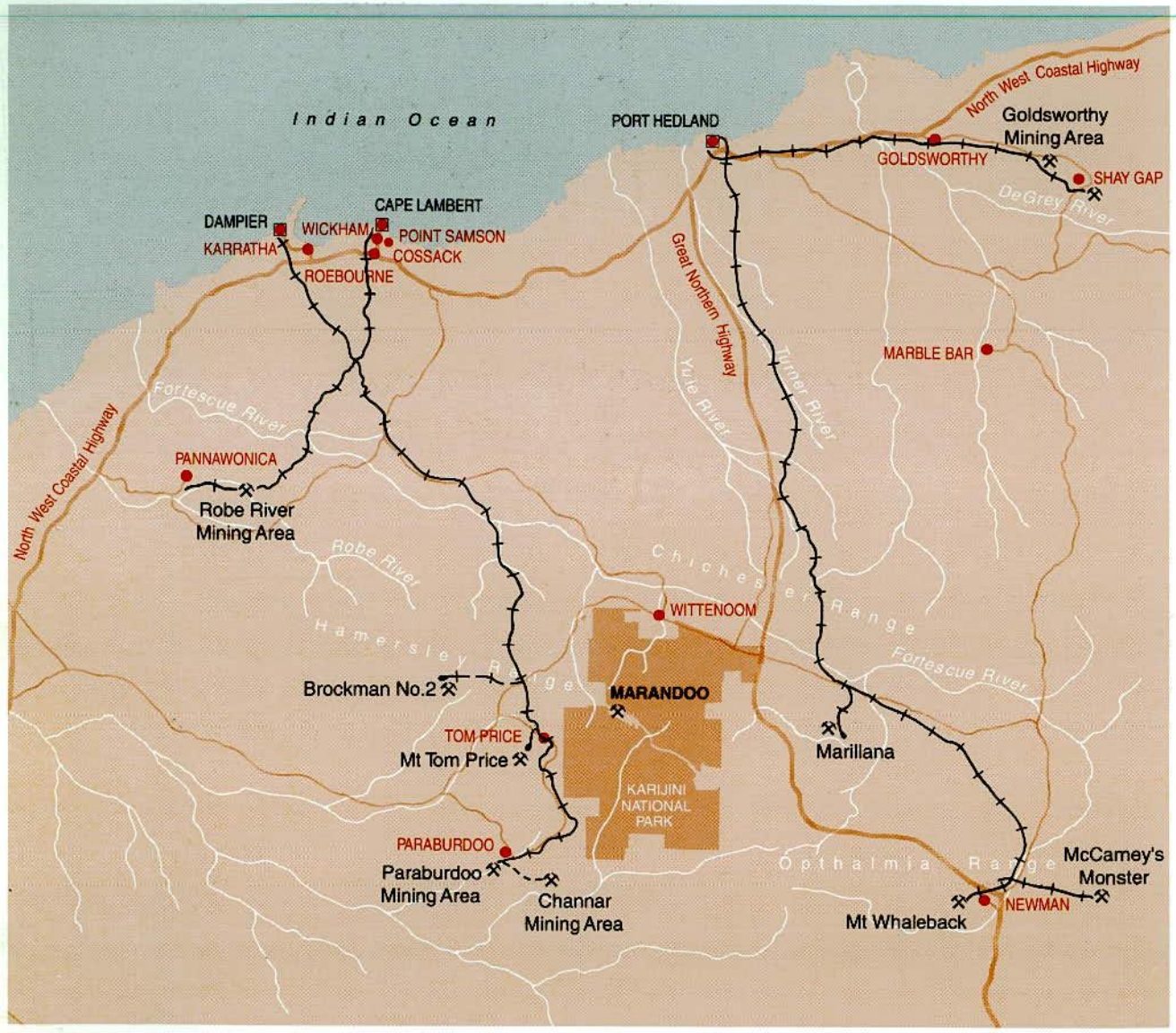
HAMERSLEY IRON PTY. LIMITED

MARANDOO IRON ORE MINE AND CENTRAL PILBARA RAILWAY

Environmental Review and Management Programme Overview



Location of the Marandoo project.

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Environmental Review and Management Programme Overview

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FACTS ABOUT HAMERSLEY IRON PTY. LIMITED

Hamersley Iron Pty. Limited (Hamersley), the proponent for the Marandoo project, is a wholly owned subsidiary of CRA Limited, which is one of Australia's largest companies.

Hamersley is Australia's largest producer of iron ore and the world's second largest iron ore exporter, with a current annual production rate of about 50 million tonnes. Production and export of iron ore by Hamersley commenced in 1966 from the Mount Tom Price mine and the port of Dampier respectively. Since construction commenced in 1965, Hamersley has invested in plant, equipment, ports, railways, towns, water supplies, power generation and associated infrastructure with a current replacement value of over $6 billion.

Within Western Australia, Hamersley directly employs about 3,100 people and indirectly another 12,000 people. It is reasonable to assume that approximately 25,000 people are supported by its mining and export activities.

Hamersley is the principal employer in the towns of Tom Price, Paraburdoo and Dampier, and a major employer in Karratha. Consequently, the company's continued stable operation is the key to sustaining the level of population and services in these towns in the medium to long term.

Hamersley's corporate policies embrace economic, environmental and cultural awareness objectives that have produced the broad management strength essential in establishing and maintaining its competitive position in the world iron ore industry. This same depth of management skill will be applied to the Marandoo project.

INTRODUCTION

The Australian iron ore industry, after a quarter century of growth and export achievement, is undergoing a period of rationalisation and new development aimed at sustaining its competitive position in the world iron ore market well into the next century.

Hamersley Iron Pty. Limited (Hamersley) is proposing to develop the Marandoo iron ore deposit, which is located about 35 kilometres north-east of Tom Price in the Pilbara. This mine will be an important step in maintaining Hamersley's position as Australia's largest iron ore producer and a major contributor to the nation's balance of payments. Development of the Marandoo project and its associated railway will enable the development of additional iron ore mines in the Central Pilbara and the continued viability of Hamersley's export-based business.

The Marandoo project involves a capital investment of more than $500 million in the construction of the mine and related infrastructure, including a 115 kilometre extension to Hamersley's rail network. Certain elements of the substantial infrastructure that Hamersley has developed in the Pilbara—in particular the towns of Tom Price, Dampier and Karratha; the export facilities at Dampier; and the railway between Dampier and Mount Tom Price—are essential to the economic viability of the Marandoo project.

WHAT ARE THE KEY ENVIRONMENTAL ISSUES ASSOCIATED WITH THE MARANDOO PROJECT?

The overriding environmental issue for the project is the appropriate environmental planning and management of a mine and railway that will share boundaries with a national park.

Key issues that have been considered in the planning and environmental assessment of this project include:

- mine planning issues—the location of the mine site and transport corridors, and alternatives to these locations;
- flora, fauna and ecosystems—the regional ecosystem, and the distribution and significance of flora and fauna;
- land-use patterns and values—pastoral, recreational and tourism land uses, and the landscape and recreational values represented by these uses;
- Aboriginal heritage—sites of importance to Aboriginal people claiming to have traditional affiliations with the land in the vicinity of the Marandoo iron ore deposit;
- issues related to the construction and operations workforces—includes the impact of the project workforce and attendant population on existing communities, the Karijini National Park and the environs;
- water management issues—groundwater systems, surface water and drainage systems, and erosion and siltation control;
- operational management issues—includes dust control, overburden management, progressive rehabilitation, and overall management of the mine area and the railway corridor and their interaction with the Park.

Detailed information on each of these issues is presented in the Environmental Review and Management Programme (ERMP), which has been prepared for consideration by government after a period of public review.

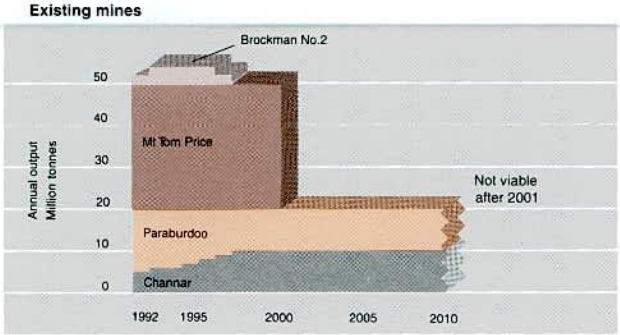
THE MARANDOO PROJECT AND THE KARIJINI NATIONAL PARK

The Marandoo project has attracted some attention because of its common boundaries with the Park.

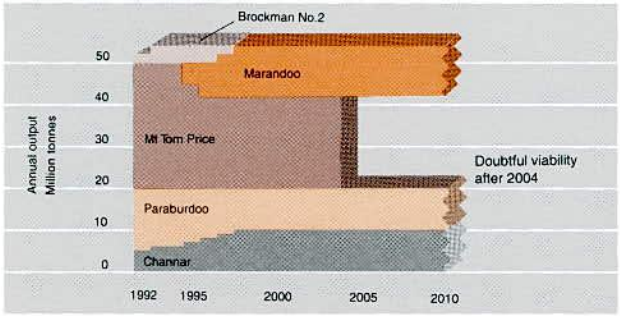
The mine and railway will extend over 115 kilometres, about 50 kilometres of which are on land excised from the Park in accordance with State Government policy.

