Marandoo Iron Ore Mine and Central Pilbara Railway

Hamersley Iron Pty Limited

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
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THE PURPOSE OF THIS REPORT

This report contains the Environmental Protection Authority's environmental assessment and recommendations to the Minister for the Environment on the environmental acceptability of the proposal to.

Immediately following the release of this report there is a 14-day period when anyone may appeal to the Minister against the Environmental Protection Authority's recommendations.

After the appeal period, and determination of any appeals, the Minister consults with the other relevant ministers and agencies and then issues his decision about whether the proposal may or may not proceed. The Minister also announces the legally binding environmental conditions which might apply to any approval.

APPEALS

If you disagree with any of the assessment report recommendations you may appeal in writing to the Minister for the Environment outlining the environmental reasons for your concern and enclosing the appeal fee of $10.

It is important that you clearly indicate the part of the report you disagree with and the reasons for your concern so that the grounds of your appeal can be properly considered by the Minister for the Environment.

ADDRESS

Hon Minister for the Environment
18th Floor, Allendale Square
77 St George's Terrace
PERTH WA 6000

CLOSING DATE

Your appeal (with the $10 fee) must reach the Minister's office no later than 5.00 p.m. on the 4 September 1992.

Contents

Figures

Tables

Appendices

Summary and Recommendations

The Environmental Protection Authority has assessed a proposal by Hamersley Iron Pty Limited (Hamersley) for an iron ore mining operation at Marandoo, 35 kilometres east-north-east of the town of Tom Price, in an enclave within Karijini National Park. Hamersley also proposes to build a railway line from the existing Paraburdoo-Dampier railway line, to service Marandoo. The rail line would then continue past Marandoo to connect with proposed future mines in the Central Pilbara. The railway line to the east of Marandoo is termed the Central Pilbara railway.

The Marandoo tenement and the corridor in which the railway line would be built were excised from the Karijini National Park by State Parliament to facilitate development of Marandoo. This followed the release of the Government's "Resolution of Conflict" policy on mining and exploration in the conservation estate of Western Australia.

When assessing proposals under the Environmental Protection Act 1986, the Authority gives consideration to both the technical merits of the proponent's environmental management commitments and also to any relevant environmental policies or principles. The Authority's advice as to the environmental acceptability of any proposal is therefore based on both the technical aspects of the proposal and its policy context.

In the case of the Marandoo mine and Central Pilbara railway the Authority is of the view that matters of policy have already been determined by virtue of Parliament's excision of the tenement and corridor. The Authority has therefore confined its assessment to the technical considerations only: that is, can all of the impacts associated with the mine and railway be satisfactorily managed so as to ensure that the environmental values of the region, particularly those of the Karijini National Park, are protected?

The proposal was referred to the Authority in 1991 and assessed at the level of Environmental Review and Management Programme (ERMP) owing to the location of the proposal in an enclave within a national park and the size and nature of the proposal.

The proposal attracted considerable interest with 610 written submissions received by the Authority during the 10 week public review phase.

The Proposal

Hamersley is proposing to construct and operate a 12 million tonne per year iron ore mining operation at Marandoo commencing in 1994. Mining would be carried out within a defined area of approximately 4 km by 2 km with all mining confined to above the water table.

Conventional open cut methods would be used, including drilling and blasting of the ore followed by loading using hydraulic excavators onto haul trucks.

The ore would be processed at Marandoo, employing crushing and screening to achieve the desired ore product. The ore would then be stockpiled prior to loading onto rail wagons for transport to Dampier.

Marandoo ore would be blended at Dampier with ore from the other Hamersley operations to achieve the strict chemical and physical parameters required by the market.

Overburden from the mining operation would initially be disposed of in shallow gullies to the south and west of the Initial Mining Area (IMA). After 4 to 5 years of mining there would be sufficient area available within the pit to dump overburden.

Water for dust suppression and domestic use would be pumped from an extensive groundwater aquifer. The proposed borefield design is a linear arrangement of five to eight production bores over a length of 4.5 to 7 km. The borefield would be located along the railway access road to the north of the mine pit.

The Central Pilbara railway line is proposed to extend from Marandoo to Homestead Junction, just to the east of the present Park boundary. The railway would provide a transport link for the proposed future Hamersley operations in the Central Pilbara which the proponent plans to develop over the next decade and beyond.

