).	116 Mt.
Overburden Storage Areas - East.	94 Mt (50 m high).
Overburden Storage Areas - North-west.	17 Mt (30 - 40 m high).
Overburden Storage Areas - West.	5 Mt (10 m high).
Water Requirements.	500,000 kL/yr (1,000 kL/day).
Power Supply.	Newman Pilbara Energy Pty Ltd Power Station.
Power Line.	32 km in length.
Infrastructure Area.	130 ha.
Rail Spur (Length).	8 km.
Rail Spur (Area)	64 ha.
Rail Loadout Facility.	24-hr, 7 days/week Operation.
Train Length (average)	240 wagons (100 tonnes capacity each).
Workforce (Permanent).	100 - 150.
Workforce (Construction).	300.
Construction Period.	50 Weeks.

* Tonnages and areas are best available estimates based on current drilling data.

\+ Disturbed areas are not additive, some scree areas will be used for later facilities.

2.1.2 Construction Workforce Accommodation

During the 50 week construction period, the on-site construction workforce is expected to peak at approximately 300 people. The workforce will be located in the town of Newman in a combination of BHP Iron Ore and other accommodation.

OPHTHALMIA RANGE

OB18 OUTLINE

PROPOSED PLANT SITE

OFFICES WORKSHOPS SITE

TRAIN LOADING INFRASTRUCTURE

RESTRICTED MINE SITE ROAD

EXISTING ACCESS ROAD

PROPOSED OB18 SPURLINE

PROPOSED NEW ROAD ALIGNMENT

PROPOSED POWER LINE

EXISTING JIMBLEBAR ACCESS ROAD

EXISTING JIMBLEBAR RAILWAY

Shovelanna Creek

299 000 mN

297 000 mN

295 000 mN

348 000 mE

350 000 mE

352 000 mE

354 000 mE

356 000 mE

LEGEND

- Pit Outline
- Existing Railroad
- Proposed Railroad
- Proposed Power Line
- Building / Structure
- Tracks
- Existing Road
- Proposed Road
- Mine Road
- Creeks
- Drainage
- Surface Contour (Index)
- Surface Contour (Inter.)

N

SCALE 1 : 25000

0 200 400 800 1200 1600 2000m

BHP Iron Ore Pty Ltd A.C.N. 008 700 981

OREBODY 18

Existing and Proposed Infrastructure

FIGURE 2.1

DRAWING No	DATE	REV
N212-585-042	April 1996	

2.2 OPERATIONS

2.2.1 Mining

Mining will be by conventional open cut methods commencing at 5 Mtpa (dry) and increasing over several years to 12 - 15 Mtpa (dry). Material will be blasted then loaded by hydraulic excavators and/or front end loaders into off-highway rear dump trucks for transport to the crusher or overburden storage areas.

The characteristics of the Orebody 18 deposit include:

- high-grade hematite iron ore;
- low phosphorus ore;
- an overburden ratio of 1:1; and
- capacity to blend ore to produce a uniform product grade.

Mining will extract hard rock ore from the pit and scree ore from the southern flanks of the hills (Figure 2.3). Ore from the pit will require drilling and blasting. The scree is often free dug, but may need to be blasted. Deep scree will be benched in the same way as the main pit.

As grade control drilling and mining progress, the definition of ore and waste within the mine is regularly updated. As a result, precise mining locations are reviewed through the life of the mine and minor changes to the final mine outlines can be expected.

Mining at Orebody 18 will be undertaken by a contractor managed by BHP Iron Ore. The contractor will be responsible for providing the necessary plant and equipment for mining, ore processing and train loading.

The mine development sequence for 30 Mt and 120 Mt of ore is outlined on Figures 2.2 and 2.3. This development sequence will involve the following:

- removal of topsoil and storage for later use in rehabilitation;
- overburden removed from the upper levels of the pit (17 Mt) will be placed in a gully to the north-west of the pit;

- mining of the ore will initially occur in three areas as indicated on Figure 2.2 and extend to the west and north; and
- the majority of the overburden (94 Mt) will be placed in a storage area extending onto the plain to the east of the pit.

The pit design criteria will include:

- pit limits following ore/basement profile;
- 12 m bench levels;
- overall pit wall slope of 45°; and
- 25 m wide haul roads with a 10% gradient.

The loading and hauling equipment used in the construction and operational phases of mine development will be typical of that currently employed at iron ore operations in the area including:

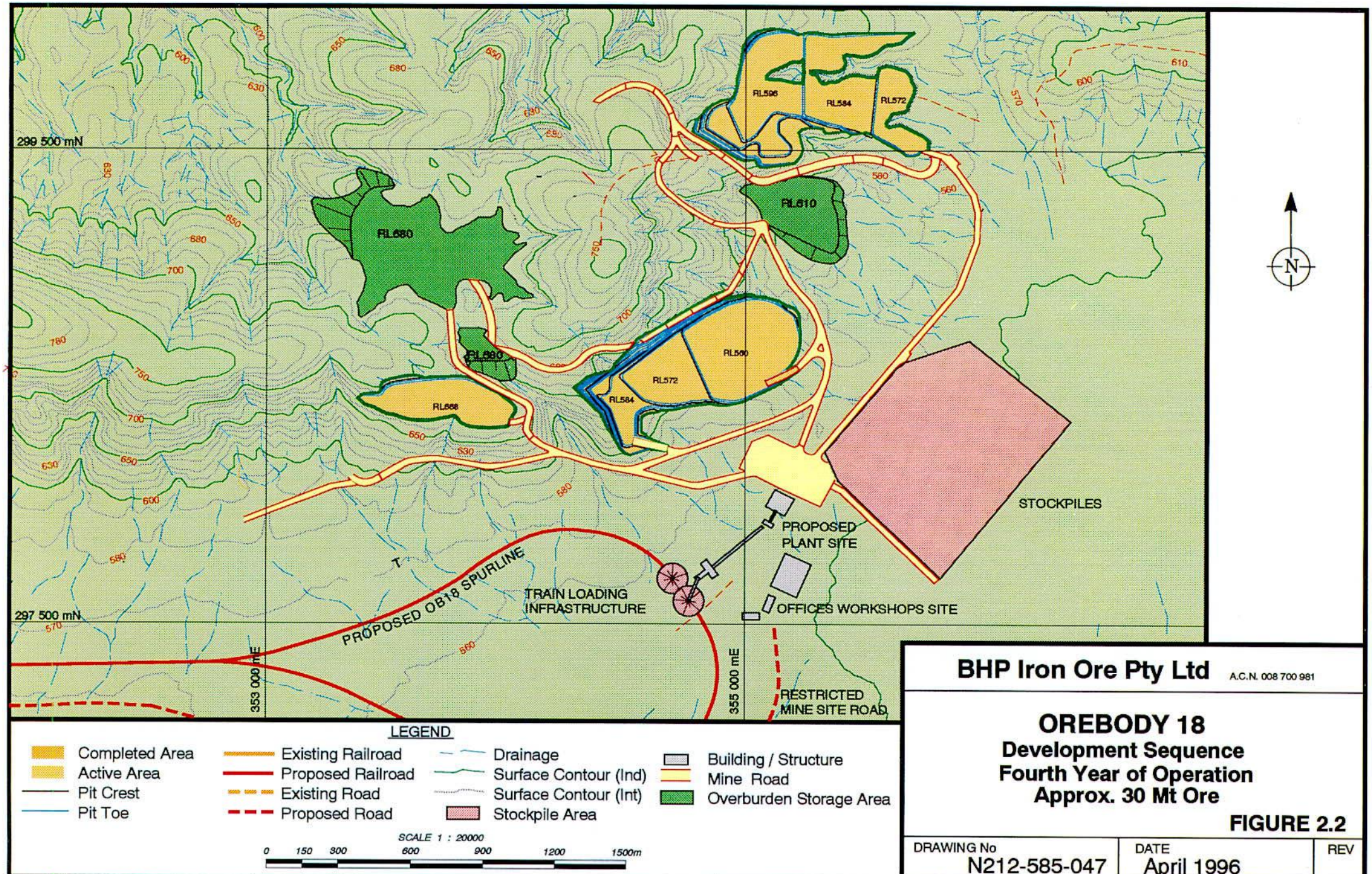
- hydraulic face shovels;
- rubber tyred loaders; and
- off-highway dump trucks.

This type of equipment provides the flexibility required to blend ore from various available pit faces to achieve a specified grade of product.

2.2.2 Overburden Management

The open pit mining method is suited to the recovery of mineral resources that occur near to the earth's surface. Open cut mines can utilise large sized mining equipment which can move considerable quantities of material in a relatively short time period. With open cut methods the overall mining cost is kept to a minimum.

The disadvantage of open cut mining is that in general, sizeable quantities of overburden material has to be moved. This is due to the requirement of having pit walls constructed to an angle that will be stable enough to ensure the safety of mining operators working below the slopes. Additionally, production would most likely be interrupted if a wall failure was to occur.



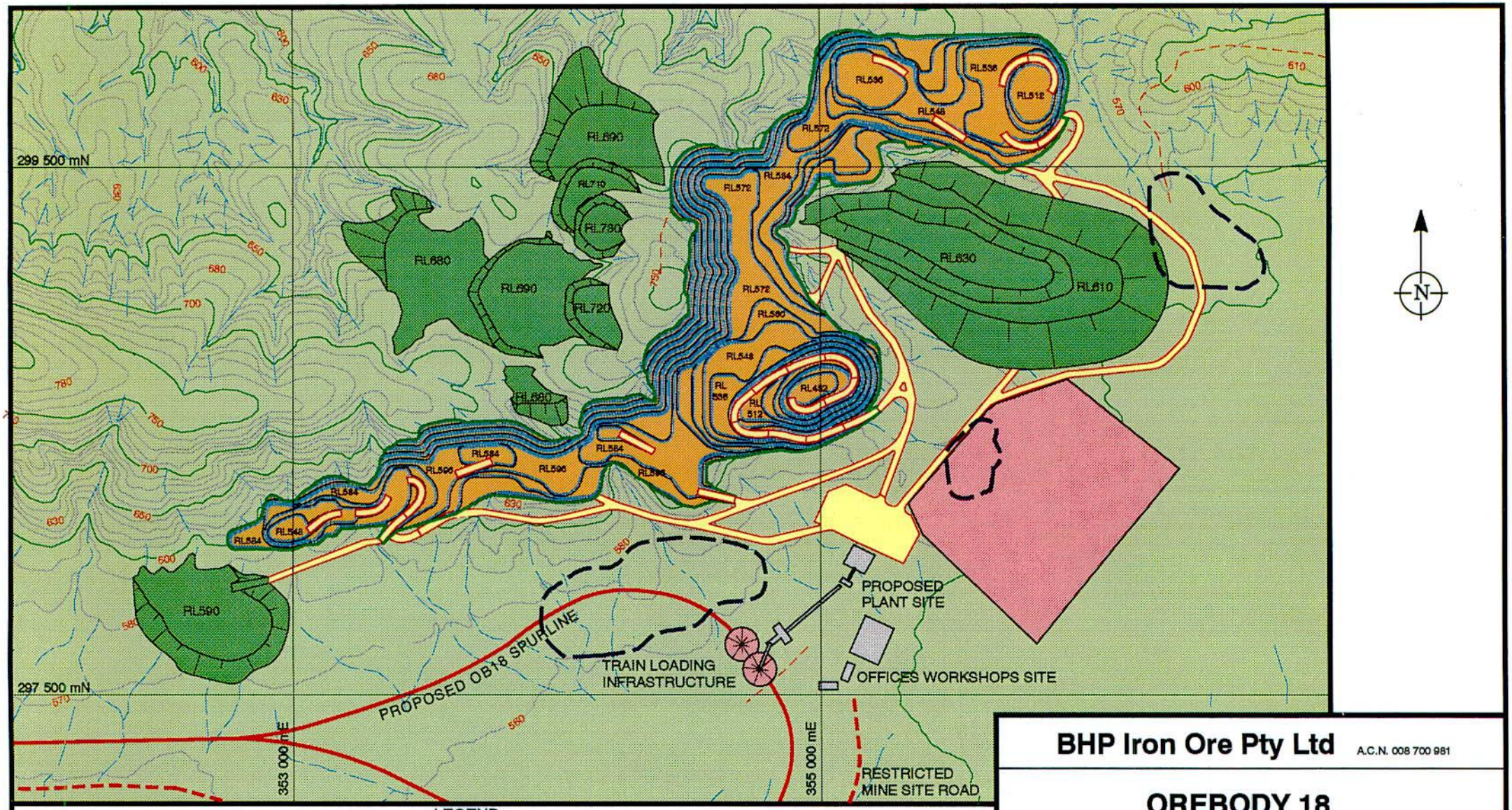
BHP Iron Ore Pty Ltd A.C.N. 008 700 981

OREBODY 18

Development Sequence
Fourth Year of Operation
Approx. 30 Mt Ore

FIGURE 2.2

DRAWING No	DATE	REV
N212-585-047	April 1996	



LEGEND

- Completed Area
- Active Area
- Pit Crest
- Pit Toe
- Existing Railroad
- Proposed Railroad
- Existing Road
- Proposed Road
- Drainage
- Surface Contour (Ind)
- Surface Contour (Int)
- Stockpile Area
- Building / Structure
- Mine Road
- Overburden Storage Area
- Potential Scree Area

SCALE 1 : 20000

0 150 300 600 900 1200 1500m

BHP Iron Ore Pty Ltd A.C.N. 008 700 981

OREBODY 18

Development Sequence Ultimate Pit (Approx. 120 Mt Ore)

FIGURE 2.3

DRAWING No	DATE	REV
N212-585-044		

It is important to establish the wall angle correctly. Too steep an angle could create instability of the material resulting in wall failures, production interruptions and possibly fatalities. Too shallow an angle would mean the necessity to remove additional quantities of material. This would result in increased capital costs in purchasing additional equipment and increased operating costs to remove the extra overburden.

There are many factors to take into consideration when determining the final angle of pit walls but generally the angle is steeper than the natural angle of repose.

In a simplified open pit design (an inverted cone) the shape is such that the deepest level of mining is recovered last. This is simply because all the mining effort at higher depths has to have first taken place so that mining can occur below. This is irrespective of whether a systematic cut-back scenario or a bench by bench system is employed.

In this simplified pit it is therefore impossible to incorporate infilling of the mine overburden into worked out areas of the pit. The overburden will simply rill down and cover the benches (ore, equipment, people) below. Therefore in this case all overburden must be placed on dumps outside of the pit's limits.

In practice, a simplified pit design is not often seen. The shape of the mineralisation results in an assortment of pit shapes. There are therefore opportunities presented where overburden can be directly infilled to abandoned (mined out) areas.

A mining sequence can also be scheduled whereby the lowest levels of a pit design can be recovered earlier than some shallower but more remote areas. This low area could then receive overburden from other higher elevated active mining areas. The governing factor in determining the mining sequence is how the grade varies as the pit develops and the overall mining effort with time.

The most suitable sequence for mining is one that delivers the required grade and the most cost effective mining scenario with time, taking into account other desirable outcomes such as environmental considerations.

Theoretically the economics appear to favour the extraction of the lower levels earlier and infill overburden from higher levels. The truck haul for this overburden would

most likely be shorter than hauling outside of the pit limits. Also the loaded truck would travel on a down gradient which would result in a fuel saving.

This scenario depends heavily on the mining effort required to allow extraction of the lowest benches to occur earlier in the mine life.

The most economically unfavourable situation would be the case where the overburden was first hauled outside of the pit limit, and at a later date (most likely after all the ore is extracted) backfilled into the mined out pit. This would have the effect of almost doubling the mining cost but also having this cost occurring at a time when there was no revenue.

In summary, there are no specific rules that can be applied to a mining development sequence in an open cut mining operation. Each situation presents different parameters than must be taken into account when determining the optimum mining scenario.

Orebody 18

The iron ore at Orebody 18 occurs on the southern side of an elevated range. Recovery of the ore will result in a pit approximately 4 km in length but with a width of only 200 - 500 metres. In one small area, the ore extends below the water table.

Due to the length of the final pit, it would be reasonable to expect that there will be an opportunity to direct infill a proportion of mined overburden into abandoned areas. The difficulty here is that a large percentage of the overburden is derived from the upper levels of the pit where the high wall is being constructed at a safe angle for mining to occur below. A combination of the narrow width and high wall means that unless one section of the pit has been completely mined out, there will be little opportunity to infill.

Another complication is that the lowest levels of the pit (area below the water table) contains the highest grade iron ore. For even presentation of grade throughout the pit's life, this high grade area will, therefore, be steadily extracted and blended with lower grade material mined from other areas. This scenario, therefore, leaves very little opportunity for direct infilling of the below water table area as mining will continue up until the end of the orebody's life.

The geography of the ore reserve and the mine development sequence, therefore, require that the majority (94 Mt) of the overburden be placed in a storage area on the plain to the east of the pit. Approximately 5 Mt will be placed in an area on the plain to the south-west of the pit. The remainder, approximately 17 Mt, will be removed from the upper levels of the pit to a gully north-west of the pit (Figures 2.2 and 2.3).