The Government's policies towards both mining and national parks have evolved to reflect changing community values and expectations. In late 1990, after a lengthy process of consid-

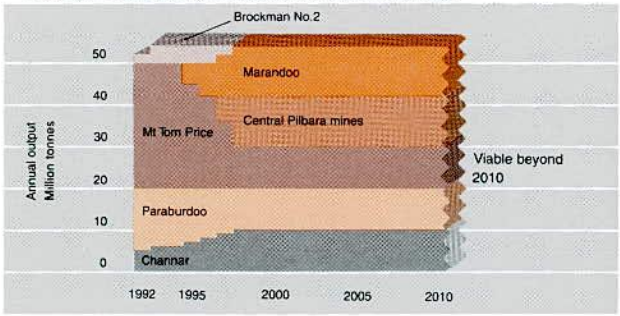
Existing mines



Existing mines plus Marandoo



Existing mines plus Marandoo plus Central Pilbara mines



The likely impact of the Marandoo and Central Pilbara mines on Hamersley's iron ore production.

WHY IS THE MARANDOO PROJECT SO IMPORTANT TO THE FUTURE OF HAMERSLEY?

The Marandoo project is designed to maintain the company's ore production and sales levels while conserving the high-grade ore of the Mount Tom Price mine. Hamersley currently produces 28 million tonnes of high-grade iron ore annually from its Mount Tom Price mine, which has been in operation for twenty-five years. At this rate of production, the Mount Tom Price mine has about eleven years of production left. However, operations at the Mount Tom Price mine can continue into the next century if the Marandoo deposit, which can be used to replace ore from the Mount Tom Price mine as that deposit is depleted, comes onstream in 1994 and a production rate of 10–12 million tonnes per annum is achieved by 1997.

The Marandoo project will enable the early development of new iron ore mines in the Central Pilbara to the east of Marandoo (see map on pages 14 and 15). These new mines will extend the life of the Mount Tom Price mine and provide a basis for increased sales. In addition to the Marandoo deposit, Hamersley has identified other substantial iron ore deposits in the Central Pilbara that will support the company's operations until at least the second half of the next century. Cost-efficient development of these deposits depends on the maximum use of the extensive existing infrastructure—railways, towns and port facilities—that Hamersley has progressively developed in the Pilbara over the past twenty-five years. A direct rail link from the Central Pilbara via Marandoo to the existing Paraburdoo–Tom Price–Dampier railway is essential for the development of these deposits in the Central Pilbara.

eration and consultation, the State Government announced its policy on mining and national parks in Western Australia. This policy allows mining exploration in only three of the State's sixty national parks, including the Karijini National Park. The excision of the railway corridor and areas required for the mine and construction camp from the Park occurred after the announcement of the State Government's policy in 1990.

A key principle of the planning of the Marandoo project has been the identification and integration of the essential social, environmental and recreational values of the Park into the project planning process. In view of the need for compatible land-use management policies for the Marandoo project and the surrounding Park, Hamersley and the Department of Conservation and Land Management (CALM) have agreed a Statement of Mutual Understanding that provides a framework for minimising the impacts of the project on the Park and for planning the longer term future of the Project Area once mining is completed.

Arrangements agreed upon by Hamersley and CALM include:

- continuation of consultation on conservation and environmental research programmes;
- continuation of Hamersley's programme of fieldwork on the pebble-mound mouse, in conjunction with CALM;
- development of a fire management programme;
- completion of detailed hydrology and engineering studies by Hamersley, after which Hamersley and CALM will discuss an appropriate final landform for the Marandoo mine site;
- a range of measures to manage the impact of humans on the Park.

This co-operative approach with CALM will result in significant benefits for both Park and mine management. The community as a whole will ultimately benefit through the establishment of an extremely important mining project, with minimum disturbance to the conservation and recreation values of the Park.

HOW HAS THE COMMUNITY BEEN INVOLVED IN THE PLANNING OF THE MARANDOO PROJECT?

Community consultation, both by Hamersley and by the consultants who have assisted in the preparation of the ERMP for the project, has played an important part in the development of the Marandoo project. Hamersley has informed representatives of government, relevant professional bodies, the media, Aboriginal groups and the wider community through:

- visits to Marandoo and presentations
- meetings and discussions
- media releases and advertisements.

During the preparation of the ERMP, twenty-six public workshops were held in towns throughout the Pilbara and in Perth. A total of fifty-four individual working groups (about 520 people) representing employees of Hamersley and their families, Aboriginal people and business interests participated in these workshops. Conservation organisations were invited, and a representative attended a Perth workshop.

The view of the majority of people who attended the workshops was that the Marandoo project should go ahead; however, some people with strong conservation interests and some Aboriginal people disagreed with this view.

Hamersley recognises the importance of ongoing consultation with special interest groups and the wider community, and the publication of this Overview is part of the consultation process.

WHY IS THE MARANDOO PROJECT IMPORTANT TO WESTERN AUSTRALIA AND AUSTRALIA?

Continued competitive ore production and export by Hamersley are important to the future of both the Western Australian and the Australian economies.

Within Western Australia, Hamersley directly employs about 3,100 people and indirectly another 12,000 people. It is reasonable to assume that approximately 25,000 people are supported by its mining and export activities.

Hamersley is the principal employer in the towns of Dampier, Tom Price and Paraburdoo, and a major employer in Karratha. Consequently, the company's continued stable operation is the key to sustaining the level of population and services in these towns in the medium to long term.

Hamersley is Australia's largest producer of iron ore and the world's second largest iron ore exporter, with a current annual production rate of about 50 million tonnes. Since 1965, Hamersley has invested in plant, equipment, ports, railways, towns, water supplies, power generation and associated infrastructure in the Pilbara to support the export of iron ore. This investment has a current replacement value of over $6 billion.

The iron ore industry is one of Australia's most important export earners and thus a key contributor to the nation's balance of payments. In 1990 iron ore exports to Japan, Korea, China and several European countries earned Australia approximately $3 billion. Hamersley provided about one-third of that total. Without the Marandoo project and the development of future mines in the Central Pilbara, Hamersley's substantial contribution to the nation's balance of payments will decrease and cease within a little more than a decade.

WHAT FACILITIES ARE REQUIRED?

The following existing Hamersley infrastructure and support systems are essential to the Marandoo project:

- the towns of Dampier, Karratha and Tom Price;
- the unloading, blending and stockpiling facilities at Dampier;
- the port and ship-loading facilities at Dampier;
- the power station at Dampier;
- the 220 kilovolt transmission line between Dampier and Tom Price;
- the 250 kilometres of railway between Dampier and Rosella Siding, and the associated service roads, signalling network and control systems;
- Hamersley's planning and quality control systems, and the expertise of Hamersley employees;
- Hamersley's marketing and sales skills;
- Hamersley's administrative support services based in its Perth office.

In addition to the construction of the mine and processing plant at Marandoo, the project will require the following new facilities to be constructed:

- a 115 kilometre railway from Rosella Siding on the Hamersley main line, through Marandoo to Homestead Junction near Juna Downs station;
- a sealed 23 kilometre access road between Marandoo and the new main road linking Paraburdoo with Wittenoom;
- a 45 kilometre long, 220 kilovolt transmission line between the Mount Tom Price mine and Marandoo;
- an unsealed airstrip at Marandoo with emergency night landing facilities;
- support infrastructure (including offices, a laboratory, workshops and other facilities) at Marandoo for mining and processing plant operations.

THE PROJECT

The planning of the Marandoo project has been undertaken at a number of levels reflecting the influence of strategic, regional and local factors, particularly those relating to environmental issues. Unlike many industrial projects, which usually have some flexibility in their location, mining projects are restricted to where the resource occurs in economically viable quantities. Project planning has to proceed on this basis.

THE MINERAL RESOURCE

Regional geology

The iron ore deposits at Mount Tom Price, Mount Whaleback and Paraburdoo occur as enriched zones within the Brockman Iron Formation, while the Marandoo iron ore deposit is an enriched zone within the older Marra Mamba Iron Formation. In the Pilbara landscape, the harder and thicker Brockman outcrops are responsible for the more pronounced features such as Mount Bruce, Mount Brockman and Mount Nameless, while the thinner Marra Mamba outcrops generally form low ridges like the Marandoo ridge.

Both the Brockman Iron Formation and the Marra Mamba Iron Formation contain distinct layers, known as 'Banded Iron Formations'. These Banded Iron Formations are sedimentary rocks that have the distinguishing characteristic of conspicuous alternating bands containing iron and silica.

Most Banded Iron Formations in the Pilbara have little commercial value because their iron content is about 30 per cent. It is only when the iron content has been enriched by natural processes to over 60 per cent that the material may be of commercial value, provided that its impurities are low and that it meets other metallurgical criteria. This natural enrichment process has resulted in portions of some Banded Iron Formations, including the upper section of the Marra Mamba Iron Formation at Marandoo, becoming iron ore deposits of potential commercial value.