Environmental Issues

The Environmental Protection Authority is concerned at the quality of the ERMP provided by the proponent. For important aspects of the proposal, notably the Central Pilbara railway, there was insufficient detail provided in the document to allow the Authority, or the community, to be able to assess the adequacy of proposed management of the potential environmental impacts of the development. This resulted in the Authority requiring further information from the proponent following the public review phase. While further details are often required at this time, the Authority's requirements were greater than usual in this case, and have led to a recommendation that an environmental management programme be prepared for the Central Pilbara railway for public review. In addition, the Authority's recommendations are of necessity wide ranging to address issues not covered in the ERMP.

Karijini National Park is part of the conservation estate of Western Australia. The primary land use of the National Park is for conservation. Tourism and recreation, insofar as they are compatible with conservation, are additional uses. The Park is host to a number of rare and endangered species such as the Pebble-mound Mouse and Grey Honeyeater as well as a number of priority flora species.

Although the Marandoo tenement, and that part of the transport corridor for the railway line that is surrounded by the Park, have both been excised from the Karijini National Park, they share extensive common boundaries with the Park and will eventually be returned to the Park.

There is no doubt that the conservation values of the affected areas have the potential to be adversely impacted by the Marandoo mining development and the Central Pilbara railway. The responsibility for the proponent and regulatory authorities is to ensure that impacts are properly managed. As well, under the Government's 'Resolution of Conflict' policy, additions will be made to the National Park to offset the excisions for Marandoo and the infrastructure corridor.

The Authority identified, from its own assessment and public submissions, the following key environmental issues associated with the Marandoo proposal:

- protection of conservation values of Karijini National Park;
- impacts associated with the eastern railway line;
- impacts of drainage;
- impacts of groundwater abstraction;
- impacts of construction, including both the construction activity and those associated with the construction workforce;
- impacts of weeds;
- rehabilitation of project area;
- impacts of fire;
- visual impacts of facilities; and
- impacts of waste disposal.

As a consequence of this assessment of the proposal, the Authority considers that all of the environmental issues associated with the Marandoo mining development and the Central Pilbara railway are able to be managed adequately, although some further details are required on how management will be effected.

Recommendation 1

The Environmental Protection Authority considers that the environmental issues arising from the proposal have been addressed and are manageable, either by the changes to the proposal made by the proponent during the assessment, by the environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations in this report.

Accordingly, the Environmental Protection Authority recommends that the project could be adequately managed and could proceed subject to the Environmental Protection Authority's recommendations in this report, and the proponent's commitments to environmental management listed in Appendix 1.

The Department of State Development has predicted that the Central Pilbara region is likely to be the focus for future iron ore mining development in the Pilbara in the next decade. If this is the case there will be an increased potential for cumulative environmental impacts on the biological resources of the region. Further information will be required to allow assessment of such impacts prior to development. Those iron ore companies involved should begin this data collection without delay.

The Environmental Protection Authority is of the view that there is a potential for cumulative environmental impacts on the biological resources of the region. Therefore, prior to any further iron ore mining development in the Central Pilbara region, an integrated biological survey should be carried out to determine the distribution of significant species of flora and fauna and geographically restricted vegetation communities. Data collection should begin without delay. The results of such a survey would allow future mining proposals to be more easily assessed.

There are a number of other iron ore mining tenements within the Karijini National Park which are the subject of State Agreement Acts. Under the Government policy on mining and exploration in the conservation estate of Western Australia, these tenements are to be evaluated and rationalised. Those tenements that, after evaluation, are found to be unsuitable for development will be relinquished by the holder. Tenements with mineable resources would be excised from the National Park to facilitate development of the iron ore resource. This may mean further mines within the boundaries of the park.

The Environmental Protection Authority is concerned with the potential cumulative environmental impacts associated with developing further mining proposals in Karijini National Park during the life of the Marandoo iron ore mining operation. The potential cumulative impacts include loss of wilderness values, groundwater drawdown, habitat destruction and impacts associated with construction camps. Therefore the Authority considers that should further iron ore mining proposals in the Park be put to Government they should not proceed until Marandoo has been decommissioned.

There are a range of significant flora and fauna found on the Marandoo tenement and railway corridor. Some of these are rare whilst others are geographically restricted or poorly known. The Authority recognises the difficulties associated with collecting information on many of these species, particularly flora, but considers they are of sufficient importance to require detailed evaluation.