Alternative out-of-pit overburden placement areas were evaluated in terms of haulage distance, access, landform impact, disturbance of flora and fauna and archaeological sites. The proposed layout has been designed to disturb the minimum practical area of land, fit with the surrounding landform profile and provide economic haulage distances from the point of mining.

In the later stages of mining, some overburden storage may be practical in the pit area. However, prospects for overburden return are limited by the need to access ore from the bottom of the pit last. There are currently no firm plans detailing overburden return to the pit. The quantity eventually returned will depend on the mining sequence adopted which will be subject to revisions during the life of the mine, depending on the ore grade encountered and market developments.

2.2.3 Dewatering

The local groundwater table is at approximately 495 - 500 m RL. An estimated 4.8 Mt of high grade ore requiring 5.4 Mt of total movement (ore plus overburden) occur below this level and will require dewatering to enable mining.

2.3 ORE PROCESSING

Ore processing facilities will be established to process up to 15 Mtpa (dry) and will include:

- a primary jaw crusher, apron feeder and screen;
- secondary and tertiary crushers, feeders and screens;
- a conveyor system;
- sample station; and
- stacker, stockpile and train loader.

The ore will be fed into the primary crusher from haul trucks or from front-end loaders reclaiming adjacent run-of-mine stockpiles. Primary followed by secondary crushing will produce a nominal 100 mm size product. After crushing, the ore will be conveyed to blending stockpiles prior to transport to Port Hedland by rail.

2.4 ORE TRANSPORT

It is proposed to construct an 8 km rail spur from the halfway mark of the existing Jimblebar line terminating in a loop at the mine site (Figure 2.1). The new track will be constructed to the same standard as other BHP Iron Ore tracks in the Pilbara. The ground to be traversed by the new section of line is relatively flat, therefore minimal cut and fill will be required. Where fill is required, it will be obtained either from borrow pits along the length of the line or from the mine area.

There are no major creek crossings encountered along the length of the rail spur. Where the line intersects minor drainage lines, culverts will be constructed under the line to maintain water flow.

Blended ore will be recovered from stockpiles for loading into rail wagons. The rail loadout facility is designed to operate 24 hours/day, seven days/week. At a mining rate of 10 Mtpa, eight trains/week will be required to transport the ore to the port. With maintenance requirements, this rate will result in two trains/day for several days per week.

A typical train length is anticipated to be 240 wagons. Each wagon has a nominal capacity of 100 tonnes.

2.5 WASTE PRODUCTS AND HAZARDOUS MATERIALS

Waste products and hazardous materials generated on the mine site may include:

- washdown water;
- sewage;
- general refuse;
- fuels, lubricants and waste oils;
- detergents, glues and paints; and
- explosives.

The following waste management practices will be employed at the Orebody 18 mine site:

- washdown water will be collected in drains and transferred to an impermeable evaporation pond at the mine site, having first passed through sediment traps and an oil separation system;

- sewage from the site will be collected in underground septic tanks;

- recyclable waste will be periodically removed from site by a contractor;

- general refuse (domestic and industrial solid waste) will be buried in a landfill site to be constructed on-site in a favourable location (ie. away from drainage lines and areas with a high water table);

- waste oils will be collected and removed from the Orebody 18 site for recycling by a contractor;

- fuels and lubricants will be stored in regulation containers situated in concrete lined and bunded areas to contain possible spillage;

- detergents, glues and paints will be stored and managed in accordance with relevant State regulations; and

- an explosives storage facility will be erected on-site to supply the mining operation and will be constructed in an area away from the other infrastructure and in accordance with mining regulations.

Details of these waste management activities will be finalised in consultation with the DEP and contained in the licence to be applied for under Part V of the *Environmental Protection Act 1986.*

2.6 SUPPORT FACILITIES

On-site support facilities will include:

- mine offices;
- workshop;
- explosives stores;
- power sub-station;
- fuelling facilities;
- water supply;
- water treatment plant; and
- waste handling facilities.

Fuel for the operation will be delivered to the site by the local distributor from Newman and stored in a concrete lined and bunded bulk fuel storage area.

2.6.1 Power

Power for the operation will be supplied via a 66 kV overhead power line (37 km) from the new Pilbara Energy Pty Ltd Newman gas-fired power station located to the north-west of the town. The line will be installed along the route of the private access road to the mine on the southern side of the railway line (Figure 2.1). This will facilitate the maintenance of the line and avoid the development of a maintenance road.

2.6.2 Water Supply

The estimated water requirement for the operation is approximately 500,000 kL/year (1,400 kL/day). Process water for the site will be obtained from a borefield along a 2-4 km east-west line immediately south of the Project site. Water quality is expected to be 1200 - 1400 mg/L TDS. A pipeline will be constructed from the borefield to the site. Water will also be available from the pit during the dewatering phase when ore is recovered from below the water table. This water (580 mg/L TDS) will be used primarily for process and dust suppression purposes.

A water treatment plant will be used on-site to provide potable drinking water.

2.7 MINING WORKFORCE ACCOMMODATION

The permanent workforce at peak production will be approximately 150 people. They will be accommodated in Newman together with their dependents. BHP Iron Ore has sufficient capacity in Newman to accommodate the Project workforce.

3.1 INTRODUCTION

This section presents a description of the regional and local environmental characteristics of the Project area. It also discusses potential impacts on the environment associated with the proposed mining operation. The degree of impact on the environment has been identified as being major, moderate, minor or negligible. These impacts are defined below from Duinker and Beanlands (1986).

- Major Impact - affects the abundance and/or distribution of an entire flora/fauna population to the degree that its population will not return to its former level in several generations. A major impact may affect a subsistence or commercial resource use over a long period.

- Moderate Impact - affects a portion of the flora/fauna population and may change the abundance or distribution of the population over a generation, but does not threaten the integrity of the population. It may also cause short-term affects on resource users.

- Minor Impact - affects a specific localised group of individuals within a flora/fauna population over a short period.

- Negligible Impact - any impacts below minor are considered negligible.

Environmental management measures are identified to minimise and avoid adverse impacts.

3.2 CLIMATE

Orebody 18 is located in the Pilbara region of Western Australia which experiences an arid climate, due mainly to the influence of the tropical maritime and tropical continental air masses. The area has two distinct seasons: a hot summer from October to April and a mild winter from May to September. Characteristic climatic features of the region include seasonally low and unreliable rainfall with high temperatures, high evaporation rates and a high daily temperature range.

There is no weather station located at the Project site, however meteorological data has been recorded since 1965 at Newman. These records give a good indication of the variation and range of climatic conditions that may be expected at the Project site. Data are compiled on the mean 9 am and 3 pm temperatures and mean relative humidity (23 years of record), mean daily maxima and minima, mean and median rainfall and mean number of rain days (25 years of record). The weather station at Newman does not record evaporation. The nearest station to do so is at Paraburdoo, 215 km to the west.

3.2.1 Temperature

Extreme temperature ranges are experienced in the Pilbara. Light frosts occasionally occur during July and August. As high temperatures and high humidity seldom occur together, the climate is generally very dry (*ecologia* Environmental Consultants, 1995).

Mean annual maximum and minimum temperatures for Newman are 31.3°C and 17.2°C, respectively. Mean monthly maximum temperatures range from 38.7°C during January to 22.1°C in July, while mean monthly minimum temperatures range from 25.1°C in January to 7.8°C in July. Summer temperatures may reach as high as 49°C, with mean maxima of 30°C, while winter temperatures generally have mean maxima of 23°C (ranging from 14°C to 35°C).

These values are based on 25 years of records collected at the Newman weather station (Bureau of Meteorology, 1995).

TABLE 3-1

SUMMARY OF CLIMATIC DATA FOR NEWMAN

Month	Temperature (°C)		Humidity (%)		Rainfall (mm)	
	Mean Daily Maximum	Mean Daily Minimum	9 am Mean	3 pm Mean	Mean	Mean No. of Raindays
January	38.7	25.1	32	22	55	7
February	37.1	24.3	34	24	72	7
March	35.9	22.3	34	22	40	5
April	31.7	18.3	37	24	23	3
May	26.0	13.0	46	30	24	4
June	22.4	9.3	51	31	20	4
July	22.1	7.8	45	28	12	2
August	24.7	10.1	40	24	10	2
September	29.2	13.6	25	15	5	1
October	33.5	17.8	22	14	4	1
November	36.4	21.2	23	14	11	3
December	38.3	23.9	24	16	27	4
Annual	**31.3**	**17.2**	**34**	**22**	**303**	**44**

Source: Bureau of Meteorology, 1995.

3.2.2 Rainfall and Evaporation

Rainfall in the Pilbara is highly variable. Recordings have been highest at stations around the Hamersley Ranges with an altitude of 900 m or more. The southern Pilbara has a bimodal distribution of rainfall 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 303 mm, occurring over 44 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.

Annual evaporation can exceed rainfall by as much as 2,500 mm per year.

3.2.3 Wind

Wind data collected at Newman indicate the dominance of easterly patterns throughout the year. Data from the Bureau of Meteorology show a tendency for afternoon winds in the period from September to November shifting from easterly to north-westerly. Wind speeds greater than 21 km/hr are recorded more often during the spring and summer months than in the winter months.

3.3 TOPOGRAPHY

3.3.1 Existing Topography

Orebody 18 is located at the eastern end of the Ophthalmia Range. The Ophthalmia and Hamersley Ranges comprise the majority of the Hamersley Plateau. Four 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) and cited by *ecologia* Environmental Consultants (1995).

- 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.

- Gorges - exposed rock gorges with steep sides, the beds of which are filled with boulders, gravels and sand.

- 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

Changes to the topography due to the Project will result from the development of the following elements:

- mine pit (163 ha);
- overburden storage areas (154 ha);
- ore stockpiles (56 ha);
- rail spur line (60 ha);
- rail load out facility (3 ha);
- borrow pits;
- access and service corridors; and
- process plant infrastructure and mine site buildings (14 ha).

Development of the pit and overburden storage area will result in the permanent alteration of approximately 317 ha.

Mining of ore from Orebody 18 will result in the formation of a mined out pit approximately 3.5 km in length and extending up to 120 m below existing ground level at its deepest point.

Approximately 116 Mt of overburden will be stored outside the pit in the overburden storage areas. The height of the storage areas will vary at the end of mine life. The eastern area will be approximately 50 m in height, the western area (located in a gully to the north-west of the pit) will be 30 - 40 m in height, and the smaller western area will be 10 m in height.

The overburden storage area located in the gully to the north-west will be below the skyline when viewed from the main access road to the mine. The two overburden storage areas on the plain will have a maximum height lower than the natural ridgelines to the immediate west and will therefore not appear inconsistent with the natural topography in this part of the Range.

Unwanted project infrastructure will be removed after the completion of mining. The resulting disturbed areas will be rehabilitated once facilities are removed.

The rail spur formation will persist beyond the life of the operation. Impacts include areas of fill, culverts on minor drainage lines and rehabilitated borrow pits.

3.3.3 Management

BHP Iron Ore has a policy of minimising environmental disturbance. This policy will apply in developing Orebody 18. The following measures will be undertaken to achieve this goal:

- Overburden storage areas will be designed to be consistent with the surrounding landform.

- Where topsoil is present, it will be removed and stored for later use in rehabilitation. Final surfaces will be formed as early as possible and battered to slopes of 20° or less. The reserved topsoil will be spread and stabilisation techniques applied to the surfaces. Seeding of plant species native to the area will then take place, as required.

- Periodic monitoring of rehabilitated areas will be undertaken to assess the success of the rehabilitation programme. Parameters to be monitored will include the establishment and growth of plants; the species composition; evidence of land degradation; and evidence of the return of fauna species.

Further detail is included in the draft Environmental Management Programme attached to the CER (Attachment A).

Close supervision of the mining contractors by BHP Iron Ore will ensure compliance with the EMP objectives. A condition will be included in all contracts which prohibits unauthorised clearing. Furthermore, the construction contractor will not be permitted to vacate the site until it has been rehabilitated. Monitoring and maintenance of the rehabilitated areas will continue until the vegetation is seen to be progressing towards a stable condition. Proposed Rehabilitation Criteria for Orebody 18 are summarised in Table 3-2.

TABLE 3-2

PROPOSED REHABILITATION CRITERIA

Site Element	Final Landform	Final Vegetation	Note
Overburden storage areas	Flat topped spurs, 20° scree outslopes, stabilised; rounded forms like existing hills	Early successional species first, final objective is scattered eucalypts over spinifex	
Open pit	Open pit to DOME safety standards, possibly with occasional open water or partially filled with overburden.	Accessible internal benches and pit floors will be ripped and seeded.	Opportunity for filling with overburden below watertable will be reconsidered when the EMP is reviewed with DEP in future.
Scree mining areas	Shallow areas recontoured to blend with surroundings. Deep areas filled or treated similarly to main pit.	Early successional species first; final objective is scattered eucalyptus over spinifex, where appropriate.	
Process plant	Consistent with existing. All infrastructure removed.	Site ripped and seeded with species consistent with the vegetation type on outwash plains.	
Road/rail spurs	Consistent with existing. All infrastructure removed. Formation retained.	Site ripped and seeded with species consistent with the vegetation type on outwash plains.	
Powerline	Consistent with existing. All infrastructure removed.	Site ripped and seeded with species consistent with the vegetation type on outwash plains.	
Borefield	Consistent with existing. All infrastructure removed.	Site ripped and seeded with species consistent with the vegetation type on outwash plains.	

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 deposits at Orebody 18 are 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 north-western most corner of Orebody 18 is dominated by the Weeli Wolli Formation. This formation consists of a sequence of interbedded BIF, chert and shale which has been intruded by several metadolerite sills.

The extreme south-eastern corner of the orebody lies in the Mt Sylvia Formation and Mt McRae Shale.

- The Mt Sylvia Formation is formed of shale, dolomite and three BIF bands (Bruno's Bands).

- The Mount McRae Shale consists of black graphitic and chlorite shales. Shale and interbedded BIF forms the uppermost part. Pyrite nodules can be found in several zones in the middle of the formation. Minor chert bands are also present. This formation is characterised by interbedded shale, chert and BIF.

To the south, the orebody is interrupted by Cainozoic Colluvium. These non-ore valley-fill deposits consist of partially to entirely consolidated ferruginised silt, sand and gravel, generally dissected by the present drainage.

Figures 3.1 and 3.2 show the cross sections for the north and south pits, respectively.

Potentially Acid Producing Material

Drill hole data indicates that small areas of black pyritic shales occur embedded within the Mt McRae shale band. This potentially acid producing material occurs at depths of between 6 and 40 m below the proposed pit floor. As a result of its depth, the pyritic material will not be intercepted by the pit. Dewatering will not occur below the level at which the McRae shale occurs either. Therefore, the pyritic shale should not be disturbed or exposed to oxygen, avoiding the potential for acid production.

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). The relationship of soil types to landform is discussed in Section 3.3.1.

3.5 SURFACE WATER

3.5.1 Existing Conditions

The orebody is situated at the head of a catchment, with surface drainage to both the east and west. Ephemeral streams in the area generally only flow following high intensity rainfall events. These drainage lines form erosional gullies in the high lands and tend to fan out and dissipate at the base of the slope as water infiltrates the permeable scree deposits (Figure 3.3).

Sub-surface flow beneath the drainage bed is not likely to be sustained for long after drainage events as the regional water table in this area generally occurs at least 50 m below ground level.