The relatively rich commercial deposits of high-quality iron ore are scattered throughout the Pilbara. The highly competitive iron ore market requires reliable, long-term supplies of ore with chemical and physical characteristics maintained within specified limits to produce consistent ore quality. This quality is achieved and maintained by careful attention to ore blending, both within Hamersley's individual mines in the Pilbara and when ores from these mines are combined at Dampier.

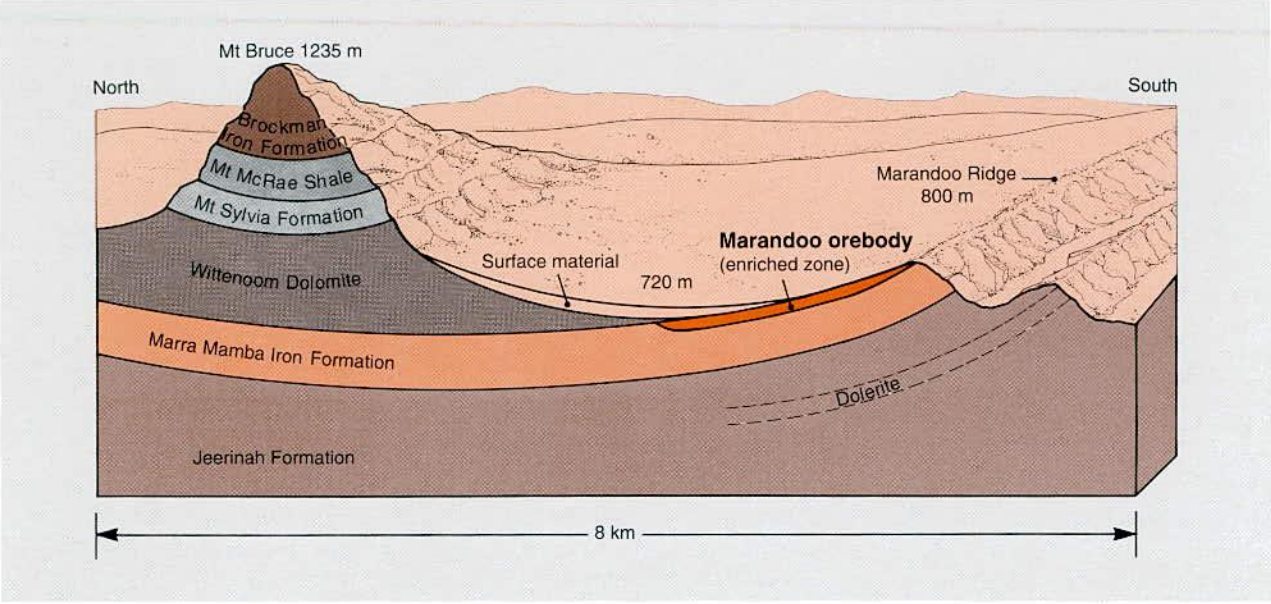
The Marandoo orebody

The Marandoo iron ore deposit is located approximately 35 kilometres north-east of Tom Price within a 48.3 square kilometre Temporary Reserve (TR 5623-H, referred to in this Overview as 'the Tenement'). The orebody generally has a shallow dip from south to north and plunges gently from west to east. Ore is exposed on the northern slopes of the Marandoo ridge and then dips to the north beneath a layer of alluvial and/or colluvial material. The thickness of the Marandoo orebody varies between about 14 metres and 40 metres, with an average thickness of about 22 metres. The orebody appears as an outcrop over a strike length of 7.2 kilometres along the ridge.

More than 500 exploration holes drilled in a period of nearly twenty years have provided information about the geology and chemistry of the orebody. Based on this information, the Marandoo ore reserves are estimated to be 370 million tonnes; however, much of this ore is below the watertable and beneath a substantial quantity of overburden. This deeper ore will not be mined as part of this project.

The Marandoo project is concerned with an Initial Mining Area approximately 4 kilometres long and 2 kilometres wide. The 175 million tonnes of proven ore in this area are entirely above the watertable. Extraction of the remaining ore, if later proven viable, would be subject to separate environmental assessment.

The ore to be mined from the Initial Mining Area will yield lump and fine ore. Because lump ore attracts a higher price than fine ore, it greatly enhances the value of the deposit.



Diagrammatic cross-section of the Marandoo valley.

THE MINE

Mine and infrastructure construction

The construction of the mine at Marandoo and all related infrastructure will take place over a 27-month period. The railway and the mine will be constructed concurrently. Fifty-five kilometres of railway will be built from the existing Hamersley railway line at Rosella Siding (250 kilometres from Dampier) to the mine site at Marandoo, and another 60 kilometres from Marandoo to Homestead Junction near Juna Downs station (about 14 kilometres east of the Park boundary). The final surveyed alignments of the railway, road and powerlines have not been determined, but they will be built within defined corridors, the subject of Miscellaneous Licences already granted to Hamersley for this purpose.

Ore handling

The sketch on page 10 shows the overall ore handling process that will be used at the Marandoo mine site. The ore crushing and screening plant operations will be similar to those used at the Mount Tom Price and Paraburdoo mines. These will involve three stages of crushing (primary, secondary and tertiary) and separation by screening of the iron ore into two discrete products:

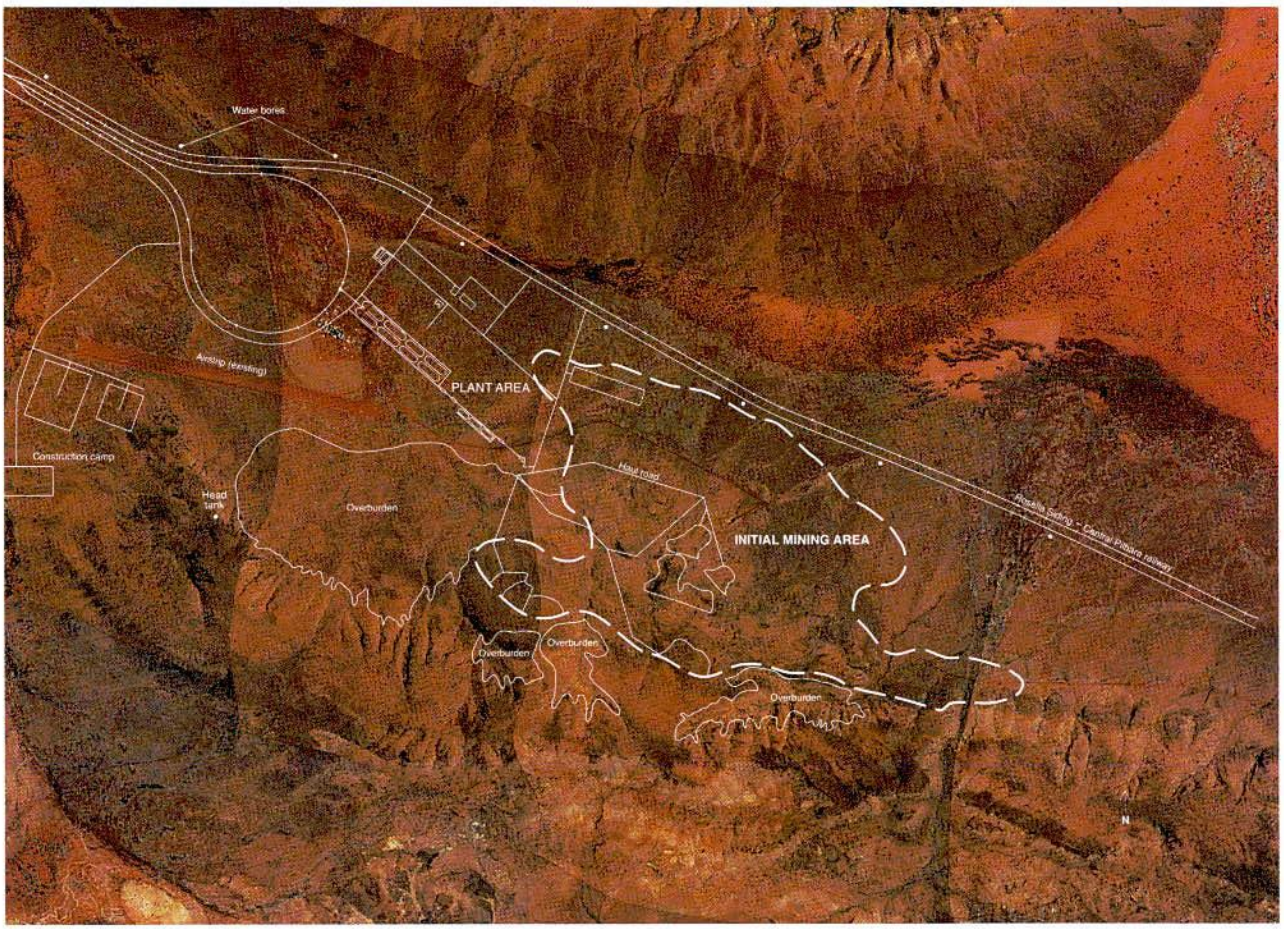
- lump (between 6 millimetres and 30 millimetres in size);
- fines (less than 6 millimetres in size).