Recommendation 2

Rare, priority and geographically restricted species of flora and fauna in the project area should be treated with special consideration. Accordingly, the Environmental Protection Authority recommends that the proponent provide details of the results of all flora and fauna surveys to be carried out, on all areas likely to be disturbed through construction and operational activity, to the Environmental Protection Authority and the National Park managers, prior to approval for those areas to be disturbed. Should it be deemed necessary specific action may be required to manage impacts so as to protect particular species.

The projected peak construction workforce for the Marandoo development would be 800 persons at any one time. The activities and potential impacts associated with the workforce would require supervision from Park staff. In order to manage the potential impacts from construction activity and workforce recreation on the National Park the proponent should take responsibility for workforce supervision.

Recommendation 3

The Environmental Protection Authority recommends that the proponent should take responsibility for the supervision of construction workforce impacts on the Karijini National Park and to assist the National Park managers in reducing the impacts on National Park values from such activities.

The Central Pilbara railway from Marandoo to Homestead Junction on the eastern side of the Park is a significant part of the proposed development. It stretches for a distance of approximately 60 kilometres, most of which has common boundaries with the Park.

A number of submissions commented upon the lack of detail provided on alternative routes for the rail route from the proposed Central Pilbara area to the port at Dampier. The Environmental Protection Authority is concerned that details of management of potential impacts was not adequately addressed in the ERMP or the proponent's response to public submissions. It is understood that the proponent has a preferred route but this should not mean that alternative routes should not be made explicit and the costs and benefits discussed.

The level of information provided in the ERMP for many aspects of the Central Pilbara railway was insufficient to allow the Authority and the public to make an assessment of the adequacy of the proposed management of the potential environmental impacts associated with this aspect of the development at this time. It is recognised that the proponent's response to public submissions provides new information on the alignment of the railway and drainage design, but does not specify the environmental management for this alignment or method of drainage management. This makes it difficult to assess the management of potential environmental impacts of the railway line in its conceptual form. Consequently, the Authority considers that while sufficient information is available to support the conclusion that the environmental impacts from the Central Pilbara railway should be manageable, further specific information on **how** the environmental impacts are to be managed for this part of the project is required to be provided to enable Ministerial clearance, upon advice from the Environmental Protection Authority following public review.

Recommendation 4

The proponent should construct and operate the Central Pilbara railway (from Marandoo to Homestead Junction) so as to minimise environmental impacts.

The Environmental Protection Authority recommends that prior to construction of the Central Pilbara Railway the proponent prepare, and subsequently implement, a separate and specific environmental management programme for the Central Pilbara railway line, in consultation with the Environmental Protection Authority, and the National Park managers to meet the requirements of the Minister for the Environment upon advice from the Environmental Protection Authority. The programme would be made available for public review by the Environmental Protection Authority.

Indicative guidelines are provided in Appendix 5 outlining the type of information required for the environmental management plan for the Central Pilbara railway. These will be finalised after appropriate consultation.

The development of the mine and railway lines will result in the modification to surface water flows in the area upon which important vegetation communities and the associated animal populations depend. It is important that careful design and monitoring is provided to minimise this impact.

Recommendation 5

The important vegetation communities in the area, in particular the coolibah and mulga woodlands, should be protected from drainage impacts associated with the development and operation of the project. Accordingly, the Environmental Protection Authority recommends that prior to construction the proponent prepare and subsequently implement a drainage management plan, in consultation with the Environmental Protection Authority and the National Park managers. The plan should include a monitoring component to determine its effectiveness and should comply with Recommendation 14.

Hamersley proposes to use groundwater pumped from a nearby aquifer for dust suppression at the mine and domestic water supply. Woodlands of coolibah and coolibah-mulga occur in the valley adjacent to the mine. The woodlands are the only examples remaining in an undamaged condition in the region and they need to be protected from any impact associated with drawdown of the aquifer.

Recommendation 6

There should be no unacceptable impact on the conservation values of the Karijini National Park from groundwater abstraction associated with the project, particularly the coolibah woodlands, to the east of Mt Bruce, where groundwater drawdown should not be detectable. Accordingly, the Environmental Protection Authority recommends that prior to commissioning of the Marandoo borefield, the proponent prepare and subsequently implement a groundwater monitoring programme, to comply with recommendation 14, in consultation with the Environmental Protection Authority, the National Park managers and the Water Authority of Western Australia.

The current proposal for mining of the Marandoo deposit is confined to the area above the water table, however, it is recognised that there are substantial ore reserves below the water table that may be suitable for mining at a later date. Any future proposal to mine below the water table would require environmental impact assessment.