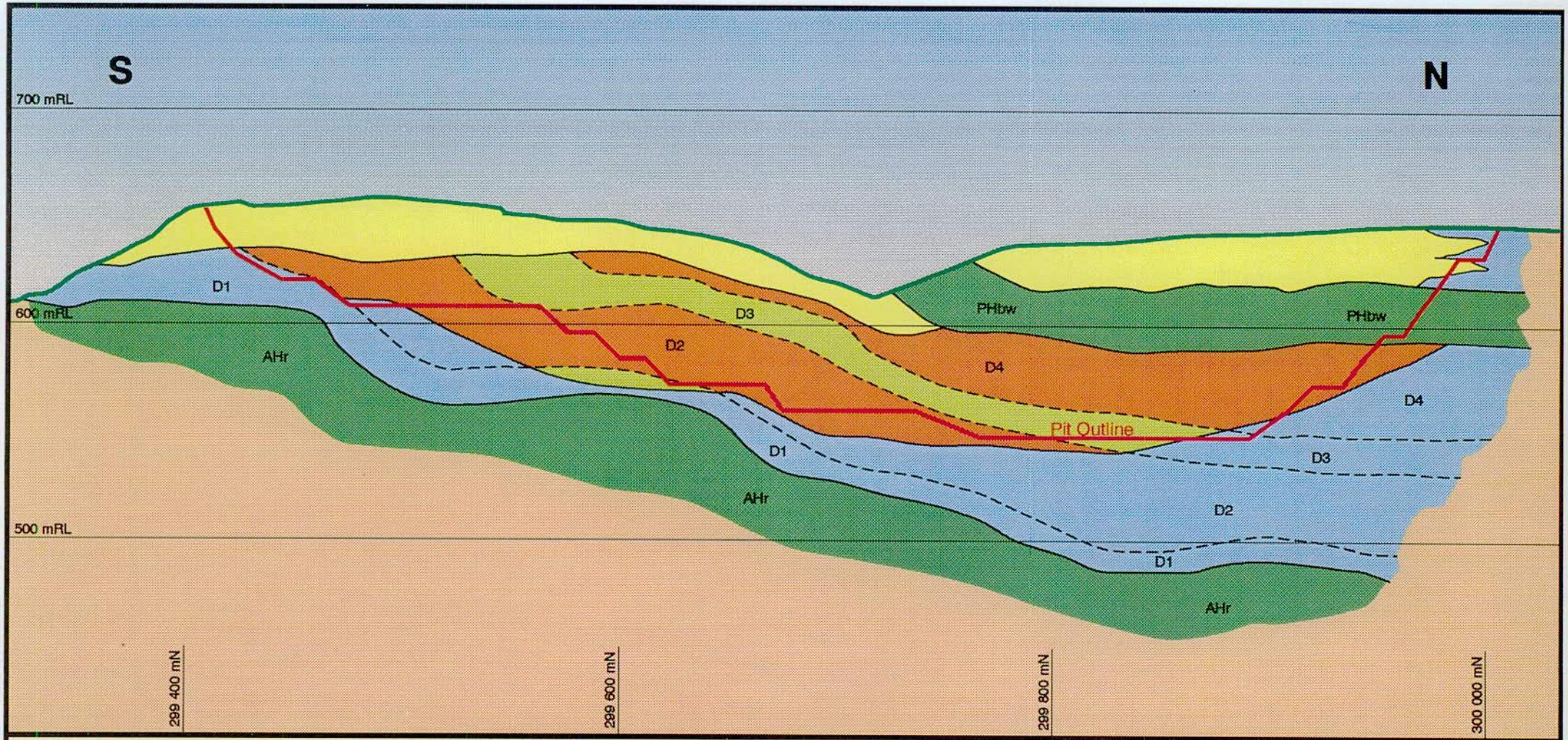
Surface flow to the west drains through the scree deposits to Shovelanna Creek, which flows to the north-west, joining the Fortescue River immediately downstream of Ophthalmia Dam. Easterly flows join Jimblebar Creek, which joins the Fortescue Valley further to the north.

3.5.2 Potential Impacts

The proposed mine pit follows the line of the escarpment and will intercept approximately 10 minor drainage lines.

Vegetation in downstream areas will not be impacted by potentially reduced surface flows since flows infiltrate through scree deposits and do not generally persist beyond the base of the slope. Water levels within the scree are generally more than 40 m below ground level and phreatophytic vegetation does not occur in the drainage channels in this area.

The overburden storage areas are to be located in two areas on the plain to the east and south-west of the pit as well as in a gully to the north-west (Figure 2.2). Since the storage areas on the plain occur at the head of the southern catchment, there will be little disruption of flow to the south. Overburden waste placed in the gully to the north-



LEGEND

Stratigraphy

Internal divisions
J6
J3-5
J2
J1
D4
D3
D2
D1

Yandicoogina Shale
Joffre Member (PHbj)
Mt Whaleback Shale (PHbw)
Dales Gorge Member
Mt McRae Shale (AHr)
Brockman Iron Formation

SCALE
0 15 30 60 90 120 150m

Ore / Rock types

PIOC
0132 Hardcap Ore (54% - 60% Fe)
0032-62 High Grade (+ 60% Fe)
4032-62 Shaley Ore (54% - 60% Fe, >3% Al_2O_3)
BIF
Shale

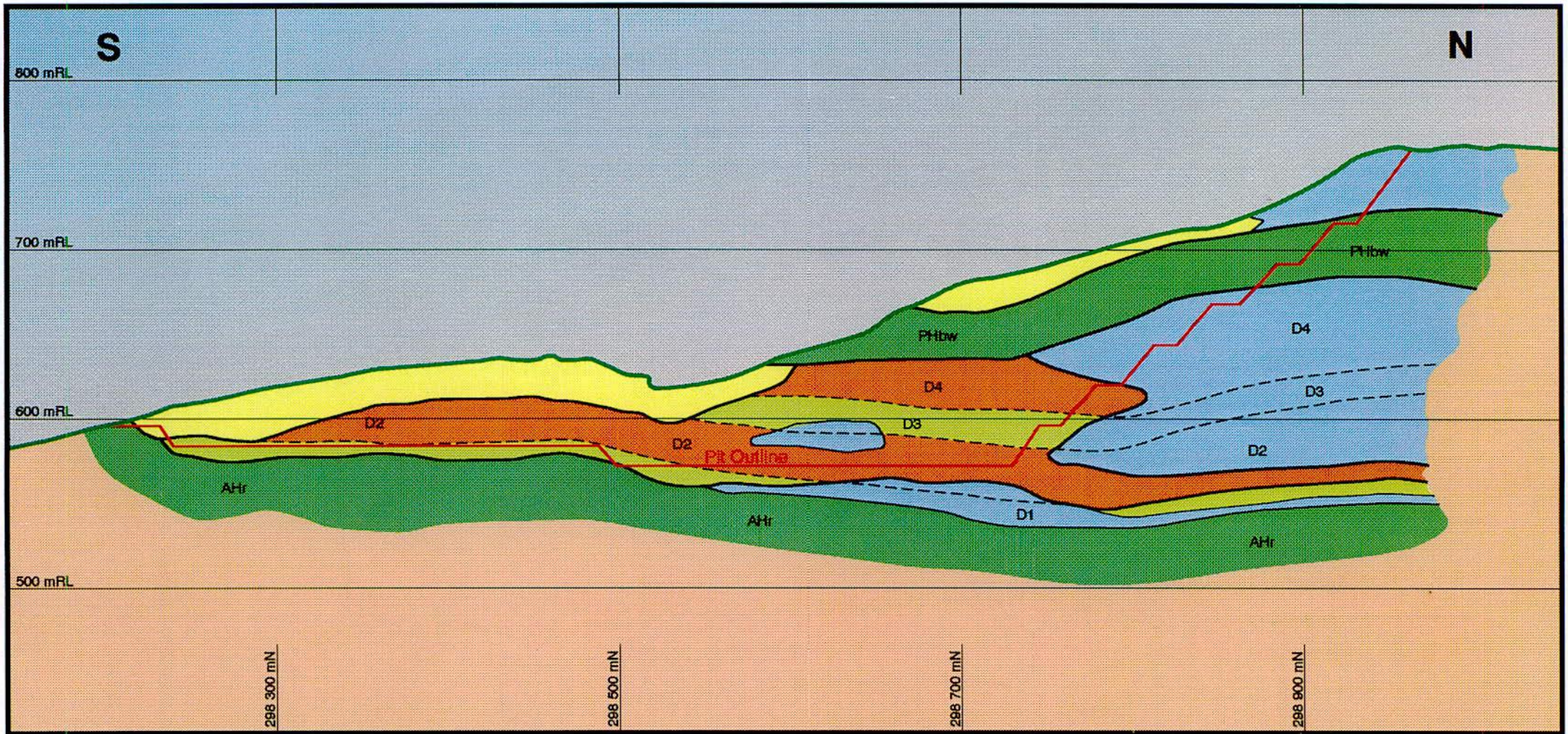
BHP Iron Ore Pty Ltd A.C.N. 008 700 981

OREBODY 18

Typical Cross Section North Pit

FIGURE 3.1

DRAWING No	DATE	REV
N212-585-041	April 1996	



LEGEND

Stratigraphy

Internal divisions		
	Yandicoogina Shale	
J6		
J3-5	Joffre Member (PHbj)	Brockman Iron Formation
J2		
J1	Mt Whaleback Shale (PHbw)	
D4		
D3		
D2	Dales Gorge Member	
D1		
	Mt McRae Shale (AHr)	

SCALE

0 10 20 40 60 80 100

Ore / Rock types

PIOC 0132	Hardcap Ore	(54% - 60% Fe)
PIOC 0032-62	High Grade	(+ 60% Fe)
PIOC 4032-62	Shaley Ore	(54% - 60% Fe, >3% Al_2O_3)
	BIF	
	Shale	

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OREBODY 18

Typical Cross Section South Pit

FIGURE 3.2

DRAWING No	DATE	REV
N212-585-040	April 1996	

FORTESCUE RIVER

Spinifex Bore

Kalgan

BM 481

BM 484

Creek

Trugallenden Pool

HIGHWAY

OPHTHALMIA DAM
(under construction)

spillway

Shovelanna Creek

SHOVELANNA HILL
803

OREBODY 18

WHEELABRA HILL
727

McCAMEYS MONSTER
706

Innawally Pool

Jimblebar Creek

Cleared

line

CREEK

NOTE:-
REFERENCE NATIONAL TOPOGRAPHIC MAP SERIES , SHEETS 2851 and 2951

1979 MAP - NO OPHTHALMIA DAM

N

SCALE 1 : 100 000

BHP Iron Ore Pty Ltd A.C.N. 008 700 981

OREBODY 18
Regional Drainage

FIGURE 3.3

DRAWING No	DATE	REV
N212-585-075	April 1996	

west of the pit may potentially impact surface flows from that particular drainage channel to the north.

Drainage from overburden storage areas could potentially increase sediment load downstream.

3.5.3 Management

Suspended sediment in surface water generated from flows over overburden storage areas is expected to be filtered out naturally as runoff enters the lower scree slopes. Surface water flows which leave the mine area will be managed by the use of settling ponds. Significant sediment loads will therefore not migrate downstream to Shovelanna or Jimblebar Creeks. As no potential pollutants occur in the overburden, other water quality parameters in the drainage lines downstream will remain unchanged.

3.6 GROUNDWATER

3.6.1 Existing Conditions

The hydrogeology of the Orebody 18 environs was investigated in late 1995 and early 1996 (Woodward-Clyde, 1996) by drilling and aquifer testing. The orebody itself is 'cradled' in the Shovellanna Syncline (which plunges west-northwest) and, in the immediate area of Orebody 18, is bounded by the Mt McRae and Mt Sylvia shale units to the north, east and south but is "open" to the west (WNW). The Shovellanna Syncline is one of many fold structures on the generally northerly dipping limb of a regional monocline type structure. To the north and northwest of the mine area the orebody aquifer system is bounded by steeply dipping shales and BIFs of the Weeli Wolli Formation. Underlying these units are Wittenoom Formation and the Marra Mamba Iron Formation which outcrops on the southern side of the valley (Orebody 39).

A schematic section (north-south) is presented in Figure 3.4 showing a conceptual hydrogeological model of the Orebody 18 area.

The groundwater system can be broadly grouped into 5 units.

- An aquifer (A1) formed by Orebody 18, (and mineralised Dales Gorge outside the orebody), which includes the relatively small volume of ore below the water table.

- An aquitard (low permeability unit/hydraulic barrier) formed by the Mt McRae and Mt Sylvia shale units.

- An aquifer (A2) formed by fractured BIF and chert basement in the lower Mt Sylvia and along the eroded top edge of the Wittenoom Formation.

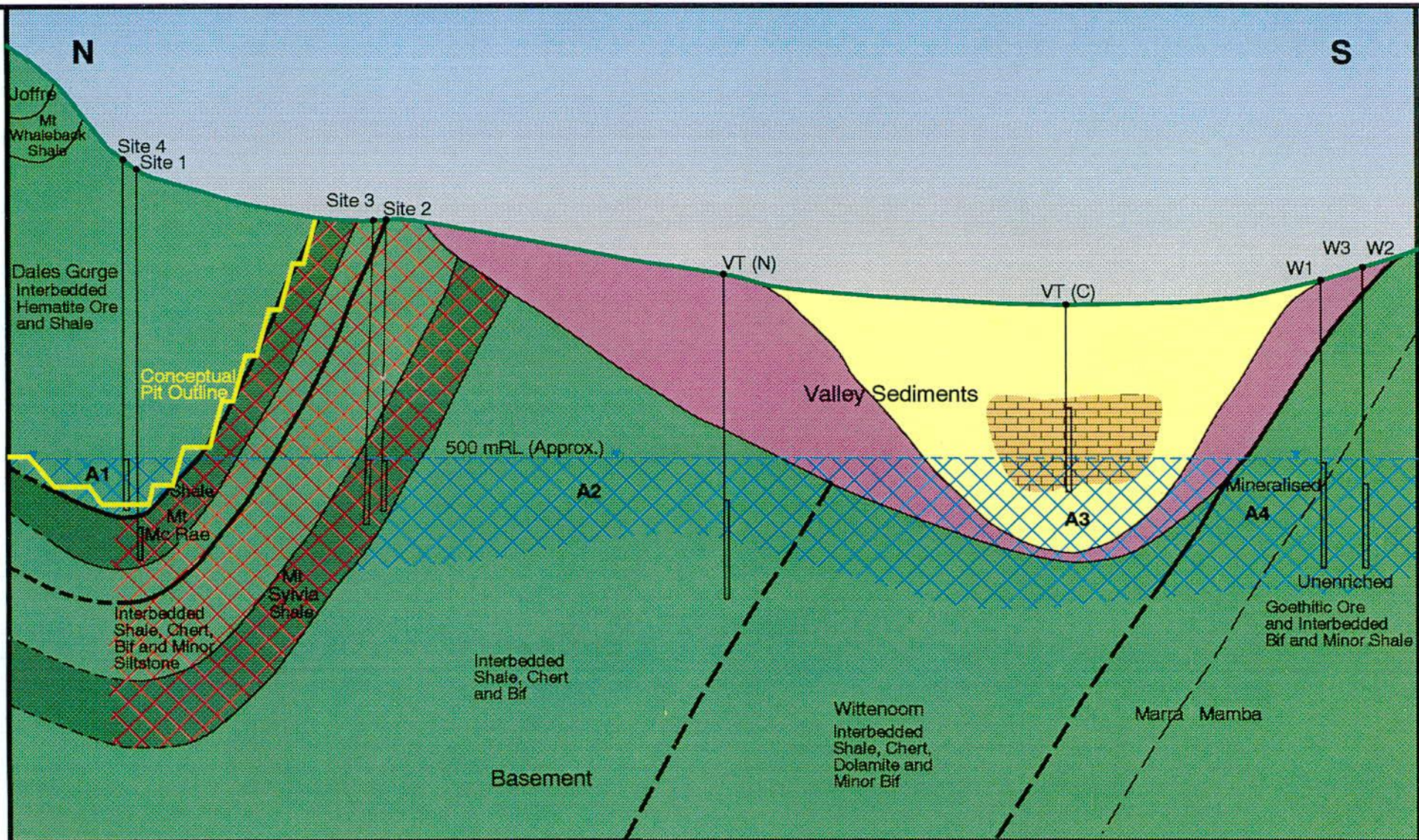
- The shallow alluvial aquifer (A3) formed by scree and alluvial clay deposits which contain minor calcrete developed below the water table.

- An aquifer (A4) formed by the mineralised and fractured unmineralised Marra Mamba Iron Formation.

Hydraulic testing of selected shale intervals within the Mt McRae and Mt Sylvia shale units (immediately below the orebody, stratigraphically) indicates these units have a low hydraulic conductivity (permeability), with estimates ranging from 10^{-3} to 10^{-2} m/d. This suggests that the Mt McRae and Mt Sylvia units form an aquitard/hydraulic barrier between the orebody aquifer and other local groundwater systems (Woodward-Clyde, 1996), except to the west-northwest where mineralised Dales Gorge Member is expected to be extensive.

Hydraulic testing of one interval within the saturated orebody indicated a relatively low hydraulic conductivity (10^{-2} to 10^{-1} m/d) at that site. However, it is considered likely that much higher values would be more likely for the aquifer as a whole. Elsewhere in the Pilbara, mineralised Dales Gorge Member generally shows hydraulic conductivities in the order of 1 to 10 m/d.

Static water levels measured in all piezometers are consistent with a water table of approximately RL 495 to 500 m AHD. However, the available data do indicate a water table rise beneath the ridge to the south of (and across the valley from) Orebody 18, and that the groundwater level within the orebody aquifer is higher than in the adjacent shales.



Stratigraphy

Internal divisions		
	Yandicoogina Shale	Brockman Iron Formation
J6		
J3-5	Joffre Member (PHbj)	
J2		
J1		
D4	Mt Whaleback Shale (PHbw)	
D3		
D2	Dales Gorge Member	
D1		
	Mt McRae Shale (AHr)	

LEGEND

Rock types

- Clay
- Calcrete
- Scree
- Shale
- Graphitic Shale
- A3 Aquifer Zone
- Aquitard
- Formation Boundary
- Water Level
- Pit Outline
- Bore Name
- Monitor Bore
- Slotted Interval

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OREBODY 18

Schematic Cross Section of Orebody Deposit

FIGURE 3.4

DRAWING No	DATE	REV
N212-585-071	April 1996	

The water supply borefield is likely to be located in the southern margin of the valley sediments immediately south of the Project area, and drawing principally from the Marra Mamba formation. The borefield could extend for 2 to 4 km in an east-west direction. The groundwater in this area has been measured at 36 m below the ground surface and does not support phreatophytic vegetation.