Mining and ore handling will be a 24-hour operation.

Product stockpiles at the mine site for both lump and fines will be designed to meet the requirements of intermittent train-loading operations. Blended material will be loaded into ore wagons for transport by rail to Dampier.

Transport of the ore

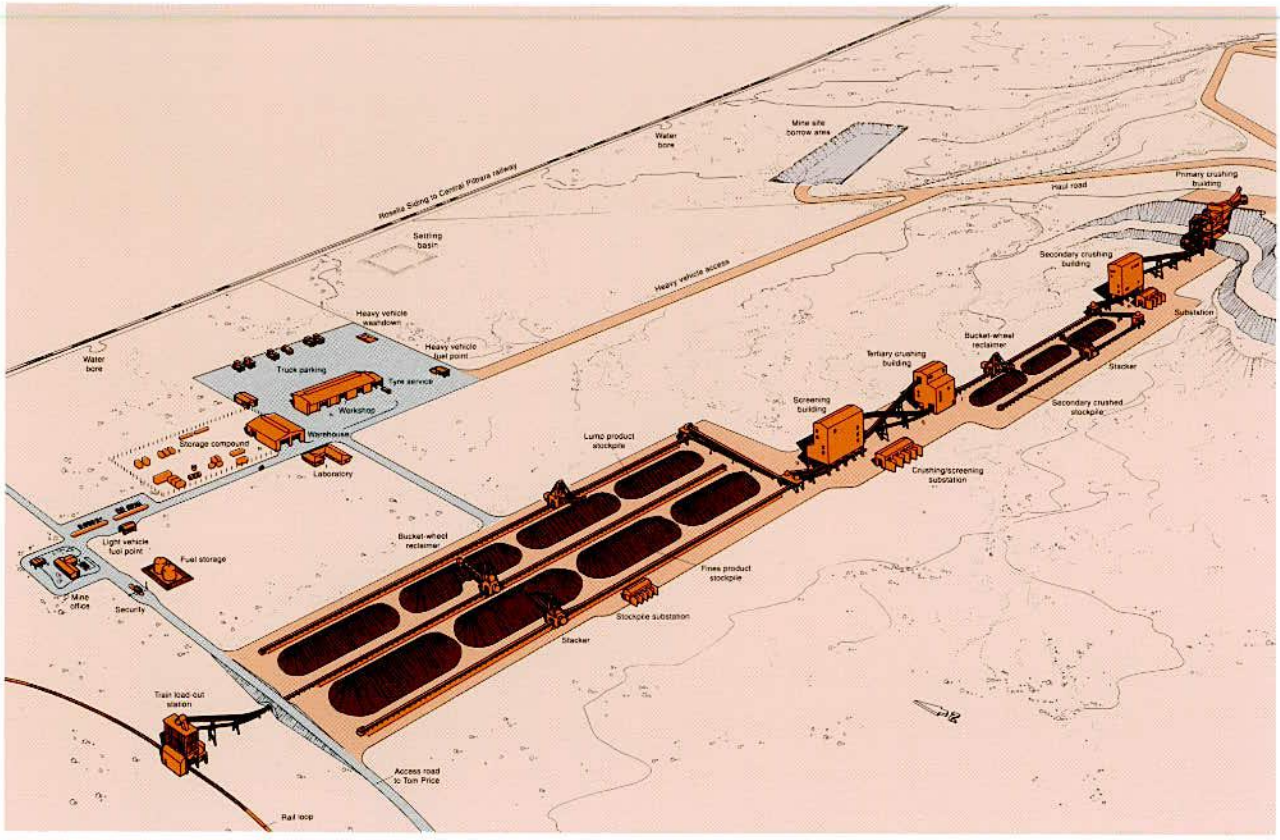
Train-loading facilities at Marandoo will be designed for continuous and automatic operation, with a loading capacity of 7,500 tonnes per hour. The railway line will be designed to allow the current maximum speed of 80 kilometres per hour for typical trains of three diesel–electric locomotives, each with 210 wagons of 100 tonne nominal capacity.



Aerial photograph of the mine site showing the location of the mine and processing plant facilities.

Overburden dumps

Management of overburden from the Marandoo mine will be an important aspect of the entire project. Although the ratio of overburden to ore is quite favourable, the small size of the mining lease, the topographic limitations on the locations of overburden dumps and the need to minimise environmental impacts make in-pit dumping of overburden an important feature of the Marandoo operation. The planned in-pit disposal of a substantial portion of the overburden has the definite advantage of reduced visual impact compared with the use of large dumps outside the pit.



Artist's sketch of the processing plant area.

THE WORKFORCE

An important benefit of the Marandoo project will be the creation of additional jobs both in the Pilbara and elsewhere during the construction period. Even more importantly, the project will ensure longer term employment opportunities for the Hamersley workforce, particularly for those employees and their families who live in Tom Price, and for the general community.

CONSTRUCTION WORKFORCE

During the 27-month construction period, the peak workforce directly employed for the main components is expected to be as follows:

- mine and processing plant—800 people
- railway line—100 people
- transmission line—50 people.

To accommodate the construction workforce for the mine and processing plant, a construction camp will be established adjacent to the mine site for the duration of the construction period. The design and operation of the construction camp will incorporate those features from other recent construction projects that have been found by both the occupants and the operators to be most effective. Catering will be provided from a central mess, and other facilities will include a wet mess, recreation facilities, a temporary diesel power station and a water supply.

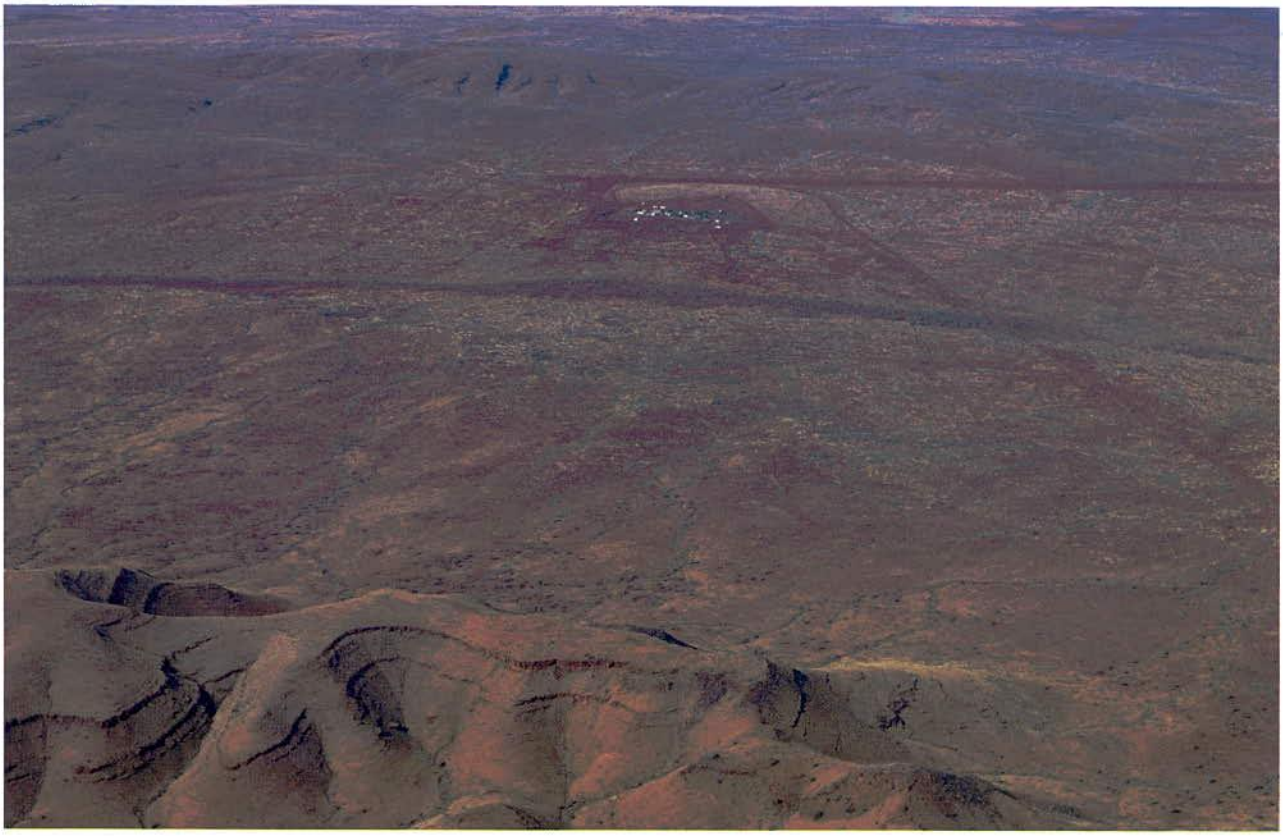
For the construction of the railway, camps will be established at Rosella Siding and at Juna Downs, and each camp will accommodate about 100 people. Both camps will be located outside the Park.