The Environmental Protection Authority considers that any proposal to mine below the water table would require referral to the Authority for environmental impact assessment.

Weed invasion can have a significant effect on the health of native vegetation communities. In areas of high conservation value such as national parks it is important to control the spread of weeds. There are a number of weed species identified at Marandoo with the potential for significant spread, during the construction and operation of the project, if not carefully controlled.

Recommendation 7

The spread of weeds resulting from the development and operation of the project should be minimised. Accordingly, the Environmental Protection Authority recommends that prior to the commencement of construction, the proponent prepare and subsequently implement a weeds management plan, in consultation with the National Park managers and the Agricultural Protection Board. The plan should prescribe hygiene, monitoring and control measures. The plan should include a monitoring component to determine its effectiveness and comply with Recommendation 14.

Fire can also significantly alter the composition of vegetation communities. With the nature of the construction work, in particular, there is the potential for more fires and consequent major damage to mulga communities.

Recommendation 8

The development and operation of the project should not lead to a significantly increased fire risk within the Karijini National Park. Accordingly, the Environmental Protection Authority recommends that prior to the commencement of construction, the proponent develop a fire management plan in consultation with the National Park managers, for the range of activities to be undertaken during construction and operation. The plan should integrate fire management with the overall fire management requirements of the Karijini National Park. The plan should include a monitoring component to determine its effectiveness and comply with Recommendation 14.

It is the understanding of the Environmental Protection Authority that the Marandoo tenement be returned to the Park at the end of mine life. It is, therefore, important that the rehabilitation of the site be in accord with this objective. The use of local native seed for revegetation at the site is an important part of a successful programme.

Recommendation 9

Rehabilitation of the project area should achieve a standard consistent with the values for return to the Karijini National Park. Accordingly, the Environmental Protection Authority recommends that prior to the commencement of construction, the proponent prepare and subsequently implement rolling rehabilitation plans, in consultation with the National Park managers, the Environmental Protection Authority and the Department of Minerals and Energy. The plan should include a monitoring component to determine its effectiveness and comply with Recommendation 14.

Recommendation 10

The Environmental Protection Authority recommends that all plant material used for rehabilitation should be sourced locally. The National Park managers should determine the acceptability of plant material used for rehabilitation. Sources of seed and species proposed for planting during rehabilitation should be included in the rehabilitation plan.

The Marandoo mine site and the associated railway lines will be clearly visible from a number of high points within the Park, including Mt Bruce, which overlooks the minesite and is the most prominent peak within the Park, . It is important that the visual impact of the development is considered when planning for the location and scale of facilities. Therefore, the Authority makes the following recommendation.

Recommendation 11

The visual impact of the proposed development should be minimised. Accordingly, the Environmental Protection Authority recommends that strategies to manage visual impact of the development during construction and operation need to be developed. Therefore, prior to the commencement of construction, the proponent should prepare and subsequently implement, in consultation with the National Park managers, a plan to mitigate the visual impact of the development to comply with Recommendation 14.

Solid waste from the construction camps would be disposed of in landfill sites. In order to prevent scavenging by animals and contamination of groundwater these sites need to be properly managed.

Recommendation 12

Waste material from the project should be contained to prevent scavenging by animals and should not pollute groundwater. Accordingly, the Environmental Protection Authority recommends that prior to the commencement of construction the proponent prepare and subsequently implement, in consultation with the National Park managers, the Health Department of Western Australia and the Water Authority of Western Australia, a plan to manage the waste disposal sites to prevent scavenging by animals including birds, and contamination of groundwater. The plan should include a monitoring component to determine its effectiveness and comply with Recommendation 14.

The Environmental Protection Authority noted submissions from organisations and individuals on archaeological and ethnographic matters and that the loss of culturally important sites and other environmental impacts could have a social impact on the contemporary Aboriginal community, its culture, leadership and cohesion.

The Environmental Protection Authority acknowledges that many submissions raised social issues related to the impact of the proposal, and the possible involvement of Aboriginal and other communities in the social benefits stemming from the proposal. The need to monitor and report on the social impacts and the proponent's commitments was raised often and the Authority acknowledges that this is an important requirement to fulfil.

Recommendation 13

The Environmental Protection Authority recommends that the proponent should establish a consultative mechanism, involving the local authorities, the community and the National Park managers, to monitor the impact of the project on local communities, as contained in the proponent's commitments, to comply with Recommendation 14.