Comprehensive chemical analyses have been carried out on the groundwater samples collected during exploration drilling in the Project area (Table 3-3). The analyses include results from the orebody aquifers and the Project borefield site.

Laboratory measurements of groundwater salinity, as total dissolved solids (TDS), indicate that the salinity varies depending on the aquifer tested. The fresher groundwaters occur in the orebody aquifer and the fractured BIF and chert/shales above the Mt Sylvia shale with measured salinities of 580 and 570 mg/L TDS, respectively. Slightly brackish groundwaters with salinities ranging from 1100 to 1400 mg/L TDS occur in the other basement units and the valley sediments. The salinity at the water supply site, 1200 - 1400 mg/L, is too saline for drinking water without treatment.

The differences between the water sampled from the orebody and that from the other local aquifers support the hydraulic conductivity and groundwater level measurements and are consistent with the orebody aquifer having only limited connection with the other aquifers. This suggests that any salts concentrated in the pit after mining will not readily migrate from the orebody aquifer into the surrounding aquifers.

TABLE 3-3

CHEMICAL ANALYSIS OF GROUNDWATER

Parameters[1]	Orebody Aquifer A1 (Site 1[2])	BIF, Chert Shale Aquitard (Site 3)	Calcrete Aquifer A3 (Site VT Centre)	Marra Mamba Aquifer A4 (Site W1)	Water Supply Borefield Site	
					Monitor Bore	Production Bore
pH	6.5	6.8	7.5	7.5	7.5	7.3
Conductivity[3]	970	1,000	2,300	1,900	2,000	2,200
Total Dissolved Solids[4]	580	570	1,400	1,100	1,200	1,400
Sodium	90	95	260	190	200	230
Potassium	17	14.5	16.5	16.5	17.5	20.5
Magnesium	37.5	40	100	85	85	85
Calcium	23.5	30	140	85	100	110
Chloride	200	220	520	360	410	480
Sulphate	180	120	250	220	200	230
Bicarbonate	10	40	250	240	245	250
Carbonate	nil	nil	nil	nil	nil	nil
Nitrate	<0.2	1.7	0.4	4.1	1.9	11
Fluoride	0.2	0.5	0.4	0.7	0.3	0.5
Silica	4	5	7	9	10	13
Iron (total)	31	420	75	1,300	80	1,600
Iron (soluble)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Manganese	0.1	0.3	<0.05	<0.05	0.1	<0.05

Note: 1. All parameters as mg/L, except conductivity (µS/cm) and pH.
2. Refer to Figure 3.4 for site locations.
3. @ 25°C.
4. @ 180°C (grav).

Source: after Woodward-Clyde, 1996.

3.6.2 Potential Impacts

Orebody Aquifer

To access all mineable reserves at Orebody 18, a groundwater pumping system (bores, sumps etc.) will be established to dewater the orebody when mining occurs below the water table at about 495 m AHD. This is limited to a small area near the proposed plant site (Figures 2.2 and 2.3). The area of pit below the water table is approximately 8 ha and will have a minimum RL of 452 m AHD at the completion of mining in this

sector. Therefore, dewatering operations will be required to dewater to at least 43 m below the water table.

Actual rates of dewatering to maintain suitable mining conditions will be dependent on the hydraulic characteristics of the orebody aquifer which will be more closely defined as the orebody is exposed.

Evidence from regional and local geology, hydraulic testing and groundwater chemistry suggests that the interconnection between the orebody aquifer and the aquifers formed in the valley sediments and basement lithologies is limited (Woodward-Clyde, 1996). The main area of hydraulic connection is expected to be to/from the west-northwest along the axis of the Shovellana Syncline and within the mineralised Dales Gorge Member.

The dewatering operations required when the mine extends below the water table will create a hydraulic head difference of some 43 m which will induce flows from the adjacent aquifers towards the mine. Most of these flows would be expected to be from the west-northwest within the orebody aquifer with only minor flows from adjacent valley sediments and basement aquifers. Any drawdown in these aquifers will have negligible environmental impact as the surrounding aquifers are around 50^{+} m below surface level and do not support phreatophytic vegetation or provide water for pastoral use.

On decommissioning it is expected that pit water levels will rise until a balance is reached between evaporative losses and groundwater inflows. Given that the orebody aquifer is relatively permeable and that potential pit inflows may be large, it is expected that the equilibrium pit water level may be close to (but below) the regional water table. There is also the potential for inundation of the pit (following rainfall/runoff) resulting in short-term pit water rises until the excess water evaporates or outflows to the adjacent aquifers and a new 'balance' is achieved.

The final pit water balance was assessed by comparing estimates of the potential evaporation rate, the drawdown effects of evaporative loss and pit inflows once dewatering had ceased. Figure 3.5 shows the expected water table configuration during mining and after decommissioning.

An extremely conservative estimate of the potential evaporation from the pit water surface when water levels approach regional table levels amounts to 224,000 m^3/yr, based on:

- average annual evaporation (nett of rainfall) = 4 m
- pan factor = 0.7
- area of pit below the water table = 80,000 m^2.

Estimates of pit inflows and the drawdown effects of evaporative loss were made using the following forms of the Darcy Equation which describes flow into (and out of) a large diameter well:

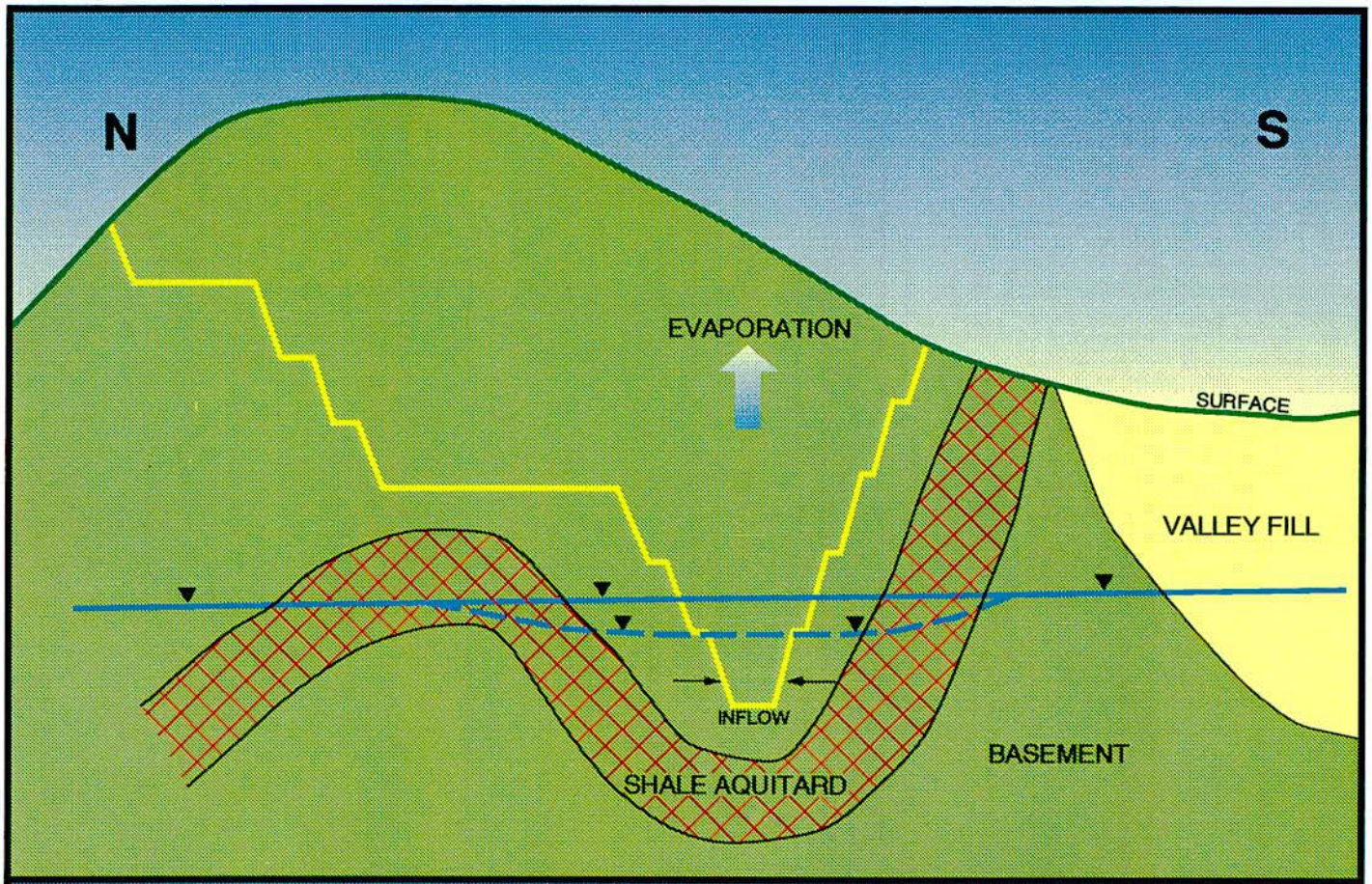
$$Q = \frac{\pi K (h_o^2 - h_w^2)}{\ln(r_o / r_{pit})}$$

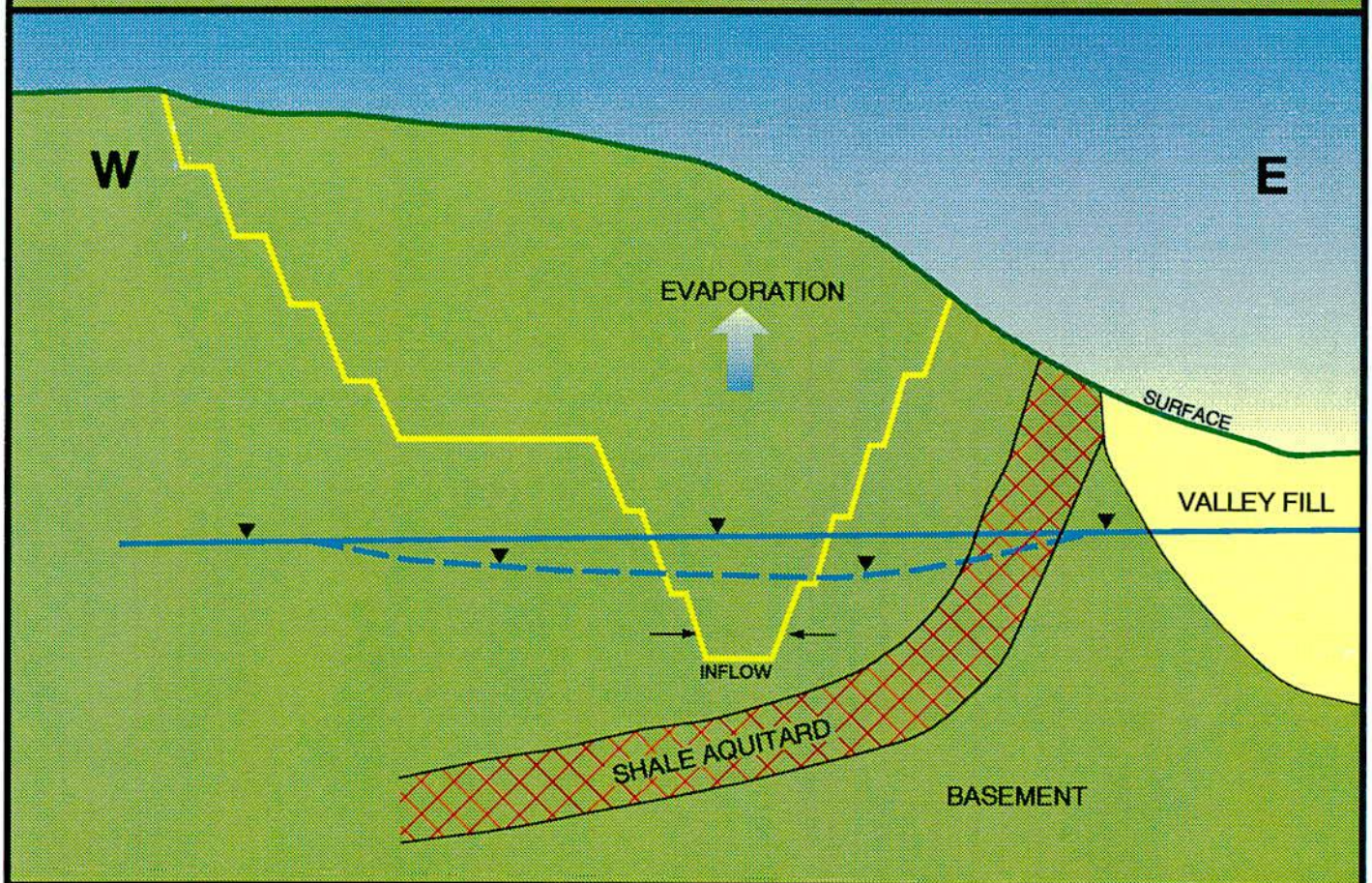
$$h_w = h_o^2 - \sqrt{\frac{Q \ln(r_o / r_{pit})}{\pi K}}$$

where Q = discharge from (or inflow to) the well, m2/d
K = hydraulic conductivity (main aquifer), m/d
h_o = height of regional water table above base of aquifer
h_w = water level in the pit/well, m
r_o = radius of influence, m
r_{pit} = radius of the equivalent large diameter well representing the saturated section of the pit, m

For the purposes of this exercise the hydraulic conductivity was assumed to be 1 m/d and the average radius of influence 2 km. Radial flow was also assumed. Using the above, it is estimated that the pit would fill to near water table level in some 2 to 5 years and that pit water levels would stabilise at about 5 m below the regional water table.

If a hydraulic conductivity of 10 m/d is adopted then the pit will fill much more quickly and it is estimated that pit water levels would rise to within about 1 m of the regional water table.





LEGEND

- Aquitard
- Formation Boundary
- Pre - Mining Water Level
- Mining and Post - Mining Water Level
- Pit Outline

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OREBODY 18

Schematic Cross Section of Final Pit Water Balance

FIGURE 3.5

DRAWING No	DATE	REV
N212-585-079	May 1996	

However, whichever hydraulic conductivity is adopted the pit will remain a groundwater sink, with evaporative losses maintaining pit water levels below the regional groundwater table. That is, other than periods when rainfall/runoff results in temporarily elevated pit water levels, groundwater will flow towards and into the pit rather than away from it. Also as outlined above, most of these pit inflows would be expected to derive from the orebody aquifer from the west-northwest with only minor flows from the shale units to the north, east and south.

Using the large diameter well equation and a segmented radial aquifer (with one third being dominated by the orebody aquifer with K = 1 m/d) and two thirds by the shales (with K = 10^{-3} m/d) it is estimated that over 90% of the inflows would derive from the orebody aquifer.

The other potential mechanism for pit inundation is due to rainfall runoff. The catchment area upstream of the part of the pit below 495 m AHD is 122 ha. The rainfall intensity for the 72 hour duration event with a 1 in 100 year average recurrence interval is 4.08 mm/hr (Australian Rainfall and Runoff, 1987), giving a total volume of 357,500 m^3 over 122 ha. This estimate assumes no losses due to interception, evaporation or runoff, and would inundate an area of 8 ha (the deepest part of the pit) to a depth of some 4 to 5 m. That is it may only bring pit water levels up to the regional water table level. Initially this would result in some pit outflows, as the water table immediately adjacent to the pit would have been some 5 m lower prior to the rainfall recharge. However, once the immediately surrounding water table recovered, which could be expected to take in the order of days, and evaporation again resulted in losses from the pit, groundwater flows would again be towards the pit.

One result of the pit being a groundwater sink due to evaporative losses will be a long-term increase in salinity of pit water. Assuming a starting salinity of 580 mg/L TDS, evaporation rates as referred to earlier and neglecting rainfall input, it is conservatively estimated that it would take some 11 years for the pit water salinity to exceed 1200 mg/L TDS and over 500 years to exceed 30,000 mg/L.

However, as outlined above, the pit will be a sink with no significant groundwater outflows expected. As such, saline pit water is not expected to migrate from the pit until such time as there develops a sufficient density contrast between saline pit water and fresher groundwaters. This may start to happen at salinities in excess of 10,000 mg/L, when the denser saline pit water could migrate to the base of the aquifer under

the influence of gravity rather than hydraulic gradient. However, due to the low permeabilities of the surrounding and underlying shales, it is expected that the saline water would be contained within the orebody aquifer. That is, any saline water that does migrate from the pit would move under the ridge to the north-north-west and would not enter the valley sediments and/or other aquifers.

In summary, the pit will partly fill with water at the completion of mining, but remain a groundwater sink with long-term groundflows into the pit rather than away from the pit. Pit water salinity will increase with time, due to evaporative concentration, but will take some 500 years to reach 30,000 mg/L TDS. At these higher salinities some densities/gravity driven migration of saline waters towards the base of the orebody aquifer may occur.

However, the impacts on water levels and salinity are expected to be restricted to the orebody aquifer and have little to no impact on adjacent aquifers (valley sediments etc).

Water Supply Borefield

The estimated water requirements for the operation are approximately 500,000 kL/yr (1,400 kL/d).