A small construction camp for up to fifty people will be located in the transmission line corridor outside the Park.

OPERATIONS WORKFORCE

The total operations workforce for the Marandoo mine and associated facilities will be approximately 350 people. The integration of operations at Marandoo with Hamersley's existing operations at the Mount Tom Price mine will result in the workforce being drawn principally from the Mount Tom Price operations. Approximately fifty additional operations jobs will be created as a result of the Marandoo project, and it is expected that the majority of these new jobs will be filled by people living in Tom Price.

All employees working on site on any aspect of either the construction or operation of the mine and associated facilities will be provided with information about the Pilbara environment in general, and about the environmental and heritage significance of the Park in particular.



The Marandoo mine site viewed from the north. The Marandoo ridge can be seen beyond the exploration camp.

The view north across the valley from the exploration camp. Mount Bruce can be seen in the background.

THE MARANDOO ENVIRONMENT

To see the Marandoo project in context, it is necessary to look at those environmental features that influence the way in which the mine and associated facilities at Marandoo will be operated. The main environmental features include physical, biological and socio-economic aspects of the local and regional areas.

In dealing with the socio-economic environment, it is also useful to look at the development of the Pilbara from a historical perspective.

THE PHYSICAL ENVIRONMENT

Climate

The climate at Marandoo is characterised by two significant seasons separated by brief transitional periods. The 'dry' season extends from May to October, during which time there are generally cloudless skies, average maximum monthly temperatures (in degrees Celsius) between the low 20s and the low 30s, gentle to strong south-easterly winds and occasional light rain. The 'wet' season extends from December to March when a low pressure region dominates most of northern Australia. Average maximum monthly temperatures (in degrees Celsius) during these months vary little between the mid and high 30s. Heavy rainfall is usually the result of isolated thunderstorms. Tropical cyclonic storms can also be experienced in the Pilbara and can bring abnormally high rainfall to inland areas, although the force of the winds moderates as they move overland.

Physiography

Marandoo is located within the Hamersley Plateau, the most extensive elevated area in Western Australia. The Hamersley Plateau is considerably eroded and dissected and, as a result, essentially consists of residual plateau and valley elements. The Marandoo airstrip is 730 metres above sea-level, while nearby Mount Bruce, the second highest point in Western Australia, is 1,235 metres above sea-level. Mount Bruce is not enriched in iron and lies outside the Project Area.

Scenic and landscape characteristics

The Pilbara, which includes some of the most rugged natural landscape in Western Australia, is characterised by differing combinations of high plains and plateaux, domed hills, segmented ridges and wide, shallow valleys. The dominant reddish orange colouring of the region is relieved to some extent by the greyish greens of the somewhat sparse vegetation.

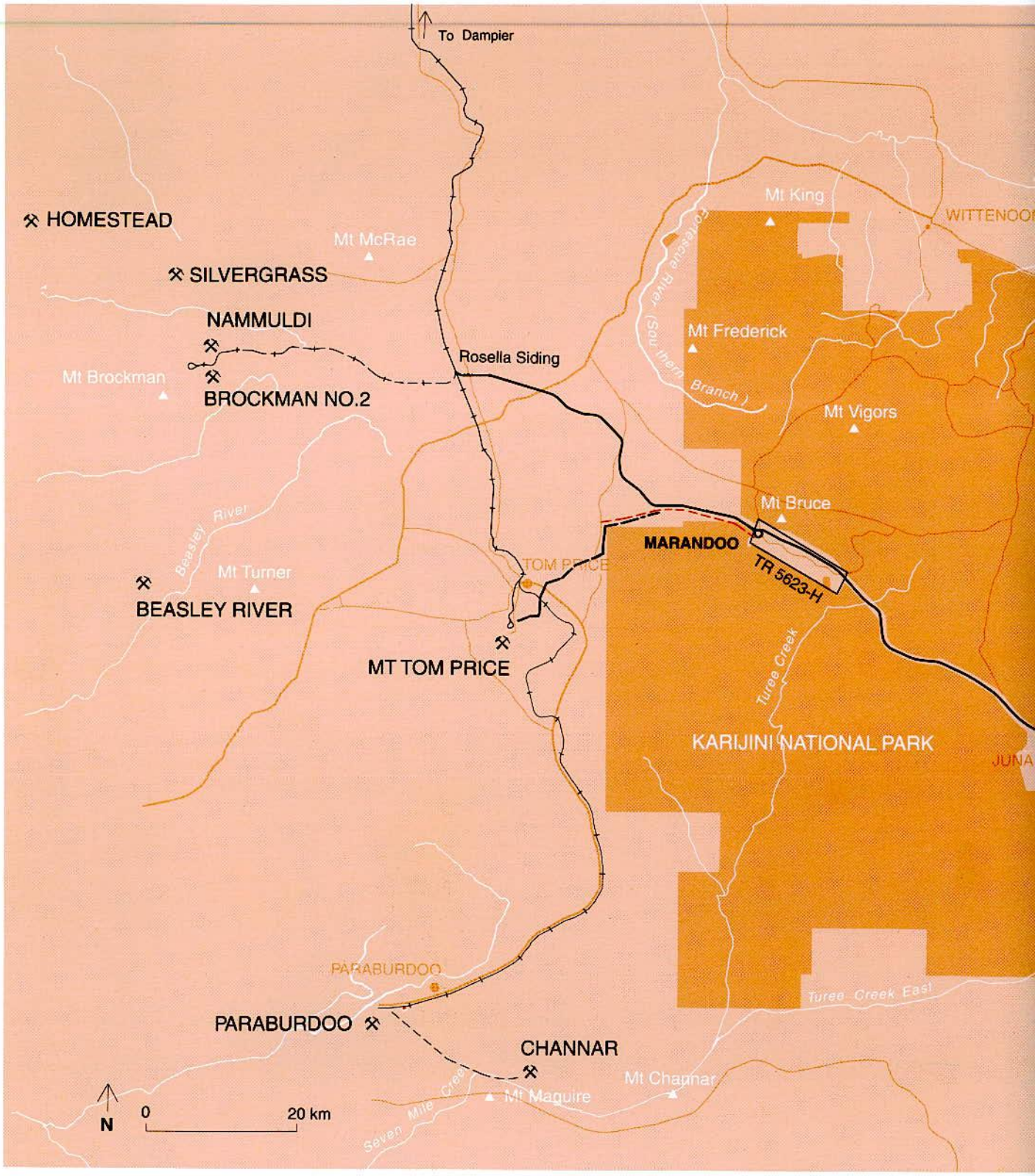
The landscape of the Marandoo area is that of a wide, flat valley dominated to the north by Mount Bruce, which provides sharp contrast to the southern side of the valley where Marandoo is located. Mount Bruce is a free-standing outcrop composed of alternating horizontal bands of varying width. These give it the distinctive dark brown and red layered appearance characteristic of the higher outcrops in the Pilbara.

Hydrology

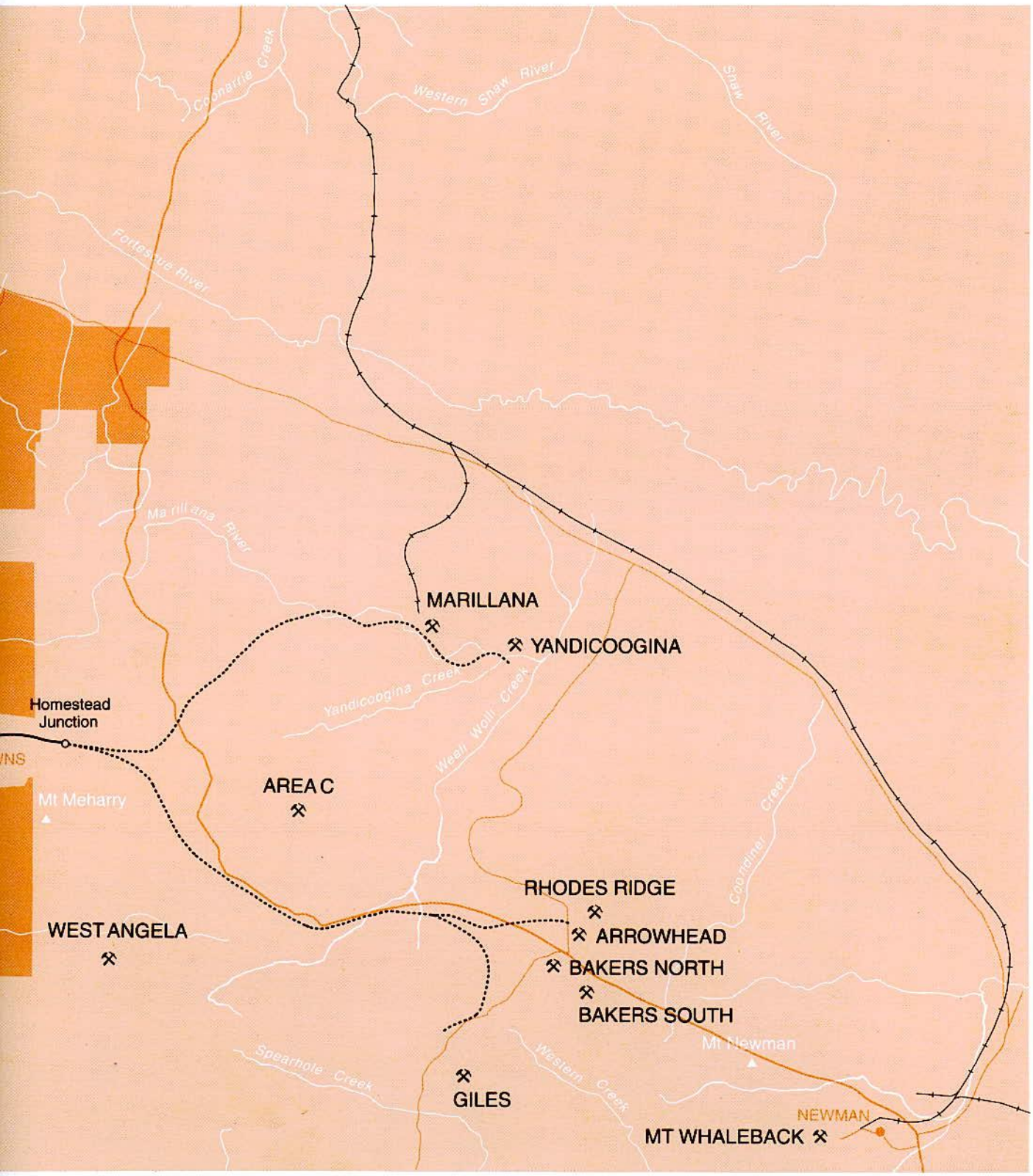
The surface drainage pattern and the groundwater resources both have a direct influence on the design and operation of the Marandoo mine. The operations in the Initial Mining Area will involve mining only ore above the watertable, so it will not be necessary to lower the watertable for mining purposes.