The Authority considers that the environmental issues mentioned above should be drawn together and managed in an overall environmental management programme.

Hamersley is required, as part of its reporting requirements under its State Agreement Act, to provide proposals for environmental management and monitoring to the Minister for State Development for approval. It would be appropriate, if possible, to produce a joint document(s) to meet the requirements of the Minister for the Environment and the Minister for State Development.

Recommendation 14

The Environmental Protection Authority recommends that the proponent prepares an Environmental Management Programme, which draws together the proponent's commitments and the previous recommendations in this report to meet the requirements of the Minister for the Environment on the advice of the Environmental Protection Authority and the National Park managers.

The programme should contain, but not necessarily be limited to, the following elements:

- **protection of significant flora and fauna (Recommendation 2);**
- **drainage management (Recommendation 5);**
- **management and monitoring of the impact of groundwater drawdown (Recommendation 6);**
- **management of weeds (Recommendation 7);**
- **management of fire (Recommendation 8);**
- **rehabilitation of the project area (Recommendations 9 and 10);**
- **management of visual impact (Recommendation 11);**
- **waste management and monitoring (Recommendation 12); and.**
- **monitoring of impacts on the community (Recommendation 13).**

The Environmental Management Programme should be prepared in stages. The first stage, prior to construction, should address the management of those parts of the environment requiring protection during construction, and should be approved prior to the commencement of site works to meet the requirements of the Minister for the Environment.

The second stage, prior to commissioning, should address the management of the other issues, and should be approved prior to commissioning of the operation to meet the requirements of the Minister for the Environment.

Subsequent stages should be prepared and submitted as necessary to meet the requirements of the Minister for the Environment.

The implementation of the approved Environmental Management Programme and on-going investigation and reporting should meet the requirements of the

Environmental Protection Authority in consultation with the National Park managers.

In the event that monitoring shows any unacceptable impacts, the proponent should prepare and subsequently implement a plan to mitigate these impacts to meet the requirements of the Environmental Protection Authority in consultation with the National Park managers.

1. Introduction

Hamersley Iron Pty Limited (Hamersley) proposes to develop an iron ore mining operation at Marandoo, 35 kilometres east-north-east of the town of Tom Price, in an enclave within the Karijini National Park (formerly Hamersley Range National Park) (Figures 1 and 2). Hamersley also proposes to construct a railway line connecting the Marandoo site to the existing Paraburdoo-Dampier railway line and to continue with the rail line to the east of Marandoo to connect with future mines in the Central Pilbara. The railway line to the east of Marandoo is termed the Central Pilbara railway.

From research carried out by the Department of State Development (DSD 1992), documented in Appendix 3, it appears that the focus of iron ore mining development in the next decade will be in the Central Pilbara. The Central Pilbara is regarded as the region between the Karijini National Park and Newman.

The Marandoo proposal was referred to the Environmental Protection Authority in March 1991, which subsequently determined that the level of assessment would be Environmental Review and Management Programme (ERMP). This level of assessment was set as a result of a number of factors, including the location of the proposal in an enclave within Karijini National Park, the size and extent of the development and the undisturbed nature of much of the area which would be impacted by the development.

The mining proposal at Marandoo is the first mining proposal to be assessed by the Environmental Protection Authority following the release of the State Government's "Resolution of Conflict" policy for mining and exploration in the conservation estate of Western Australia.

2. Government Policy on Mining in National Parks

In November 1990 the State Government of Western Australia released the "Resolution of Conflict" policy for mining and exploration in national parks, nature reserves and other conservation reserves. The policy bans mining and exploration in all but 5 national parks where there are conflicting land use claims that are specifically addressed in the policy. These parks are, Karijini, Rudall River, D'Entrecasteaux, Neerabup and Watheroo National Parks.

2.1 Marandoo Tenement and Infrastructure Corridor

When assessing proposals under the Environmental Protection Act 1986, the Authority gives consideration to both the technical merits of the proponent's environmental management commitments and also to any relevant environmental policies or principles. The Authority's advice as to the environmental acceptability of any proposal is therefore based on both the technical aspects of the proposal and its policy context.

The Marandoo iron ore mine and Central Pilbara railway proposal is the first of the mining tenements in the Karijini National Park to be the subject of a proposal for mining. To facilitate this development, the Parliament of Western Australia has excised the Marandoo tenement from the National Park, and has also excised a corridor of one kilometre width, to be used for infrastructure for Marandoo and future developments, including those of the State. Therefore, the Authority is of the view that matters of policy have already been determined by virtue of Parliament's excision of the tenement and corridor. The Authority has therefore confined its assessment to the technical considerations only: that is, can all of the impacts associated with the mine and railway be satisfactorily managed so as to ensure that the environmental values of the region, particularly those of the Karijini National Park, are protected?