Some potential exists for drawdown in groundwater levels near the water supply borefield. The water table at the borefield site is 36 m below ground level and does not support phreatophytic vegetation. Therefore, any drawdown will not affect vegetation in the area. The nearest pastoral bore to the borefield is located 2 km to the south-west. Drawdowns at the borefield are therefore unlikely to impact on the quality or quantity of water for pastoral use.

The construction of a pipeline from the water supply borefield to the mine site will have a minor impact on the local vegetation.

A water treatment plant will be required at the Project site to provide water of drinking quality.

3.6.3 Management

Orebody Aquifer

Limited hydraulic testing within the saturated orebody and data from elsewhere in the Pilbara indicates moderate permeabilities. This suggests dewatering of the small portion of ore below the water table is likely to be accomplished using sumps and dewatering bores when the pit base approaches the water table (Woodward-Clyde, 1996).

Licences will be applied for under the *Water Authority Act 1984* and Part V of the *Environmental Protection Act 1986* for water abstraction and discharge. Pumping rates and groundwater levels will be monitored as required, in compliance with the conditions of these licences. In addition, samples of discharged borewaters will be submitted to NATA-registered laboratories for chemical analyses, as required in the relevant licences.

During the dewatering phase this water will be used as process water wherever possible. If excess supply results, any water released to the environment will be discharged via settling ponds to ensure that the water finally released meets the criteria specified in licence conditions.

On the commencement of dewatering, monitoring will be carried out to assess any drawdown of the water table outside the pit area. Three monitoring bores are already in place to the south of the proposed pit and historical groundwater level and quality data collection has commenced.

Water Supply Borefield

The abstraction of supply water for the operation is not expected to have any detrimental effect on vegetation or pastoral bores in the vicinity of the borefield.

The pipeline from the bore field to the site will be constructed along the shortest route possible to minimise the area disturbed. The pipeline will be buried and will be located to avoid large trees and shrubs along the route.

3.7 VEGETATION AND FLORA

Orebody 18 is situated within the Eremaean Botanical Province, in the Fortescue Botanical District. The Fortescue Botanical District is characterised by tree and scrub steppes in this area. The District is composed of eight sub-districts of which the Hamersley Plateau sub-district is relevant to this Project.

The Hamersley Plateau covers a large region of the interior of north-western Western Australia. Vegetation communities on the Plateau range from tree steppes on the ranges containing jaspilite and dolomite, riverine woodlands at the bottom of gorges and mulga (*Acacia aneura*) and spinifex associations on the basalt hills. The Project area is dominated largely by a tree steppe of low, scattered trees/mallees of *Eucalyptus leucophloia* over an open hummock grassland of *Triodia wiseana*. *Eucalyptus gamophylla* may also be present in low numbers (Beard, 1975).

3.7.1 Vegetation Associations

An extensive survey programme was undertaken to classify vegetation associations particular to the Project area (*ecologia* Environmental Consultants, 1995). A summary of the *ecologia* survey findings is presented below.

The survey identified a total of 12 vegetation associations, the distribution of which is mapped on Figure 3.6. The associations have been grouped according to their position in the landscape (refer to Section 3.3.1) as follows:

<u>Ridges and Hills</u>

Association 2	Tree-steppe of *Eucalyptus terminalis/Eucalyptus kingsmilli/ Eucalyptus leucophloia* over *Triodia basedowii*.
Association 6	Open *Eremophila exilifolia* shrubland.

<u>Gullies/Gorges</u>

Association 1	Open *Eucalyptus leucophloia* woodland in gorges.

SCALE BAR

0 200 400 800 1200 1600 2000m

OPHTHALMIA RANGE

TELSTRA TOWER

LEGEND

- Pit Outline
- Existing Railroad
- Proposed Railroad
- Building / Structure
- Tracks
- Existing Road
- Proposed Road
- Mine Road
- Overburden Stockpile Area
- Ore Stockpile Area
- 29 Detailed flora and fauna survey site

VEGETATION INDEX

- Tree - steppe of ***Eucalyptus terminalis / E. kingsmillii / E. leucophloia*** over ***Triodia basedowii***
- Tree - steppe of ***E. terminalis / E. desertícola*** over ***T. basedowii***
- Shrub -steppe of ***Senna*** species over ***T. basedowii***
- Open ***Eucalyptus leucophloia*** woodland in gorges
- Dense ***Acacia monticola*** tall shrubland
- Open ***E. terminalis / E. gamophylla*** woodland over dense spinifex in drainage
- ***E. terminalis / E. gamophylla*** over open shrubs over moderately dense ***T. basedowii***
- ***E. terminalis*** over open low shrubs over moderately dense ***T. basedowii***
- Dense ***Acacia aneura*** tall shrubland / woodland
- ***Acacia*** woodland over ***Eremophila fraseri***
- Open ***Eremophila exilifolia*** shrubland
- Shrub - steppe of ***Maireana georgei*** over mixed spinifex
- ***Triumfetta machonochleana ms.*** populations

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OREBODY 18

Vegetation Location Plan

FIGURE 3.6

DRAWING No	DATE	REV
N212-585-072	April 1996	

Scree Slopes

Association 3	Tree-steppe of *Eucalyptus terminalis/ Eucalyptus deserticola* over *Triodia basedowii*.
Association 4	Shrub-steppe of *Senna* species over *Triodia basedowii*.
Association 5	Low shrub-steppe of *Maireana georgei* over mixed spinifex.
Association 9	*Eucalyptus terminalis* over open low shrubs over moderately dense *Triodia basedowii*.
Association 10	Dense *Acacia monticola* tall shrubland.

Outwash Plains

Association 7	Open *Eucalyptus terminalis/Eucalyptus gamophylla* woodland over dense spinifex drainage.
Association 8	Open *Eucalyptus terminalis/ Eucalyptus gamophylla* woodland over open shrubs over moderately dense *Triodia basedowii*.
Association 11	Dense *Acacia aneura* tall shrubland/woodland.
Association 12	*Acacia* woodland over *Eremophila fraseri*.

3.7.2 Vegetation Significance

The vegetation associations and landforms of the Project area are widespread in the Pilbara with significant representation within conservation reserves, notably the Karijini and Chichester Range National Parks (*ecologia* Environmental Consultants, 1995). Given this widespread occurrence, there do not appear to be any vegetation associations of regional significance in the Project area.

Local significance was determined by applying the following criteria:

- habitat, landform or vegetation association poorly represented in the Project area;
- habitat, landform, vegetation association or location supporting features or species of conservation or ecological significance;
- habitat, landform, vegetation association or location with the capacity to support site-specific elements; and
- habitat, landform or vegetation association in better condition than other similar locations.

Based on these criteria, the only vegetation-landform association identified as being of local significance is the gully area which has a relatively high floristic diversity, and may contain some landform-specific species, including the Priority 2 species *Triumfetta maconochieana* ms.

3.7.3 Flora

A total of 250 taxa of flora was identified during the survey of the Project area. The taxa belong to 120 genera of 46 families, 16 of which are represented by a single species only.

The species rich families represented in the Project area are:

- Poaceae (grasses) - 30 taxa;
- Mimosaceae (wattles) - 24 taxa;
- Asteraceae (daisies) - 19 taxa;
- Amaranthaceae (mulla-mullas) and Caesalpiniaceae (sennas) - 15 taxa;
- Papilionaceae (peas) - 14 taxa;
- Chenopodiaceae (samphires, etc) - 12 taxa; and
- Goodeniaceae (leschenaultias etc), Myrtaceae (eucalypts etc) and Malvaceae (hibiscus etc) - 11 taxa.

The genera represented by the greatest number of species are *Acacia*, *Senna*, *Ptilotus, Eucalyptus* and *Eremophila*. The most widely distributed species within the sample areas were *Troidia basedowii*, *Dysphania rhadinostachya*, *Ptilotus exaltatus*, *P. calostachyus*, *P. polystachyus* var. *polystachyus* and *Trachymene oleracea*.

The flora includes two subspecies of *Ptilotus polystachyus*, six subspecies of *Senna glutinosa* and three subspecies and two hybrids of *Senna artemisioides*.

The areas with the highest species richness (with 63-85 species/ha) are associated with the drainage lines. The lowest species richness (with 19-25 species/ha) occurs in areas generally associated with the spinifex steppes on the ridges.

No Declared Rare Flora species listed in the CALM Rare Flora Schedule 1995 were located within the Project boundaries. However, one Priority 2 species, *Triumfetta maconochieana* ms.(Tiliaceae), was recorded from four deep gullies within the Project area (Table 3-4). As a Priority 2 species, *Triumfetta maconochieana* ms. 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" (CALM, 1995). Three previous collections of this species are lodged with the Western Australian Herbarium. These were collected from rocky hills near Harding River Dam (approximately 390 km north-west of the Project area), Woodstock Station (216 km to the north-north-west) and Rudall River (212 km west-north-west). Therefore, while the Orebody 18 Project area is well within the east-west distribution of this species, the Ophthalmia Range represents the most southern location currently recorded for this species.

Within the Project area, 84 individuals of *Triumfetta maconochieana* ms. were recorded at sparse densities from three sites. Each site was within a deep gully. Additional survey work in the greater Newman area identified a further nine populations with 340 individuals. Table 3-4 indicates populations of *T. maconochieana* ms. within the Orebody 18 and surrounding areas. *Triumfetta maconochieana* ms. was recorded from half of the gorges searched in the area. It was regularly found where the banded ironstone substrate was tilted vertically, forming vertical cracks. Given the small proportion of gorges surveyed, it is highly likely that *T. maconchieana* ms. is both more abundant and widespread in the area than recorded to date. The number of populations now recorded indicates that a review of the Priority 3 status of *T. maconchieana* ms. may be warranted.

TABLE 3-4

POPULATIONS OF *TRIUMFETTA MACONOCHIEANA* MS. WITHIN OREBODY 18 AND THE GREATER NEWMAN AREA

Area	Population Number	Location	Number of Plants
Orebody 18	1	Site 20 - Ophthalmia Range	71
	2	Gorge immediately south of site 20	3
	3	Site 6 - Ophthalmia Range	10
Outside Orebody 18	4	Site 8 - Ophthalmia Range	8
Greater Newman Area	5	Ophthalmia Range	60
	6	Ophthalmia Range	7
	7	Ophthalmia Range	6
	8	Ophthalmia Range	110
	9	Ophthalmia Range	41
	10	Eastern Ridge	56
	11	Ophthalmia Range	14
	12	Cathedral Gorge	38

Two species which have not yet been formally described, were collected from the Project area. *Calocephalus* sp. Pilbara-Desert and *Podolepis* sp. Great Victoria Desert are both daisies which are relatively well represented in the Western Australian Herbarium. The Orebody 18 Project area is well within the known distribution of both these species.

Three species of introduced flora were recorded within the Project area. *Sonchus oleraceus* was collected from three of the 32 detailed flora sites, while *Rumex vesicarius* and *Bidens bipinnata* were each collected from a single site. All weed species were recorded at sparse densities and were generally associated with drainage lines.

3.7.4 Potential Impacts

Vegetation Clearing

Three populations of *Triumfetta maconochieana* ms. are located in the proposed pit area or overburden storage areas (Populations 1, 2 and 3 - Figure 3.6). This will result in the removal of three of the 12 populations (84 of 424 individuals) identified in the survey area. *Triumfetta maconochieana* ms. is also known from other populations in the region, at least one of which is reserved, within the Rudall River National Park.

There are many other gullies in the local area other than those already surveyed which may support suitable habitat for *T. maconochieana* ms. It is also likely to occur elsewhere in the Pilbara as the preferred substrate is commonly recorded on geological maps.

The construction of the proposed Orebody 18 Project will cause the short-term loss of other vegetation through clearing. The area lost from the development is not significant in relation to the regional extent of the vegetation associations represented at the Project site.

Vegetation will be lost as a result of the following operations:

Pit Area

A single open-cut pit is proposed in the Project area. The orebody follows the southern face of the range and encompasses a number of gorge areas. A total of 74 individuals of *Triumfetta maconochieana* ms. will be removed by the mining operation. Given that the gullies have the highest floristic diversity and that two gullies support this Priority 2 flora species, mining would be expected to have a moderate impact on vegetation at the local level.

Overburden Storage Areas

Mine overburden will be placed in two large gully systems on the northern side of the range and two additional areas on the lower footslopes and plains. The footslopes support spinifex steppes which are widespread in the area and typically have a low species richness in terms of both flora and fauna. Hence, impacts to the vegetation on

the footslopes are not expected to be significant. The gorge systems, however, support a more diverse flora. One population of *Triumfetta maconochieana* ms. containing 10 individuals (Population 3) will be removed by the placement of overburden in the northern gully area.

Haul Roads and Rail Spur

The site access road will generally follow the alignment of the current gravel road to the Project area and as such will involve minimal impact other than vegetation clearing associated with widening the road and for construction of a small section from the existing road to the site. The road will generally run through the widely distributed tree-steppe vegetation association.

The rail spur will be constructed within the tree-steppe association occurring in the southern portion of the Project area and will necessitate clearing of this vegetation.

Power Line

The proposed overhead power line from the Newman power station will follow the alignment of the private access road to the south of the rail line. This will avoid the construction of a separate maintenance road for the line and the associated vegetation disturbance.

Exotic Flora Species

Three introduced species were recorded from the Project area. Of these, Ruby Dock Weed (*Rumex vesicarius*) is the only species which may be of significance. Though not a Gazetted Declared Weed, as listed by the Agriculture Protection Board, this species has been identified by the EPA as a significant threat to the conservation values of the Pilbara Region (*ecologia* Environmental Consultants, 1992). It is widespread in regions of heavy disturbance such as road and rail alignments. Elsewhere within the region, it is predominantly confined to drainage lines and gullies which provide a more mesic habitat over the drier months. Within the Project area, this species was recorded from a single specimen found within the southern spinifex drainage association.

3.7.5 Management

All clearing operations will be kept to a minimum to reduce the impact on surrounding ecosystems. Plans for clearing will be prepared in advance and checked regularly to ensure adherence to the plan.

During the construction phase, topsoil and vegetation will be stripped and used immediately for rehabilitation or stored for later use. At the end of construction, all areas no longer required, such as borrow pits, temporary access roads and hardstand areas, will be contoured as necessary, topsoiled (where soil is available) and ripped. If required, areas will then be seeded with a mixture of local species according to the approved rehabilitation procedure documented in the Environmental Management Programme.

Overburden storage areas, disused access tracks and other works areas will be progressively rehabilitated to meet the requirements of the post-mining land use. These works will be in accordance with the rehabilitation programme devised in consultation with the Department of Minerals and Energy and other relevant authorities.

Proposed Rehabilitation Criteria for Orebody 18 are listed in Table 3-2.

Procedures developed by BHP Iron Ore over many years will be employed in the rehabilitation of the overburden storage areas. Slopes will be progressively battered to an overall angle of approximately 20°, spread with topsoil (where available) and stabilised to prevent erosion and encourage vegetation establishment. Erosion control and water harvesting techniques will be applied to the slopes. Where necessary, the slopes will be seeded using a mixture of local species. This technique has been used successfully at Newman and on a large scale at the decommissioned operations at Goldsworthy and Shay Gap-Nimingarra. The long-term goal of the rehabilitation programme will be the re-establishment of *Eucalyptus* trees over *Triodia basedowii* to create suitable local habitats similar to the surrounding tree-steppe.

3.8 FAUNA

In conjunction with the vegetation and flora survey, a field survey of fauna and fauna habitats was also conducted during August 1995. The following presents a summary of the findings (*ecologia* Environmental Consultants, 1995).

Four major fauna habitats were recognised within the Orebody 18 Project area:

1. Spinifex Steppe (on ridges and hills): Sparse *Eucalyptus* trees over moderately dense *Triodia basedowii*. The substrate consists of red sand, usually with a surface layer of pebbles.

2. Gully: Open *Eucalyptus leucophloia* woodland over moderately dense to dense spinifex. The substrate consists of exposed rock with patches of red sand in the gorges and deep gullies.

3. Scree Slope: Open *Eucalyptus leucophloia* trees over moderately dense spinifex. The substrate consists of steep rocky scree slopes with patches of gravel.

4. Spinifex Drainage (on outwash plains): Scattered trees over dense *Triodia basedowii* and *Plectrachne* species with a red sand substrate.

3.8.1 Fauna Habitats

The Spinifex Drainage habitat has the greatest species richness in the Project area. It is by far the most species rich in terms of both birds and reptiles and would be expected to support a relatively rich diversity of species which could potentially exist in the area. This habitat, however, contained the lowest number of native mammal species and was the only habitat from which introduced mammals were recorded (all habitat types are expected to support introduced mammals).

The Spinifex Drainage provides the most structural vegetation diversity, with a moderately dense canopy overlying the complex branches of shrubs and other understorey species and a vigorous growth of *Triodia*. Such habitat heterogeneity provides a rich 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.

The Spinifex Steppe has a large expected species list as a result of the high number of reptiles expected to occur and the relatively large number of birds expected to use the tree overstorey. The number of species actually recorded from this habitat, however, was low. This is possibly attributable to the exposed nature of the hill crests and slopes on which the spinifex steppes occur. These areas are very windy, and consequently, support few birds. They also have a paucity of insects which would affect the reptile diversity.