Groundwater resources

Subterranean aquifers exist throughout the dry inland Pilbara, with occasional springs such as those at Millstream. At Marandoo, the valley floor lies 20–40 metres above an aquifer that contains an extensive supply of potable groundwater, which will be used for dust suppression and for personal and industrial needs. This aquifer extends to the west at least as far as the Southern Fortescue borefield, which supplies Tom Price. The Marandoo Tenement forms part of a major divide between catchments: towards the eastern end of the Tenement, groundwater from the Mount Bruce Flats flows south-east towards the Turee Creek catchment (and subsequently into the Ashburton River), while elsewhere groundwater flows broadly west-



Map of the Project Area.


Coonarrie Creek
Western Shaw River
Shaw River
Fortescue River
Marillana River
MARILLANA
YANDICOOGINA
Yandicoogina Creek
Weeli Wolli Creek
Homestead Junction
AREA C
Mt Meharry
RHODES RIDGE
Coppin Creek
WEST ANGELA
ARROWHEAD
BAKERS NORTH
BAKERS SOUTH
Mt Newman
Spearhole Creek
Western Creek
GILES
NEWMAN
MT WHALEBACK

ward towards the Southern Fortescue River catchment.

Surface drainage

There are no significant standing surface waters close to Marandoo, but there is an extensive system of surface drainage lines that carry runoff from heavy rainstorms. There are two 'permanent' springs in the area—Mindi Spring and Bandjima Pool.

THE BIOLOGICAL ENVIRONMENT

Conservation value of the region

The conservation value of the region adjacent to the Project Area is recognised by its inclusion in the Park. The Park contains a representative sample of the Fortescue Botanical District within a range of arid land ecosystems and habitats. The riverine ecosystems associated with the gorges of the northern Hamersley Plateau and the springs of the Turee Creek catchment (located more than 30 kilometres and 25 kilometres from the Marandoo Project Area respectively) support a diverse range of flora and fauna.

As the Hamersley Range area has had only a brief history of European settlement and pastoralism, parts of it remain in relatively undisturbed condition. The geology of the Park is a feature of considerable significance for those with an interest in the investigation of earth's earliest life-forms, as some of the oldest exposed rock formations on the Australian continent are contained within the Park.

Flora and vegetation

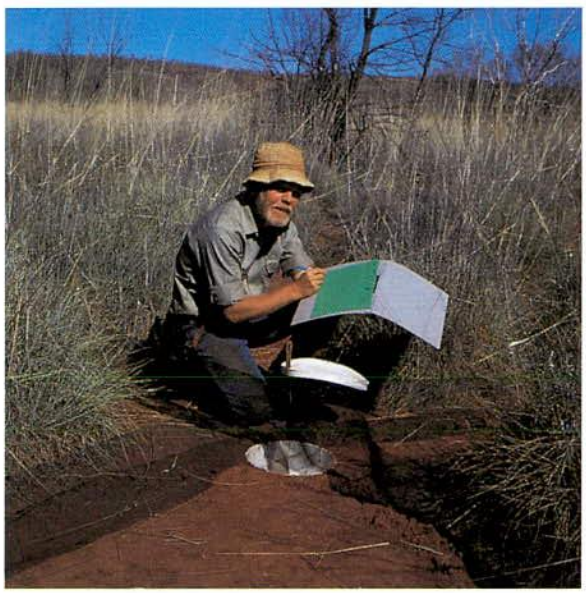
The Project Area lies in the Fortescue Botanical District, within the Eremaean Botanical Province. The flora of the Fortescue Botanical District are somewhat related to those of the neighbouring Kimberley.

In terms of regional species richness, the gorges and low-lying areas within the Park display greater species richness than the uplands of the plateau areas of the Pilbara, such as the area in which the mine will be located.

A comparatively large number of botanical investigations have been undertaken in the Project Area since 1974, to the point where the flora and vegetation of the area are better known than those in any other similarly sized region of the Pilbara.

Comprehensive sampling during 1990 and 1991 was combined with earlier work to develop an extensive species list (comprising 68 families and 462 vascular plant species) and a vegetation map for the entire Project Area. The vegetation mapping defined 37 different plant communities and resulted in the drafting of eleven large-scale maps. This was one of the largest vegetation mapping projects of its kind in Western Australia.

Typical vegetation in the Marandoo valley.



Biological studies have provided valuable information on the Pilbara. A fauna specialist records the results of overnight sampling.

The Project Area is generally dominated by harsh 'porcupine' grasses or spinifex. Other important botanical families in the area include hibiscus, wattle, cassia, pea, mulla mulla, native fuscia and daisy. Mulga is predominant in the deeper alluvial soils of the broad valley floors. Although *Eucalyptus* species are often visually prominent as emergents in the hummock grasslands, it is usually only in the creeks and river beds that they become dominant. The majority of the plant communities defined for the Project Area extend into the Park. Indeed, many of the species found in the Project Area have very wide distributions elsewhere and occur only in a few areas of appropriate habitat within the Project Area.

No declared rare flora species have been recorded to date in the Project Area; however, six species on CALM's priority flora lists occur, or may occur.

Fauna

The fauna investigations for the Marandoo project were designed not only to prepare a comprehensive species list but also to gain an understanding of the relationships of fauna with their habitats and broader ecological processes.

The fauna of the Marandoo Project Area can be categorised as follows:

- birds: 118 species;
- mammals: native—30 species, introduced—9 species;
- amphibians and reptiles: 86 species;
- ants: 10–15 species.

The majority of the bird species have wide ranging distributions. Many are nomads and none of these species is found only in the Pilbara. However, amphibians, reptiles and small mammals, being less mobile, have a substantially higher chance of being found only in the Pilbara. None is known to be restricted only to the Project Area.

All wildlife in Western Australia is protected under the *Wildlife Conservation Act 1950–1979*. The fauna studies for the Project Area recorded the sighting of four species listed as either rare or in need of special protection. These species are as follows:

- birds: peregrine falcon and grey honeyeater
- mammals: pebble-mound mouse
- reptiles: Pilbara olive python.

Burrows thought to have been dug by the bilby have also been recorded. This species is also listed as rare.

Two species of migratory birds that have been recorded in the Project Area are protected by international agreements. These two species—the fork-tailed swift and the rainbow bee-eater—are not expected to be affected by the project because of their sporadic occurrence in the Pilbara.

THE SOCIO-ECONOMIC ENVIRONMENT

Aboriginal heritage

Human presence in the Pilbara dates back many thousands of years, while the geological processes that have given the Pilbara its extensive and valuable iron ore resources date back many hundreds of millions of years. For several thousand years prior to European settlement, the Pilbara was home for approximately 1,000 Aboriginal people, who were organised into about a dozen language groups. Then, as now, it was a harsh environment for human settlement but the Aboriginal lifestyle was well adapted to that environment.

Prior to European settlement, the Marandoo area is considered to have been occupied by the Punjima people. After the 1860s when European settlers introduced pastoral activities to the Pilbara, Aboriginal people undertook much of the work on the pastoral stations. When the pastoral industry declined in the 1950s and 1960s, the inland Aboriginal population fell and many Aboriginal people resettled in towns on the coast, such as Onslow and Roebourne.

Studies undertaken in the Marandoo area in the mid-1970s sought to establish ethnographic information about the previous Aboriginal occupation of the area and to locate any significant sites. This work and subsequent archaeological and anthropological studies provided the first information on local Aboriginal sites, and revealed artefacts and occupation sites both in the open and in rock shelters. In this respect, the area is typical of much of northern Australia. No sites warranting preservation or protection were identified in areas required for the project.

More recently, further investigations and consultations with Aboriginal people were undertaken both by Hamersley and by the State Government.

In February 1992 steps to clarify the legal position of the project were taken. The Western Australian Parliament passed the *Aboriginal Heritage (Marandoo) Act 1992* to ensure that the land required for the project would not be subjected to delay caused by unwarranted legal challenge.

European settlement

European settlement of the Pilbara effectively began in the 1860s with the establishment of the pastoral industry. The town of Roebourne was founded in 1867 and the nearby port of Cossack was developed concurrently. The pastoral industry was based for about a century on sheep, but overstocking and poor pasture management, combined with natural fluctuations in the weather and severe fluctuations in the wool price, led to the collapse of the industry in the late 1960s. Cattle are now the focus of pastoral activity in the Pilbara, which continues to be an important contributor to the regional economy.

In settlement terms, the metamorphosis of the Pilbara occurred as a result of the development of iron ore resources from the mid-1960s onwards. In the decade to 1975, about $1,800 million were invested in mines, railways, ports, power supplies and new towns in the Pilbara. Hamersley alone spent $800 million, including $500 million on industrial and social infrastructure, which included the three new towns of Dampier, Tom Price and Paraburdoo. The State Government shared in the development of the regional centre of Karratha.

The development of the iron ore industry and the associated expansion of community infrastructure in the Pilbara have led to the development of the region's tourism industry. The iron ore mines are one of the most frequently visited features. Together with the outstanding natural beauty of the Pilbara, important economic activities such as mining are providing a basis for further growth of the tourism industry and the gradually increasing economic diversity of the region.

As a result of the iron ore industry, the regional population of the Pilbara has increased by over 1,000 per cent since the early 1960s to about 48,500 in 1986, with Karratha being the largest centre of population. Tom

Price, the nearest town to Marandoo, will be where the workforce for the Marandoo project will be located. The population of Tom Price has grown progressively since the mid-1960s to its current estimated level of 3,800. This level will not change significantly as the Marandoo project will require fewer than fifty new employees, mainly recruited from residents of Tom Price.

The community infrastructure of Tom Price now includes primary and secondary schools, shops, a library, a community centre, a hotel, service stations and medical services. A wide variety of sporting and other recreational activities is available both within the town of Tom Price and regionally. Regional activities include day trips and camping in the Karijini National Park, while the Millstream-Chichester National Park is an oasis midway to the coast. Activities along the coast include fishing, diving and swimming.

The town of Tom Price.

Looking west along the Marandoo ridge to the airstrip and exploration camp in the background.

MANAGEMENT OF THE IMPACTS OF THE PROJECT

The management of the construction and operation of a $500 million project such as Marandoo and its integration into both Hamersley's existing $6 billion infrastructure and the management plans for the surrounding Park are complex tasks involving engineering and environmental issues, and employee relations. The management of the environmental impacts during the construction of the project, the operation of the mine, and the post-mining and decommissioning phase will all be undertaken in accordance with the Environmental Management Plan. This plan has been presented in detail in the ERMP, together with formal commitments on environmental management made by Hamersley.

Hamersley has adopted the environmental philosophy that integration of monitoring and management programmes provides the basis to maximise efficiency and minimise adverse impacts. Monitoring provides information for management and enables it to respond to changes as the project progresses.

The major environmental issues were identified from items addressed in the ERMP. Hamersley's corporate objectives and the management plans for each of these issues are summarised below. In the ERMP, Hamersley makes specific commitments on programmes or actions that will address the potential impacts associated with the Marandoo project.

PROTECTION OF KARIJINI NATIONAL PARK VALUES

The natural and social values associated with the Park will be protected against impacts caused by the Marandoo project. Hamersley has an agreement with CALM for the management of potential project impacts on the Park. The agreement covers relevant aspects of issues such as the presence of construction employees, access roads, fire and safety, flora protection, fauna protection and management, final landform of the mine site and public awareness.

ABORIGINAL SITES

Hamersley aims to increase awareness among its workforce of Aboriginal cultural heritage and the legal obligations relating to this issue. Hamersley will comply with the *Aboriginal Heritage Act 1972–1980*, where it applies. Included in the induction course for construction and mine workers will be information about relevant Aboriginal traditions and culture to increase the level of informed awareness of such issues. Hamersley will continue to assist Aboriginal people through training and employment-related programmes.

TOM PRICE COMMUNITY

Up to eight hundred workers will be involved in the 27-month construction phase of the Marandoo project. Periodic visits by these workers may produce some impacts upon the Tom Price community. However, negative impacts will be minimal, as was the case at Paraburdoo during the development of the Channar project, which was much closer to the town. In particular, construction workers will work a six-day week and, as a consequence, their contact with the Tom Price community will be limited. A full range of recreational activities will be provided at the construction camp and the need for private vehicles reduced as far as possible.

During the operations phase, fewer than fifty new people will be employed and it is unlikely that there will be any significant change in the population of Tom Price. Given that the town is already well equipped and serviced for a large population, there should be no negative population impacts during the operations phase of the project. Indeed, an extension of viable operations for the Mount Tom Price mine beyond this decade will have a strong positive effect on community life and outlook.

TOPOGRAPHY AND LANDFORM

The very nature of open-cut mining means that change to the land surface of the mining area during the operations phase is inevitable. However, it is important to confine the area of disturbance and to minimise the extent and nature of alteration to the existing topography.

Only the minimum area required for construction activities will be cleared. Engineering design will utilise existing topography and use cut-and-fill techniques to reduce the amount of fill material required from borrow pits. Borrow pits will be selected and operated with a view to minimising erosion, damage to the surrounding vegetation and visual impact. Each pit will be rehabilitated when sufficient fill material has been obtained.

Once construction is completed, areas no longer required will be contoured and slopes stabilised and vegetated. Contractors will not be released before landform and surface preparation have been completed to Hamersley's satisfaction.

In the early years of mine operation, overburden will be placed in low valleys along the southern edge of the Tenement. The skyline as viewed from the north should exhibit little discernible change. After the first four or five years most of the overburden will be replaced in mined-out areas, thus providing flexibility in the planning of final landforms within the pit. These planning features will result in appropriate surface profiles for creation of landscape, vegetation and habitat values that are consistent with and enhance the recreation and conservation values of the adjacent Park.

The presence of the Marandoo mine will not be obvious to Park visitors unless they choose to leave the road and seek a vantage point near Mount Bruce.

DRAINAGE PATTERNS

Construction and operation of the mine have the potential to affect existing surface drainage patterns and thereby cause erosion and impacts to flora and fauna. Hamersley's objective is to maintain, wherever practical, the existing drainage patterns to avoid such impacts. For example, it is planned to intercept runoff from upper slopes adjacent to the mine site and borrow pits, and divert it around the pit boundary to re-enter the natural drainage system away from the development areas. Where runoff to pits is unavoidable and water collects, it will be returned by pit-floor pumps and sediment traps to natural drainage systems downslope from the pit.

Drainage for the railway and service road will be designed for conditions expected to occur in the inland Pilbara. A drainage structure will be designed for each specific watercourse.

Appropriately sized and positioned culverts, together with a system of floodways and diversion channels, will be provided to maintain the principal drainage patterns. These will ensure that, in the event of major rainfall events, vegetation upslope of the railway and the service road does not become inundated with water for prolonged periods and cause detrimental impacts to existing habitats. Similarly, the design will ensure that waterflow downslope from culverts does not cause erosion. Where necessary, waterflow will be redistributed to avoid shadowing of dependent vegetation communities.

GROUNDWATER RESOURCES

The principal impact of the project on groundwater will be caused by extraction of water for mining processes, dust control and personal use. These impacts will be local in nature as there are no downstream users for about 20 kilometres and the estimated use of 5,000 cubic metres per day is small in comparison with the indicated resources. Drawdown is not expected to affect the Tom Price water supply or the two springs some 10 kilometres and 18 kilometres away.

Further hydrogeological studies are planned, and will be designed to provide more detailed information about the aquifer system surrounding the borefield. The principal aim of the studies will be to verify the calculations of potential drawdown developed using computer models.

As mining of the Initial Mining Area will not proceed below the watertable, no local lowering of the watertable will be necessary for mining purposes.

To prevent groundwater contamination, the following measures will be implemented:

- Toxic wastes will be removed from the mine site.
- On-site solid waste disposal will be minimised.
- Process and washdown water will be collected and processed.
- Sewage treatment plants will be located away from the borefields and will comply with the requirements of the Health Department.
- Emergency procedures will be established for handling accidents involving toxic substances.