The Scree Slopes are a specialised habitat used by relatively few species. The small caves and loose rocks provide shelter for species such as the Fat-tailed Antechinus (*Pseudantechinus macdonnellensis*) and Common Rock Rat (*Zyzomys argurus*) as well as providing roosting spots for several species of bat. Smaller crevices are used by reptile species such as *Gehyra punctata* and *Oedura marmorata*.

The Gully habitat would be expected to support a diverse array of vertebrates. This habitat has good structural diversity with an open canopy of trees and tall shrubs over a dense spinifex layer and supports the most diverse array of native mammals.

3.8.2 Mammals

The available literature suggests that the Project area may support 23 native and seven introduced mammal species.

Fourteen species of mammal were actually recorded during the field survey. Ten of these species were native and four introduced. Four families of native fauna were represented comprising Dasyuridae (carnivorous marsupials), Macropodidae (kangaroos and wallabies), Monotremata (Echidna) and Muridae (native rodents).

The Spinifex Steppe habitat contained the lowest number of species with only two recorded. There was little variation in species numbers between the other habitats with four to six species in each habitat .

The presence of the Western Pebble-mound Mouse (*Pseudomys chapmani*) within the Spinifex Steppe habitat was inferred from the presence of active pebble mounds.

Within the survey area a total of 91 pebble mounds were located. Of these, 16 were assessed as being active while the other 75 were identified as disused or old and abandoned mounds (Figure 3.7). None of the active mounds is located within the proposed pit area. The greatest density of pebble-mounds was observed on the gentle footslopes at the base of Shovelanna Hill.

Eleven of the active mounds are located within or near proposed overburden storage areas and ore stockpile areas (Figure 3.7).

Extremely old nests of the Lesser Stick-nest Rat (*Leporillus apicalis*) were recorded within the gully habitat. It is understood that the species is now extinct.

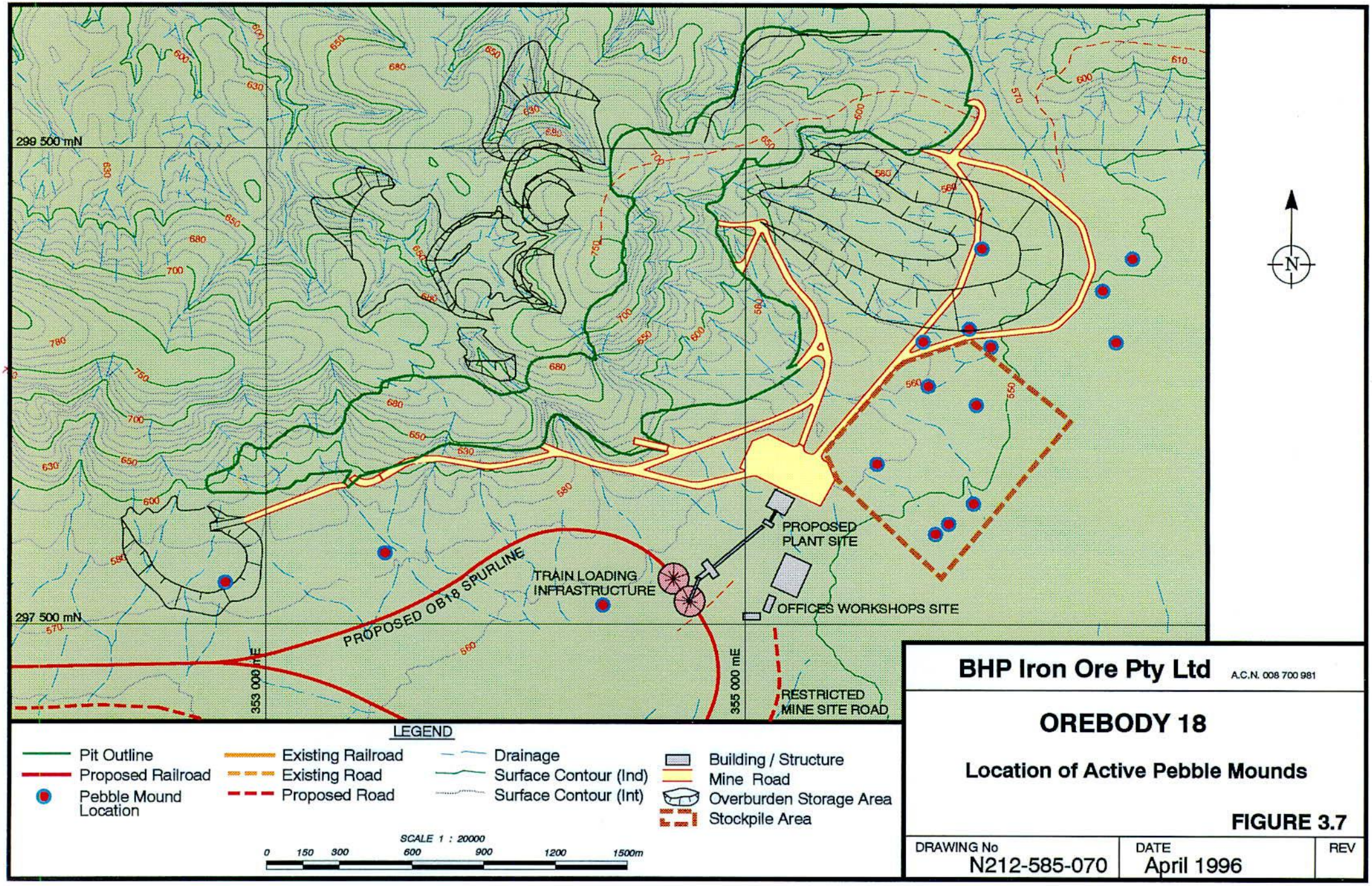
Dog tracks were found in several locations within the Project area and, presumably, belong to the Dingo (*Canis familiaris dingo*), a single individual of which was observed. Scats of the Echidna *Tachyglossus aculeatus* were also found within the gully habitat.

3.8.3 Birds

Using known habitat preferences and species distributions, up to 92 species comprising 42 non-passerines and 50 passerines potentially occur within the Project area. The area is unlikely to support the full complement of species at any one time since many species are transitory visitors, especially aerial species such as raptors. A total of 44 bird species was actually recorded for the Project area. Of these 44 species, 25 were passerines and 19 were non-passerines.

The most numerous passerine species identified, accounting for almost 54% of all individuals recorded, were Budgerigars (*Melopsittacus undulatus*), Zebra Finches (*Poephila guttata*), Diamond Doves (*Geopelia cuneata*), Painted Firetails (*Emblema pictum*) and Grey-headed Honeyeaters (*Lichenostomus keartlandi*). Honeyeaters (family Meliphagidae) made the greatest contribution to species richness, although honeyeater sightings accounted for less than 20% of all individuals.

The Whistling Kite (*Haliastur sphenurus*) (SD habitat), Brown Falcon (*Falco berigora*) (SP), Port Lincoln Ringneck (*Barnardius zonarius*) (SD), Spotted Nightjar (*Eurostopodus argus*) (GU), Spinifexbird (*Eremiornis carteri*) (SD) and Mistletoebird



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OREBODY 18

Location of Active Pebble Mounds

FIGURE 3.7

DRAWING No	DATE	REV
N212-585-070	April 1996	

(*Dicaeum hirundinaceum*) (SD) were sighted opportunistically, but were not subsequently recorded in any census.

In terms of fauna habitats, the Spinifex Drainage habitat was used by more bird species (36 species) than any other within the Orebody 18 Project area. The Scree Slope habitat and the Gully habitat with 18 and 21 species respectively, were moderately well used by birds. The Spinifex Steppe habitat with 17 species had the lowest rate of bird observation.

Most of the species likely to use the habitats in the Orebody 18 Project area have broad distributions over much of Western Australia. The majority of species having more restricted ranges tended to have Eyrean biogeographic affinities. Many of the species which could be expected to use the habitats present in the Project area are at the northern limit of their range. These include the Chiming Wedgebill (*Psophodes occidentalis*) and Grey Butcherbird (*Cracticus torquatus*). The dominance of passerines is typical of an area with little or no permanent water.

3.8.4 Reptiles and Amphibia

Based on known species distributions and habitat preferences, up to 87 reptiles and three frogs may occur in the area. Trapping and opportunistic collecting within the Project area recorded 31 reptile species from seven families.

The most abundant reptile recorded from the Project area was *Gehyra punctata*, with almost 20% of the records. The Scincidae was the most species rich family, with 13 species recorded from the Project area. The Gekkonidae contributed nearly 20% of the total species richness with six species. Four species from the Varanidae and Agamidae families, two species from Pygopodidae and one species each from the Boidae and Typhlopidae families were recorded.

The Spinifex Drainage habitat was the most used reptilian habitat (12-18 species), the Gully habitat the next most important (4-8 species) with the Scree Slope (5 species) and Spinifex Steppes (3 species) the least used by reptiles.

Using preferred habitat information and Western Australian Museum records, a list was compiled of reptilian species which could be present in the Orebody 18 Project area. Some species (e.g. *Diplodactylus wellingtonae*) are at the most northern part of

their range, while others are occurring at the southern extreme of their range (e.g. *Carlia munda*). Several species have restricted distributions in the northern/central Pilbara area which encompass the Orebody 18 Project area (e.g. *Varanus pilbarensis* and *Lerista chalybura*).

3.8.5 Rare and Specially Protected Fauna

The Western Pebble-mound Mouse is gazetted as a Schedule 1 Rare and Endangered Fauna species according to the Department of Conservation and Land Management and is also on the Australian and New Zealand Conservation Council (1991) List of Endangered Vertebrate Fauna. Schedule 1 species are 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. A total of 91 pebble-mounds was recorded in the Project area, 16 of which were considered active. Western Pebble-mound mice are now considered to be common in similar habitats in Karijini, Rudall River, Millstream, Chichester and Collier Range National Parks (CALM, pers. comm.).

Two other Schedule 1 species may potentially occur within the Orebody 18 Project area.

- Grey Falcon (*Falco hypoleucos*)

  While potentially occurring in the Project area, it is a wide ranging species and is not dependent on any habitat which is to be disturbed.

- Grey Honeyeater (*Conopophila whitei*)

  Grey Honeyeaters were not recorded during the 1995 survey and the species may be transitory in the Project area.

The only Schedule 2 fauna (species presumed to be extinct) that historically would have occurred in the Project area is the Lesser Stick-nest Rat (*Leporillus apicalis*). This large native rat species formerly ranged over much of central Australia, as is evident by the nest remains found in small caves and breakaways. The animal itself has not been officially reported since 1933, however, there are several unconfirmed reports of contemporary nests from the Canning Stock Route area (Gratte, 1972).

The remains of an old nest were found within the Project area, indicating that the species previously inhabited the area. However, it is estimated that the nest had been abandoned for several decades and it is considered that the species is extinct within the Orebody 18 Project area.

No Schedule 4 species (generally uncommon, probably declining in settled regions; still well established in remote areas) were recorded within the Project area. It is considered, however, that the following two species may potentially occur.

- Peregrine Falcon (*Falco peregrinus*)

  This species is widely distributed throughout Australia. It is nomadic, sedentary or partly so and prefers coastal or inland cliffs and gorges, timbered watercourses, plains and open woodlands (Pizzey, 1983). It is a wide ranging species and is not dependent on any habitat which is to be disturbed in the Project area.

- Major Mitchell's Cockatoo (*Cacatua leadbeater*)

  This species is widely distributed throughout Australia. The species is either sedentary or nomadic, often occurring near timbered watercourses with River Red Gums (*Eucalyptus camaldulensis*). While potentially occurring in the Project area, it is a wide ranging species and is not dependent on any habitat which is to be disturbed.

The following two bird species which could potentially occur in the Orebody 18 area are protected by the China-Australia Migratory Bird Agreement (CAMBA). This is an international agreement designed for the protection of migratory birds and birds in danger of extinction. It also addresses the management and protection of the environments of these species.

- Rainbow Bee-eater (*Merops ornatus*)

  In the Pilbara, the preferred habitat of the Rainbow Bee-eater is the upper strata of the tree canopy and sand banks or sloping sandy soil occurring along drainage lines. The Project area does not present suitable habitat for this species except for transitory foraging.

- Fork-tailed Swift (*Apus pacificus*)

  Although the Fork-tailed Swift potentially occurs in the Project area, it is an aerial species and rarely lands.

3.8.6 Exotic Species

Three exotic (introduced) species were recorded from the Project area: the Introduced Mouse (*Mus musculus*), Feral Cat (*Felis catus*) and Camel (*Camelus dromedarius*). All exotic species were recorded in the Spinifex Drainage habitat, although all habitat types are expected to support introduced mammals.

3.8.7 Potential Impacts

The fauna of the Project area, both native and introduced, can be broadly described as being of two types:

- widely dispersing (e.g. kangaroos, wallabies, most birds); and
- poorly dispersing (e.g. smaller marsupials, most reptiles).

There will be local impacts on the fauna of the area as a result of the mining operation. Initially, there will be a loss of habitats resulting in the loss of the non-mobile species occupying these sites. However, once disturbance ends, the rehabilitated sites will be recolonised from surrounding areas if appropriate habitats are re-created.

One scheduled fauna species occurs in the Project area and five scheduled species may potentially occur within the area. These species are listed below together with the potential impact of the mining operation on their distribution.

- Western Pebble-mound Mouse (Schedule 1 species) - Eleven active pebble-mounds recorded in the vicinity of the proposed pit and overburden and stockpile storage areas will be removed by the operations (Figure 3.7). This impact is considered to be Moderate on a local scale and Minor on a regional scale given their security and abundance in several National Parks in the Pilbara.

- Grey Falcon (Schedule 1 species) - this species could potentially occur in the Project area, however, it is considered that the Project will present no significant impact on the species as it is not dependent on any habitat which is to be disturbed.

- Grey Honeyeater (Schedule 1 species) - this species may be transitory in the Project area, however, the mining operation will not significantly impact on the species due to the extremely limited impact to its widespread preferred habitat of the mulga shrublands.

- Peregrine Falcon (Schedule 4 species) - this wide ranging species could potentially occur in the Project area, although it was not actually recorded in the 1995 fauna survey. It does not depend on any habitat which is to be disturbed, therefore, the Orebody 18 Project is not considered to present a significant impact to the species.

- Major Mitchell's Cockatoo (Schedule 4 species) - this species is wide ranging in Australia and could potentially occur in the Project area. It is not dependent on any habitat to be disturbed by the operation, therefore, the Project will not significantly impact on the species.

- Fork-tailed Swift - this species which could potentially occur in the Project area, is protected under the China-Australia Migratory Bird Agreement (CAMBA). It is an aerial species and rarely lands, therefore, the Orebody 18 Project is not considered to present any significant impact to the species.

Vehicle and train noise is likely to have some impact on populations occurring in the immediate area of the mine. Increased traffic may cause localised death of larger mobile species, predominantly kangaroos and monitor lizards. Any impacts however, are considered to be minor as these species are commonly found in abundance in the region.

3.8.8 Management

The impacts on fauna will be minimised by staging clearing; limiting clearing to that which is absolutely essential; and limiting road and track development.

Management of habitat disturbance will be achieved by close supervision of the construction contractor to ensure that the minimum area required for construction of the mine infrastructure is disturbed. The contractor will not be permitted to leave the site until any such disturbance is rehabilitated.

Rehabilitation of faunal habitat will occur co-incident with rehabilitation of vegetation.

Procedures for the management of the Western Pebble-mound Mouse will be developed in consultation with Department of Conservation and Land Management (CALM). Mice from any mounds that require disturbance will be either relocated or included in research programmes. A licence to collect mice will be arranged with the CALM. Research on the Western Pebble-mound Mouse will be structured such that it can be integrated with other regional research programmes in consultation with CALM.

3.9 ABORIGINAL HERITAGE

In 1981, a field survey to identify archaeological Aboriginal sites was conducted in the area of Orebody 18. Ten sites in the vicinity of the deposit were identified comprising surface artefact scatters and a rock shelter, as presented in Table 3-5. Clearance for disturbance was obtained for seven of these sites under Section 18 of the *Aboriginal Heritage Act 1972-1980.*

TABLE 3-5

PREVIOUSLY RECORDED ABORIGINAL SITES

Site No.	Location [1]	Site Type	Site Name	Status [2]
P3121	196.416	Artefacts	Shovelanna Hill 4	-
P3122	196.416	Artefacts	Shovelanna Hill 5	UP
P5895	196.421	Artefacts	Shovelanna Hill 36	-
P3123	197.416	Artefacts	Shovelanna Hill 6	UP
P3124	198.416	Rockshelter	Shovelanna Hill 7	UP
P3125	199.417	Artefacts	Shovelanna Hill 8	UP
P3126	199.417	Artefacts	Shovelanna Hill 9	UP
P3129	199.418	Artefacts	Shovelanna Hill 12	CP
P3127	200.418	Artefacts	Shovelanna Hill 10	CP
P3128	201.419	Artefacts	Shovelanna Hill 11	-

Notes: 1. Location from 1:250,000 Mapsheet SF51-13.
2. Status UP - Unconditional Permission to disturb.
CP - Conditional Permission to disturb.