FLORA AND HABITAT

Extensive sampling and analysis of flora and vegetation since 1974 have provided Hamersley with a good understanding of the geographical distribution of flora on CALM's priority flora lists, and of the communities and habitats considered to be sensitive and important. This information is essential as it will enable detailed design of the mine, processing plant and infrastructure to minimise impacts.

The potential impacts of the Marandoo project on flora and habitats include clearing of vegetation for construction purposes; alteration of drainage patterns; reduction in watertable levels; introduction of weeds, diseases and exotic species; changes to existing fire regimes; and the effects of dust on vegetation.

The management of impacts on drainage patterns has already been discussed. Hamersley intends to minimise impacts in sensitive areas when the detailed engineering design phase for the transport corridors is reached. Detailed vegetation mapping has already indicated areas of flora and habitat sensitivity, for example, areas of broad drainage or along major flow-lines and creeks. Advice will be sought from Hamersley's environmental consultants when final engineering alignments are determined for infrastructure in the corridors. This will ensure that roads, the railway and the powerline have minimal impact on important plants and habitats.

In areas where the removal of particular communities is imperative, such as in locations that must be mined, the advice of CALM will be sought prior to determining the appropriate action. Where important species are involved, it may be necessary to study their distribution or obtain information about their propagation and survival.

Vegetation of particular interest in relation to the Marandoo borefield includes an extensive coolabah woodland (some 10 kilometres from the mine site) and stands of mulga, particularly along the valley floor between the mine site and Mount Bruce. Computer model simulations suggest that abstraction from the borefield aquifer could reduce the watertable near the woodland by between 0 and 5 metres (the latter based on the unlikely assumption of zero recharge from rainfall for ten years). Simulations also suggest that the groundwater level beneath the mulga near the mine site could be lowered by 12–16 metres over a ten-year period.

The groundwater level beneath this vegetation is normally 20–40 metres below the surface. Although not definitive, evidence suggests that it is unlikely that either mulga or coolabah has roots to a depth of 20 metres. They are therefore likely to be reliant on stored moisture rather than on the underlying groundwater for survival over long periods.

Because it seems unlikely that the small to medium-sized trees (mulga and various eucalypts) will be strongly dependent on groundwater, the abstractions are unlikely to have a significant effect.

The Southern Fortescue borefield, located about 20 kilometres downstream from Marandoo, provides a useful field trial for lowering groundwater levels below an established woodland. Since the borefield's establishment in 1972 to supply water to the town of Tom Price, water levels originally in the range of 20–40 metres below ground have been drawn down by 3–25 metres. In areas that have not been heavily grazed, regeneration of mulga has been observed. This mulga has tolerated falling groundwater levels similar to those predicted for the immediate Marandoo borefield area.

FAUNA

The potential impacts of the Marandoo project on the existing fauna of the area include loss of habitats, partitioning of habitats by the establishment of inhibiting structures, and impacts associated with the workforce.

Contractors and their workforces will be made aware through the conditions of their contracts of Hamersley's objective of minimising disturbance to habitats. Hamersley will oversee construction contractors to ensure that clearing limits are observed, and areas to be cleared for a short duration will be rehabilitated as soon as practical after use.

Partitioning of habitats will be avoided where practical; for example, roads will be located to minimise impacts on vegetation communities identified as being of special importance. In addition, the drainage design will also assist small animals to cross roads and the railway line.

Education of the workforce will include the distribution of an employee's handbook, which will include a statement of rules for the protection of fauna. The objective will be to ensure that the workforce causes minimal accidental or intentional impacts on fauna. These rules will include the prohibition of:

- the possession of any firearms on site in the Project Area and the transport corridors by project personnel;
- off-road use of recreational vehicles by project personnel in the Project Area;
- keeping of pets, particularly cats and dogs, at Marandoo, or at any construction camp;
- unnecessary removal of habitat, and capture or disturbance of fauna.

The employee induction procedure will include a section on environmental awareness and will be supplemented with an employee's handbook and other visual aids.

Compliance with these management measures will be required as a condition of employment, and will be monitored by supervisors and the use of security surveillance.

DUST

Activities with the potential to increase ambient dust will include:

- construction;
- mining;
- processing (e.g. crushing, screening, stockpiling and load-outs);
- transport (e.g. use of unsealed roads);
- wind erosion from the mine pit and waste dumps.

The likely impacts of the above activities will be confined to the health and comfort of the workforce, although dust may also affect the biological environment.

Management of dust generation will broadly follow the proven procedures adopted at existing Hamersley mines. In most cases, the Channar project provides the most relevant model because it is the newest mine with the most up-to-date dust management programme.

Dust levels from construction and operations activities will be suppressed by regular application of water to areas that have the potential to be a source of dust. Water tankers will apply water to unsealed roads, haul roads and construction areas. In the processing plant area, water will be introduced into the ore stream at appropriate points. All crushing equipment and screens will be fitted with appropriate dust control and collection equipment.

The permanent access road from Tom Price to Marandoo and frequently used roads to the processing plant area will be sealed to prevent generation of dust. Access to Marandoo from the east will be limited to the railway service road. Use of this unsealed service road will be restricted to maintenance and inspection vehicles to reduce vehicle-related dust emissions.

A dust and fibre monitoring programme will be established in accordance with the requirements of the Department of Mines.

The health and extent of flora and vegetation communities in areas adjacent to recognised potential dust sources will be regularly monitored as part of Hamersley's ongoing vegetation studies.

NOISE

Sources of potential noise will include:

- blasting
- mining
- ore processing
- transport of ore.

Blasting will be infrequent and intermittent, and will not normally occur more than once a day. On average, there will be no more than two loaded trains leaving Marandoo each day.

Surveys will be undertaken of workplaces to determine whether employees are likely to be exposed to unacceptable noise levels. Monitoring of occupational noise levels will be in accordance with the *Mines Regulation Act Regulations 1976*.

Noise will be managed to ensure that the daily level of noise to which employees are exposed is below 90 decibels (A-weighted) over an eight-hour period.

A rock outcrop on the northern slopes of the Marandoo ridge. Low shrubs, scattered eucalypts and mulga over spinifex are typical of this landform.

END USE OF THE MINE

The planning and implementation of mining activities at Marandoo must take into account the need for an appropriate end use of the mine site once mining activities have been completed. The railway system will continue for some time after the closure of the Marandoo mine, and its end use will be negotiated at the time of decommissioning.

The end-use planning of the Tenement has the ultimate objective of possible affiliation with the Park. Hamersley is committed to consultation with CALM about the end use of the mine area once studies relating to mine planning and local hydrogeology have been completed.

At this stage in the preliminary planning, sufficient information is available to indicate that:

- sufficient out-of-pit dump area is available for early placement of overburden below the ridge line, without the need for the high dumps that are characteristic of larger mines;
- sufficient in-pit dumping capacity will be available after the fifth year of mining to substantially accommodate overburden from subsequent mining;
- some flexibility exists to schedule dumping to conform to a final landform plan;
- permanent ponds can be provided in the pit floor if desired or can be avoided if doubt exists about water quality or ecological impacts.

Continuing studies will provide information that will be used to plan the details of these concepts after consultation with CALM.

BEYOND MARANDOO

The Marandoo project is the first step by Hamersley towards developing new mines to the east of its present operations. Hamersley has already begun the process of strategic planning for these mines to identify their individual potential to contribute to a marketable blend of iron ore in the long term. An important part of this planning involves the development of a regional environmental data base to facilitate ecologically sound planning of the new mines. This approach to integrated regional environmental studies will provide new and better information about the ecology of the Pilbara, an area that is, on the whole, not well researched at present. This information will also be used by Hamersley to continually refine its environmental management programmes at all its operations.

FURTHER INFORMATION

Further information about the Marandoo project can be obtained by writing to:

The Marandoo project
Hamersley Iron Pty. Limited
GPO Box A42
Perth, Western Australia 6001

or contacting:

Telephone: (008) 802 399
Facsimile: (008) 805 974

NOTES

THE BENEFITS OF THE MARANDOO PROJECT

Development of the Marandoo iron ore deposit will result in substantial benefits at the local, State and national levels:

- The Marandoo project must be considered in the context of both the mine and the railway, which are the key to the next generation of Hamersley's iron ore projects in the Central Pilbara. These projects will ensure the continuity and viability of the present Hamersley enterprise. Iron ore producers such as Hamersley must be assured of access to high-quality ore resources for decades in order to obtain firm long-term markets overseas.

- The Marandoo project will provide job security for residents of Tom Price, Paraburdoo, Dampier and Karratha by enabling the development of new mines in the Central Pilbara and extending the life of the vitally important Mount Tom Price mine.

- The Marandoo project will continue the economic use of the substantial infrastructure—towns, railways, port facilities and other elements in the Pilbara—in which Hamersley has invested.

- The Marandoo project will provide employment for an on-site construction workforce of up to 800, plus continued employment for 350 people during the operations phase.

- The Marandoo project will result in 900 person-years of employment during construction and about $52 million in wages.

- The flow-on effects on the Western Australian economy are estimated to result in some 3,600 person-years for labour, $500 million of output and $90 million of income.

- Of the total mine expenditure of $500 million, about $370 million will be spent in Western Australia.

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