Source: Quartermaine, 1995.

A further survey of the proposed rail route and infrastructure locations took place in 1995 (Quartermaine, 1995). Two newly recorded archaeological sites were identified in the vicinity of the proposed railroad. The first site comprised a surface artefact scatter, the second two scarred trees.

As with most of the archaeological sites in the Project area, the two new sites are of low archaeological significance due to their small size, lack of lithic variety, lack of stratigraphic potential and disturbance due to water movement (Quartermaine, 1995). The location of most of the archaeological sites near ephemeral creeks is a common feature of the distribution of sites in arid areas where access to water is important.

BHP Iron Ore has held discussions and arranged visits with Aboriginal representatives who speak for the area with regards to the ethnographic significance of the area. The

Aboriginal people have indicated that there are no ethnographic sites of significance in the proposed mining area.

3.9.1 Potential Impacts

Field surveys, discussions and visits with Aboriginal representatives have indicated that there is no special ethnographic significance attributed to the proposed mining area. The archaeological sites are of low significance.

The two new archaeological sites recorded in the recent survey were in the vicinity of the proposed railroad. The railroad has now been located to avoid these sites.

Seven of the ten previously recorded sites have already received Ministerial approval for disturbance. The other three sites previously recorded are not likely to be disturbed by the Project. Ministerial approval will be sought for these sites if they are to be disturbed.

3.9.2 Management

Wherever possible, disturbance of Aboriginal sites will be avoided. Ministerial approvals will be sought, in accordance with the Act, if disturbance cannot be avoided.

All employees and contractors will undergo a compulsory induction where they will be advised of their responsibilities under the *Aboriginal Heritage Act 1972-1980.* Ongoing education of personnel will take place. There is also a standing requirement that all employees and contractors promptly report any potential sites discovered in the vicinity of the operations to the environmental officer.

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 1991 census was 48,620 with a majority living in coastal towns such as Port Hedland and Karratha and mining towns such as Newman, Tom Price and Paraburdoo.

Approximately 9,500 people lived in the East Pilbara Shire during 1995 (pers. comm. East Pilbara Shire, 1996). The population of the Town of Newman for the year of 1995 was estimated to be 4,000.

Population figures for the Town of Newman and the East Pilbara Shire for the last five years are provided in Table 3-6.

TABLE 3-6

POPULATION CHANGES FOR THE EAST PILBARA SHIRE AND TOWN OF NEWMAN

Year	Town of Newman	East Pilbara Shire
1990	5500	9,500
1991	5627	10,200
1992	5400	10,000
1993	5200	9,300
1994	3500	9,300
1995	4000	9,500

Source: pers. comm. East Pilbara Council 1996.

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. Part of the mine is located on the northern boundary of Sylvania Station, which is owned by BHP Iron Ore.

3.10.2 Potential Impacts

The Project will have a positive impact on the economy of Western Australia. During the construction phase, 300 people will be employed and up to 150 people will have permanent employment once the mine is in operation. Employees will be sourced from Western Australia, wherever possible. A variety of contractors and specialist consultants will also be employed during the mine development. Again, wherever possible, these contractors and consultants will be sourced from within the State.

During the operational phase of the mine, there will be an ongoing need for contractors, consultants and materials for the maintenance and upgrade of equipment. People and materials for this work and the construction of on-site facilities during the construction phase will be sourced from Western Australia provided they are competitive with respect to price, service and delivery.

The public road in the area has been upgraded to service existing mining operations at Jimblebar and will remain open.

Royalties from the Project will be collected by the Western Australian Government for the benefit of the State. Additional benefits to Australia include export sales affecting the balance of trade, the payment of Federal taxes, and the returns to shareholders.

4.1 DUST

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

4.1.1 Potential Impacts

The generation of dust from open-cut iron ore mining can occur when large volumes of dry materials are moved. Activities which have the potential to generate dust include:

- drilling and blasting;
- ore and overburden mining and loading operations;
- ore and overburden hauling;
- road haulage;
- truck unloading (tipping);
- primary crushing and screening;
- conveyor transfer points; and
- rail loadout.

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. Wind blown dust may be generated at high wind velocities.

The nearest residence to Orebody 18 is Sylvania Station, located 30 km to the south. It is therefore unlikely to be affected by any dust generated by the Project activities. The public recreation area at Ophthalmia Dam is 15 km away and similarly unlikely to be affected by dust generated by the Project. 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.

4.1.2 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) (EPA, 1992) at neighbouring residential properties. Since the nearest residence is 30 km away, nuisance dust will not be an issue.

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

The following measures will be implemented as appropriate to control dust generation:

- water tankers will be used to apply water to sites within the operations area which have the potential to generate dust, particularly along unsealed roads, haul roads and construction areas;
- transfer points will be enclosed and fitted with water sprays;
- spray systems will be fitted to the crusher; and
- dust collection and extraction systems will be installed in the train loadout facility.

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.

4.2 NOISE

The proposed mine site is isolated, being 32 km from Newman, the nearest centre of population, 30 km from the nearest homestead and approximately 15 km from Ophthalmia Dam. Based on BHP Iron Ore experience operating existing satellite mines, background noise studies were not considered to be required in the Project area.

4.2.1 Potential Impacts

Noise will be generated during construction by earthmoving equipment and plant assembly activities. Noise will originate during mine operation from blasting, earthmoving equipment, the processing plant and the rail load out facility.

Noise from these sources will be localised and not create a significant nuisance impact beyond the mine boundary. Some increased noise levels will be associated with the ore train movements along the spur line.

4.2.2 Management

Since noise impacts associated with the proposed mine will be more than 30km from the nearest neighbours at Sylvania Homestead and Newman, noise emissions 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.

4.3 BLASTING

4.3.1 Potential Impacts

Blasting of the ore and overburden will be necessary. Blasting will occur at regular intervals during daylight hours, that is, between 7.00 am and 6.00 pm Monday to Saturday.

The distance to Sylvania Homestead and Newman from the site and the sparse population of the region means that residents are unlikely to be affected by blasting noise.

4.3.2 Management

To minimise the noise impact, blasting will be undertaken during daytime only and at specified times in accordance with the *Noise Abatement (Neighbourhood Annoyance) Regulations 1979.*

4.4 WASTE PRODUCTS AND HAZARDOUS MATERIALS

4.4.1 Potential Impacts

The mining operation at Orebody 18 will generate waste materials including scrap metal, tyres, wood, paper and domestic solid and liquid waste. While not hazardous, these materials require proper treatment and disposal.

The development and operation of the Project will also necessitate the use of a range of products termed 'hazardous materials'. These materials, including fuels, lubricants, detergents, explosives and paints also require proper treatment and disposal.

Samples from drilling throughout Orebody 18 were tested for asbestiform minerals by an independent NATA registered laboratory. All samples were reported as 'asbestos not detected' according to NATA reporting guidelines (Analabs, unpublished report).

4.4.2 Management

Process and Sewage Water

The management of process water on-site will involve a closed water system. All water from potentially contaminated areas (e.g. workshops) will be collected via a closed system. This water will pass through an oil separator to remove oil and grease before being discharged to an impermeable evaporation pond.

The open system will involve directing runoff water generated by rainfall around areas where hazardous materials are stored or used. Runoff from the overburden storage areas will be included in this system.

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.

Domestic sewage will be collected and treated in underground septic tanks.

Hydrocarbons and Oily Wastes

Hydrocarbons include oils, greases, fuels (petrol and diesel), de-greaser, emulsified oils and oily waste water. The correct management of these products requires five integrated steps:

- appropriate storage and handling procedures;
- minimal generation of waste and associated contaminants;
- segregation of hydrocarbon waste from stormwater and other water;
- clean-up procedures for spills; and
- environmentally acceptable disposal of captured waste.

Hydrocarbons will be managed in order to minimise the potential risk of spills and the area of contamination should spillage occur. Management practices will include, but not be limited to:

- installation of appropriate bunding around all 200 L drum and other bulk storage areas;
- drums in use being placed on spill capturing platforms;
- permanent refuelling areas will be impervious and drainage will be directed toward central collection points;
- effective maintenance of all valves and piping systems; and
- use of oil capturing systems in heavy and light vehicle service areas.

All fuels and oils will be stored in accordance with the Australian Standard for *The Storage and Handling of Flammable and Combustible Liquids* (AS 1940-1993). All hydrocarbon storage facilities will conform to EPA Licence requirements.

All waste collecting systems will be designed for ease of use (depositing and collecting) and prevention or capture of spillage.

To prevent potentially contaminated waste water from affecting surface or groundwater, stormwater runoff systems will be separated from hydrocarbon waste drainages. This will require:

- diverting stormwater from rainfall events around potentially contaminated areas; and
- passing all water from potentially contaminated areas through oil traps in workshops and sediment traps in vehicle washdown areas prior to discharge.

Potential spillage will be contained and appropriately addressed by techniques including the placement of absorbent material and the excavation and removal of contaminated soil to a remediation site. Washdown from hardstand areas (e.g. workshop floors and washdown pads) will be directed to drains and passed through an oil separator.

Any soil contaminated by hydrocarbons will be disposed of in a designated site for bioremediation or other appropriate treatment in accordance with the EPA *Guidelines for Oil Farming of Oily Wastes.*

Oily wastes generated at site will be collected and disposed of in accordance with conditions specified by the DEP Office of Waste Management.

Hazardous Materials

To ensure the safe handling of all hazardous materials used on site, BHP Iron Ore will implement its existing formal Hazardous Materials Management Programme (HMMP) which will incorporate the following elements:

- adoption of a formal policy statement;
- designation of responsibility for all elements of the programme;
- employee participation;
- training of personnel;
- dissemination of information;
- establishment of purchasing and inventory controls; and
- environmental monitoring.

The storage, handling and disposal of these materials will comply with all relevant local and State regulations, such as the:

- *Mines Safety and Inspection Regulations 1995*;
- *Dangerous Goods Regulations 1992*; and
- Australian Standard for *The Storage and Handling of Flammable and Combustible Liquids* (AS 1940-1993).

Bulk fuel will be stored in above-ground tanks located in impermeable, bunded enclosures in accordance with DME requirements. Explosives will be stored in a magazine remote from workshops and the mine site. The DME requirements for the transport and storage of nitrate-based explosives will reduce the risk of escape of these materials into the environment.

Other Waste Products

Wherever practicable, materials (e.g. batteries, 205 L drums, scrap metal) will be recycled. All non-recyclable solid waste will be disposed of in accordance with the DEP *Code of Practice for Country Landfill Management*.

Operation of the sanitary landfill site will include:

- diversion of surface water around the landfill site;
- regularly (weekly) cover of the landfill face to a depth of 230 mm; and
- a litter fence around the landfill perimeter.

4.5 COMPLETION OF MINING

4.5.1 Potential Impacts

Operations at Orebody 18 will continue for approximately 12 - 15 years. Residual longer-term impacts at the completion of mining operations at Orebody 18 will be mainly associated with the stabilisation of post-mining landforms and hydrological impacts as discussed in previous sections of this CER.

4.5.2 Management

At the completion of mining, all infrastructure will be removed. Concrete footings will be excavated and buried. Remaining surfaces of borrow pits or overburden storage areas that have not previously been rehabilitated will be battered to an angle of 20° or less. Top-soil which was stripped and stored prior to the commencement of mining will be returned for use in areas to be rehabilitated. Stabilisation techniques will be applied to exposed surfaces and local native seed applied where necessary.

In addition, borrow pits will be rehabilitated in accordance with BHP Iron Ore guidelines (Walker, undated). Shallow scree mined areas will be recontoured, stored topsoil spread and the areas ripped, in a similar way to borrow pits, to promote revegetation. Deeper scree pits will be used as repositories for waste rock, wherever possible, and then rehabilitated.

Safety bund walls will be constructed around the decommissioned pits and their design will comply with guidelines established by the Department of Mines (199F1).

All compacted surfaces resulting from the operation of the mine will be ripped to promote water penetration and the catchment of wind blown seed. Where necessary, reseeding will take place using species present in the area.

In order to leave the site in a condition that will minimise the impact caused by erosion in ensuing years, pre-existing drainage networks will be re-established where required. Revegetation activities will continue beyond the mine closure to enable final overburden storage areas to be contoured and stabilised. Monitoring following decommissioning will consist of periodic site visits to assess the progress of revegetation.

5.0
ENVIRONMENTAL MANAGEMENT PROGRAMME

BHP Iron Ore is committed to achieving a high standard of environmental management at Orebody 18 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 of the operations.

A draft Environmental Management Programme (EMP) has been developed by BHP Iron Ore for the operation at Orebody 18 and is attached to this CER (Attachment A). The EMP has been designed to provide a structured approach to managing the environmental issues associated with all activities at Orebody 18. The management standards under which the EMP will be required to operate, however, will not all be completely known until the CER has been assessed by the EPA, conditions set by the Minister for the Environment and licences are issued by the relevant authorities. Therefore, certain management and monitoring practices included in the draft EMP may alter as a result of further assessment and licence requirements.

The environmental conditions which will guide the EMP are as follows:

- Western Australian Government Environmental Ministerial Conditions (*Environmental Protection Act 1986)*;
- *Iron Ore (Mount Newman) Agreement Act 1964*;
- Department of Environmental Protection (DEP) Licence Conditions; and
- Groundwater Well Licence Conditions, Water Corporation.

An environmental officer will be designated for the Orebody 18 operations and will have the following responsibilities:

- to ensure that the management aims and monitoring responsibilities of the Environmental Management Programme are upheld;
- to maintain routine contact with BHP Iron Ore and the Contractor to ensure the integration of environmental objectives with the mining operation;
- to provide periodic reports on environmental issues;
- to provide information/training to employees and contractors regarding their environmental obligations; and
- to liaise with the contractor and government agencies as required.

A programme of employee education will be implemented to ensure that all personnel are aware of BHP Iron Ore's environmental responsibilities. The programme will include general and local area inductions with specific emphasis placed on the individual's responsibilities to adhere to environmental rules, regulations and policies.

5.1.1 Management

The EMP will be periodically reviewed and updated accordingly based on the results of monitoring, auditing and changing industry practices.

5.1.2 Commitment

The Proponent will prepare, to a timetable agreed upon by the DEP, and implement an Environmental Management Programme (EMP) for the Orebody 18 Project to the satisfaction of the EPA, 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 the following topics:

- *Topsoil management;*
- *Surface drainage;*
- *Groundwater;*
- *Flora and Fauna;*
- *Overburden Storage Areas;*
- *Rehabilitation;*
- *Aboriginal sites;*
- *Dust;*
- *Noise;*
- *Waste Management and Hazardous Materials;*
- *Decommissioning; and*
- *Continuous improvement.*

It must be noted that various components of the EMP will be required at different stages of the mine development from construction to decommissioning and that they, therefore, will be prepared as required.

6.0
SUMMARY OF COMMITMENTS

The proposal to establish a mining operation at Orebody 18, as described in this CER, provides the ability to help meet BHP Iron Ore's current and mid-term requirements 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 is committed to achieving a high standard of environmental management at its Orebody 18 operation. The commitment listed in this CER has been formulated with the intention of including specific environmental management practices in the Environmental Management Programme, a draft of which is attached to this CER for public comment. The EMP will be periodically revised by BHP Iron Ore and submitted to the Department of Environmental Protection 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.

The following commitment is made by BHP Iron Ore:

Commitment

The Proponent will prepare, to a timetable agreed upon by the DEP, and implement an Environmental Management Programme (EMP) for the Orebody 18 Project to the satisfaction of the EPA, 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 the following topics:

- *Topsoil management;*
- *Surface drainage;*
- *Groundwater;*
- *Flora and Fauna;*
- *Overburden Storage Areas;*
- *Rehabilitation;*
- *Aboriginal sites;*
- *Dust;*
- *Noise;*
- *Waste Management and Hazardous Materials;*
- *Decommissioning; and*
- *Continuous improvement.*

7.0
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Fauna Protection Agreements cited in the Text

Australian and New Zealand Environment and Conservation Council (ANZECC) Convention 1991.

8.0
ABBREVIATIONS

ANZECC	Australian and New Zealand Environment and Conservation Council
AS	Australian Standard
BHP Iron Ore	BHP Iron Ore Pty Ltd
BIF	banded iron formation
CAMBA	China-Australia Migratory Bird Agreement
CALM	Department of Conservation and Land Management
CER	Consultative Environmental Review
DME	Department of Minerals and Energy
DEP	Department of Environmental Protection
EMP	Environmental Management Programme
EPA	Environmental Protection Authority
ha	hectares
HMMP	Hazardous Materials Management Programme
kL	kilolitre
km	kilometre
km^2	square kilometre
km/hr	kilometre per hour
kw	kilowatt
L	litre
m	metre
mg/L	milligrams per litre
ML	Mineral Lease
mm	millimetre
Mt	million tonnes
Mtpa	million tonnes per annum
NATA	National Association of Testing Authorities
°	degrees
°C	degrees Celsius
ROM	run-of-mine
TDS	total dissolved solids
tpa	tonnes per annum
µS/cm	microsiemens per centimetre

APPENDIX A

ENVIRONMENTAL PROTECTION AUTHORITY GUIDELINES

MINING OF OREBODY 18, ML 244SA, BHP IRON ORE PTY LTD

CONSULTATIVE ENVIRONMENTAL REVIEW GUIDELINES

Overview

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

Throughout the assessment process it is the objective of the Department of Environmental Protection (DEP) to assist the proponent to design and improve the proposal such that the environment is protected in the best manner possible. The DEP will co-ordinate relevant government agencies and the public in providing advice about environmental matters during the assessment of the Consultative Environmental Review (CER).

Contents of the CER

The contents should reflect the purpose of the CER, which is to:
- communicate clearly with the public (including government agencies), so that Environmental Protection Authority (EPA) can obtain informed public comment to assist in providing advice to government;
- describe the proposal adequately, so that the Minister for the Environment can consider approval of a well-defined project; and
- provide the basis of the proponent's environmental management programme, which shows that the environmental topics and issues related to the proposal can be acceptably managed.

The language used in the body of the CER should be kept simple and concise, considering the audience includes non-technical people; any extensive, technical detail should either be referenced or appended to the CER. Remember that the CER would form the legal basis of the Minister for the Environment's approval of the proposal and, hence, should include a description of all the main and ancillary components of the proposal, including options if necessary. A summary table of the key proposal characteristics is essential.

The CER should include the basis of an Environmental Management System for the proposal, which should be developed in conjunction with the engineering and economic programmes to assist in whole-of-project planning. The DEP recommends that the basis of an environmental management programme, including an audit programme, be described in the CER.

The fundamental contents of the CER should include:
- introduction to the proponent, the project, land tenure and location;
- the legal framework, decision making authorities and involved agencies;
- description of the components of the proposal and identification of the potential impacts (including a table of the key characteristics of the proposal and a summary table of the impacts);
- description of the present state of the receiving environment which may be impacted (including an overlay of the proposal on the key environmental systems);
- discussion of the key environmental topics, including an assessment of the significance as related to objectives or standards which may apply (including a pollution source flow sheet and water balance, if applicable);
- discussion of the proposed management of the topics, including commitments to appropriate objectives and/or plans (including the envisaged resultant state of the environment); and
- a summary of the environmental management programme, including the procedures/actions to achieve the commitments and an auditing programme. The EPA considers that the proponent should approach environmental management in terms of best practice, which includes:
  - development of an environmental policy and agreed environmental objectives;

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

Key environmental topics

The key environmental topics can be determined from a consideration, called scoping, of the potential impacts, including pollution potential, from the various components/actions of the proposal on a receiving environment, including the biophysical environment and people (social surroundings). The topics and the EPA's corresponding management objectives, as known at this stage, are included in the table below (not in priority order). For this proposal, activities The topics, from which the key issues are derived (and their corresponding objectives) at this stage are included in the table below, and include mine construction and operations, provision of infrastructure and services, dewatering and waste management.

Topic	Management Objectives
Plants and animals	Protect rare and priority species.
Local and regional environment	Minimise loss of locally and/or regionally significant vegetation associations and habitats.
Surface water	Minimise impacts on the quality and quantity of surface water.
Groundwater	Minimise short and long term effects caused by groundwater use.
Overburden storage	Maximise return of overburden to pits and ensure stability.
Noise and dust impacts on nearest neighbours	Achieve compliance with noise regulations and guidelines for nuisance dust levels.
Aboriginal sites	Comply with provisions of the Aboriginal Heritage Act.
Environmental Management System	To ensure that the project is managed during all phases under an effective Environmental Management Programme.
Rehabilitation of the project area	Define an acceptable end land use, rehabilitation criteria and mine closure strategy.
Cumulative environmental impacts from this mine.	To minimise the cumulative impact of mining on the regional environment.
Social issues	Minimise impacts on social surroundings.

The proponent should consider these topics in relation to the construction, operation and decommissioning phases of the project. Further topics and key issues may be raised during the preparation of the CER, and on-going consultation with the DEP and relevant agencies is recommended.

In relation to groundwater, short, long term and cumulative environmental impacts caused by:

- mining below the watertable and the effect this has on surface drainage systems; the quality and quantity of groundwater in the affected aquifers; local and regional effects on flora, fauna and plant communities, local and regional wetlands or marsh systems; and impacts on other users; and
- the exposure of ground water in mined out pits and the potential to impact on the environment by increasing water salinity and acidity, modifying groundwater flow and lowering water table levels locally and regionally;

should be comprehensively dealt with in the CER.

The information presented should be based on best available data and where uncertainly exists provide best and worst case scenario's. It may be that an impact is inevitable or there is little prospect for management. The significance of such impacts in a local and regional sense and the management options (if any) to attenuate the impacts should be provided. This should include options that would not necessarily be the ultimate engineering solution or least cost, but would significantly reduce the environmental impact. Options should be ranked according to the level of protection afforded to the environment and should include an explanation of each, and the proponent's preferred option and why it is preferred. Assessments of the significance of an impact should be soundly based rather than unsubstantiated opinions, and the assessment should lead to a discussion of the management of the issue.

Minor issues which can be readily managed as part of normal operations for similar projects may be briefly described. Information used to reach conclusions should be properly referenced, including personal communications.

In discussing the key topics identified in the table above, the CER should contain:

- a table summarising the key characteristics of the proposal. For example, clearing rates, mining rate, separation & processing rates, and trucking rate. This will facilitate the assessment of any future changes to the operation;
- pollution source flow sheet;
- two base maps and an overlay of the proposed project layout. The base maps should show the existing physical and social environment, which when displayed with the overlay illustrate the physical disturbance likely, and the impacts on residents and residential centres;
- a table summarising the environmental impacts of the proposal and describing:
  - the present state of the environment;
  - potential impacts of the proposal on the environment;
  - environmental management objectives for those aspects which require management;
  - environmental management proposed to manage impacts to meet those objectives; &
  - envisaged resultant state of the environment.

  These topics should be presented under the major headings used in the table above, biophysical environment, pollution potential, and social surroundings.

Public consultation

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

Environmental management commitments

The method of implementation of the proposal and all commitments made by the proponent in the CER become legally enforceable under the conditions of environmental approval issued by the Minister for the Environment. Commitments which address key environmental topics form a schedule to the Minister's environmental conditions and will be audited by the DEP. The commitments have the form of: the proponent (who) will prepare a plan or take action (what) to meet an objective, to the timing for its achievement (when), and to which agencies will be consulted or to whose requirements, if not the DEP, the action/plan will be prepared.

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

Issue bio-physical	Objective	Commitment	Timing (Phase)	Whose requirements	Specification (Performance Indicator)
Protect-ion of conserv-ation values of reserve	Manage surrounding land in concert with reserve	Develop a plan of recommended conservation strategies	Within 1 year of start of pipeline	CALM, NPNCA	Agreements signed with adjacent landowners; fences built; optimum cattle stocking rates determined; etc

PLATES

Plate 1. View of part of the orebody, looking north from the plain.

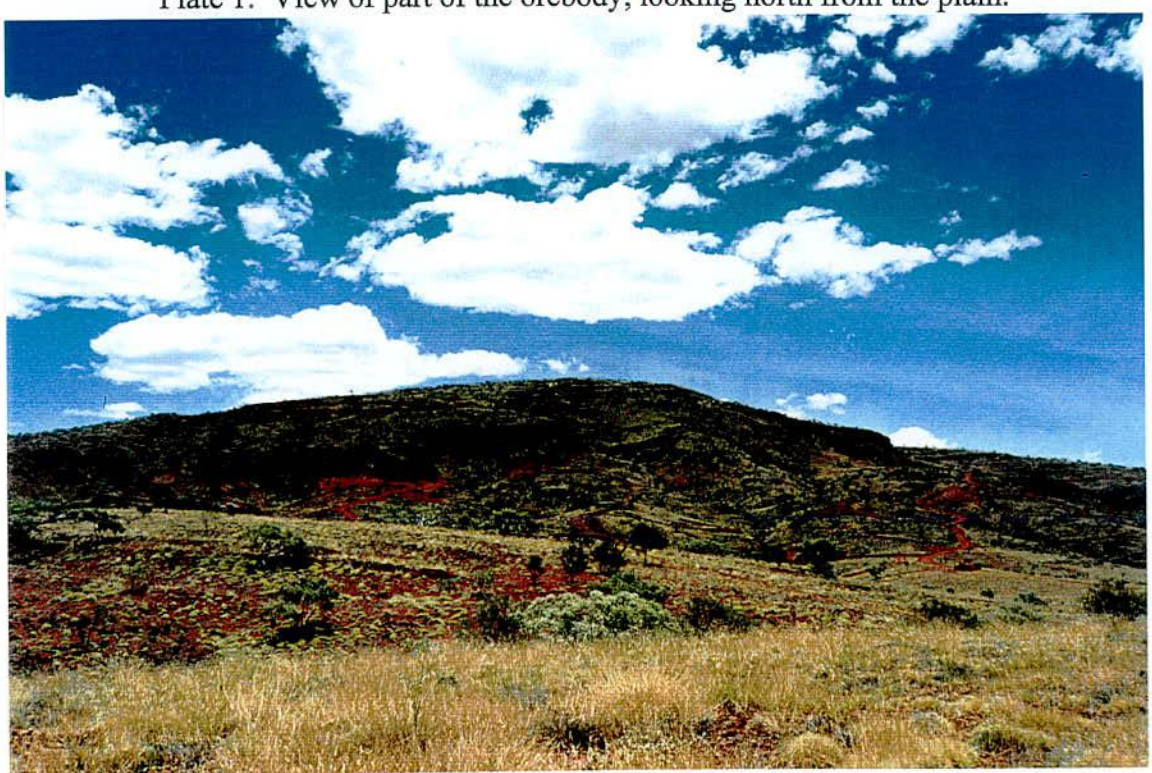

Plate 2. View from the top of the orebody, looking south-east down over the scree and onto the plain. The largest overburden storage area will be located on the plain to the left of the photograph. Part of the stockpile and infrastructure area will be located to the right.

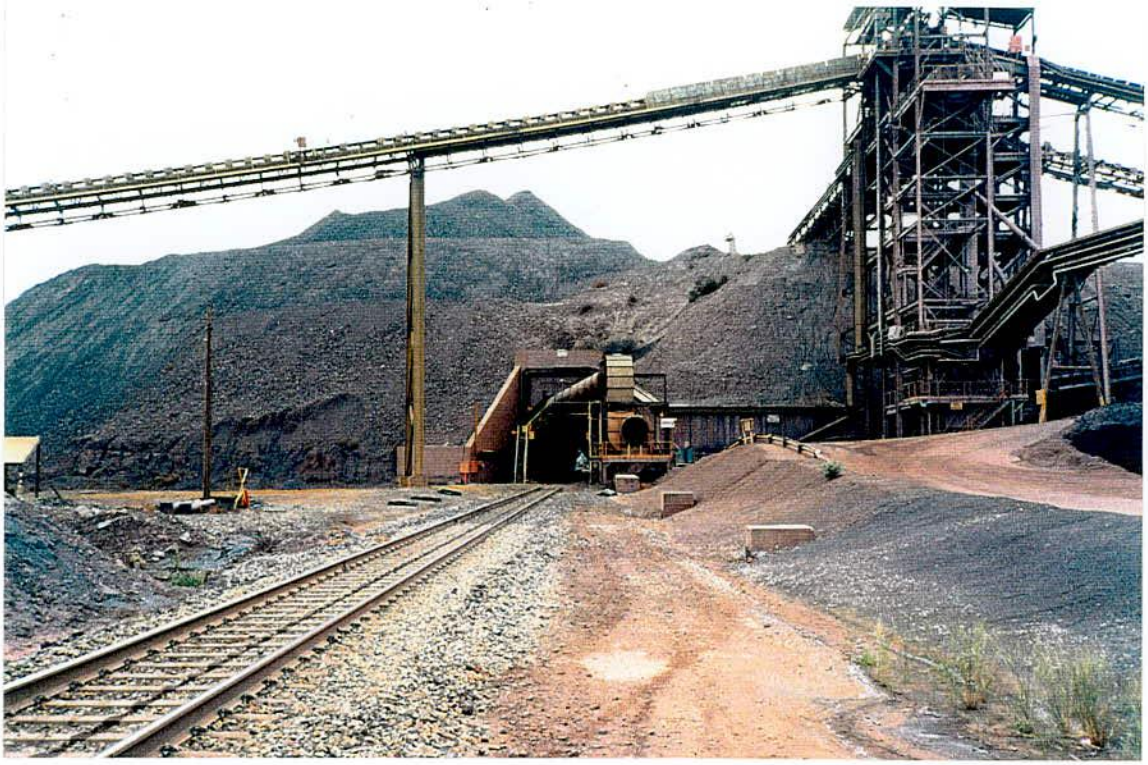

Plate 3. Example of a typical iron ore stockpile and rail load-out facility.

9.0
GLOSSARY

Acid Rock Drainage	Acid water (low pH) drainage usually created by the passage of water through oxidising sulphide mineralisation.
Actinolite	A light green amphibole mineral.
Aquifer	A usually porous and permeable rock unit capable of supplying groundwater for bores and wells.
Aquitard	A semi-pervious layer over or underlying an aquifer.
Archaean	The oldest rocks of the earth's crust, older than 2,400 million years.
Banded Iron Formation	A type of sedimentary rock which is characterised by its high iron content and a conspicuous banding caused by extreme variations in the iron content of the different bands.
Borrow Pits	Pits used as a source of rock, soil, sand or other construction materials for building mining operations infrastructure (e.g. roads, foundation pads, railroad formation).
Bund	An earth, rock or concrete wall or mound constructed to restrict the inflow or outflow of liquids or noise.
Cainozoic	Geological era comprising the Tertiary and Quaternary periods, about 65 million years ago.
Catchment	The area from which a river or waterway collects surface water runoff.

Chert	Dense flinty rock composed almost wholly of silica.
Chlorite	Dark replacement mineral related to mica.
Colluvium	Loose and incoherent deposits usually at the foot of a slope and transported there by gravel.
dB(A)	The sound level or noise level most appropriate to the human ear is usually expressed in terms of decibels (dB), which is measured as the 'A-weighting' filter incorporated in sound level meters.
Doleritic	Term to describe material formed of medium-grained crystalline basalt.
Drawdown	A lowering of the groundwater level as a result of withdrawal.
Dyke	Tabular igneous intrusion cutting across bedding or other planar structures in the country rocks.
Epidote	Calcium aluminium silicate mineral.
Exotic Species	An introduced species of flora or fauna.
Feldspar	A very abundant group of rock-forming silicate minerals in which calcium, sodium and potassium are in combination with aluminium.
Felsic	Fine grained igneous rocks with a very low content of mafic minerals.
Habitat	The particular local environment occupied by an organism.

Impermeable	Not allowing the passage of a fluid through interstices.
Impervious	Not able to be penetrated.
Infrastructure	The support installations and services that supply the needs of the project.
Metadolerite	Metamorphic rock derived from dolerite.
Open Cut	Surface mining in which ore is exposed by the removal of overburden or waste rock.
Overburden	Unmineralised material overlying an orebody.
Passerine	Relating to birds characterised by the perching habit.
Phreatophytic	A plant having very long roots that reach down to the water table or the layer above it.
Priority Species	Plant species which are not Declared Rare Flora but which are considered by CALM to be in need of further research.
Process Water	Water required for the processing of ore which is used for wetting down, crushing and dust suppression.
Pumpellyite	Pumpellyite occurs principally in low-grade regionally metamorphosed schists.
Pyrite	A common pale-bronze or brass-yellow mineral. The most widespread abundant of the sulphide minerals. Also known as 'fools gold'.

Pyroxene	Family of silicate minerals that usually contain iron and magnesium and commonly calcium.
Relative Humidity	Ratio of the mass of water vapour actually present in a unit volume of the air to that required to saturate it at the same temperature.
Rehabilitation	Restoration of an area, disturbed by mining, to a suitable landform.
Royalties	A percentage of the revenue from the sale of goods.
Run-of-mine	Ore that has been recently mined in its natural, unprocessed state.
Schedule 1 Species	Those 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.
Sedimentary	Term describing rocks formed by the deposition of particles suspended in wind, water or ice.
Shale	Sedimentary rock formed by the consolidation of mud or silt.
Sill	Wall-like intrusion of igneous rock that is concordant with the structure of the older adjacent rocks.
Skeletal Soils	A thin layer of soil of rock.
Stilpnomelane	Stilpnomelane occurs in iron- and manganese-rich low grade regionally metamorphosed sediments and associated veins.

Stratigraphic	Term relating to the formation, composition and occurrence of stratified rocks in the earth's crust.
Topsoil	The general term applied to the surface portion of the soil including the average plough depth or the A horizon, where it is deeper.
Volcanic	Class of igneous rocks that have flowed out or have been ejected at or near the Earth's surface, as from a volcano.