To this extent the Authority's assessment of the proposal has been influenced by the broader Government policy framework within which this proposal sits and it is appropriate that the major elements of this framework are noted here.

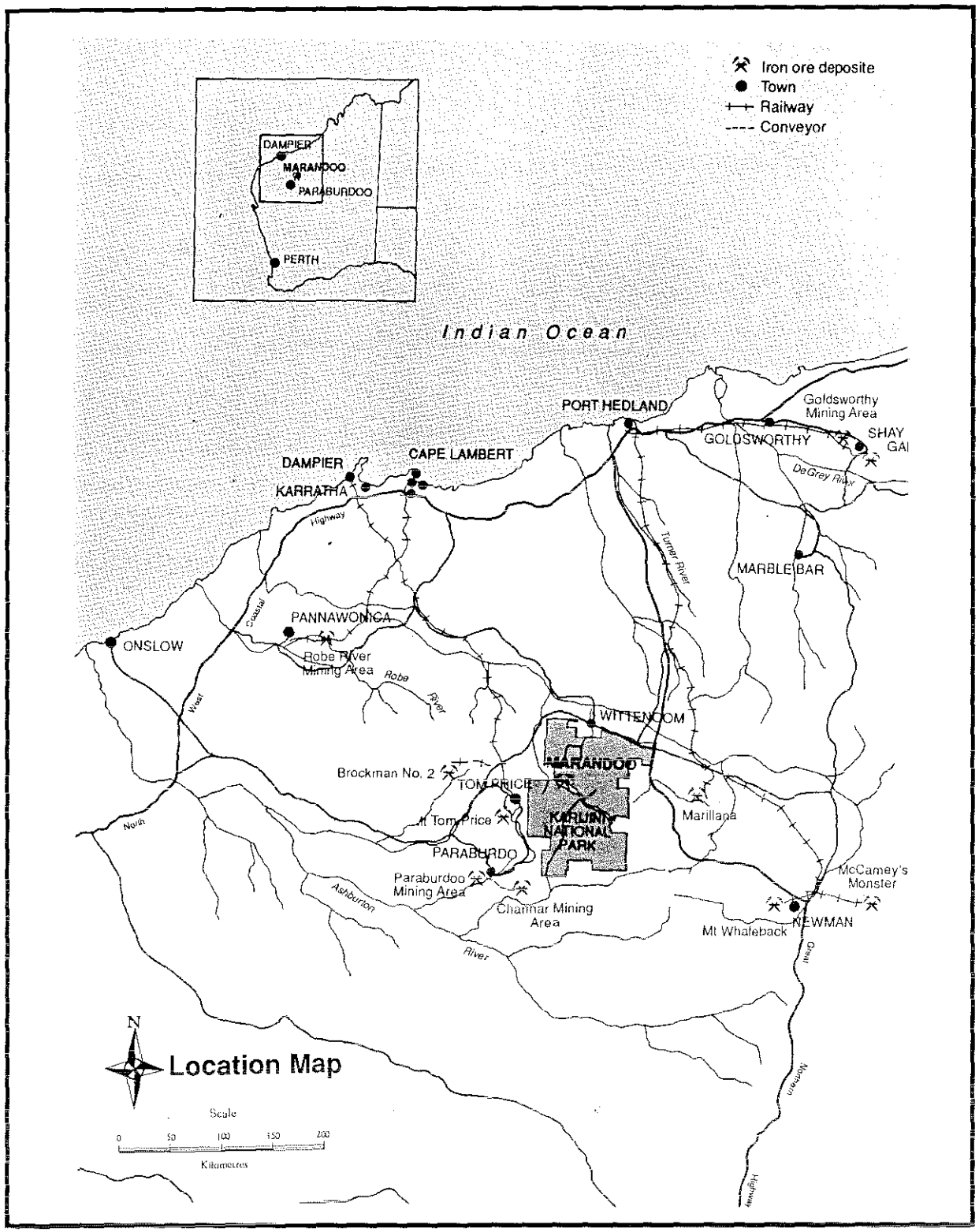

Figure 1: Location of Proposal and Karijini National Park

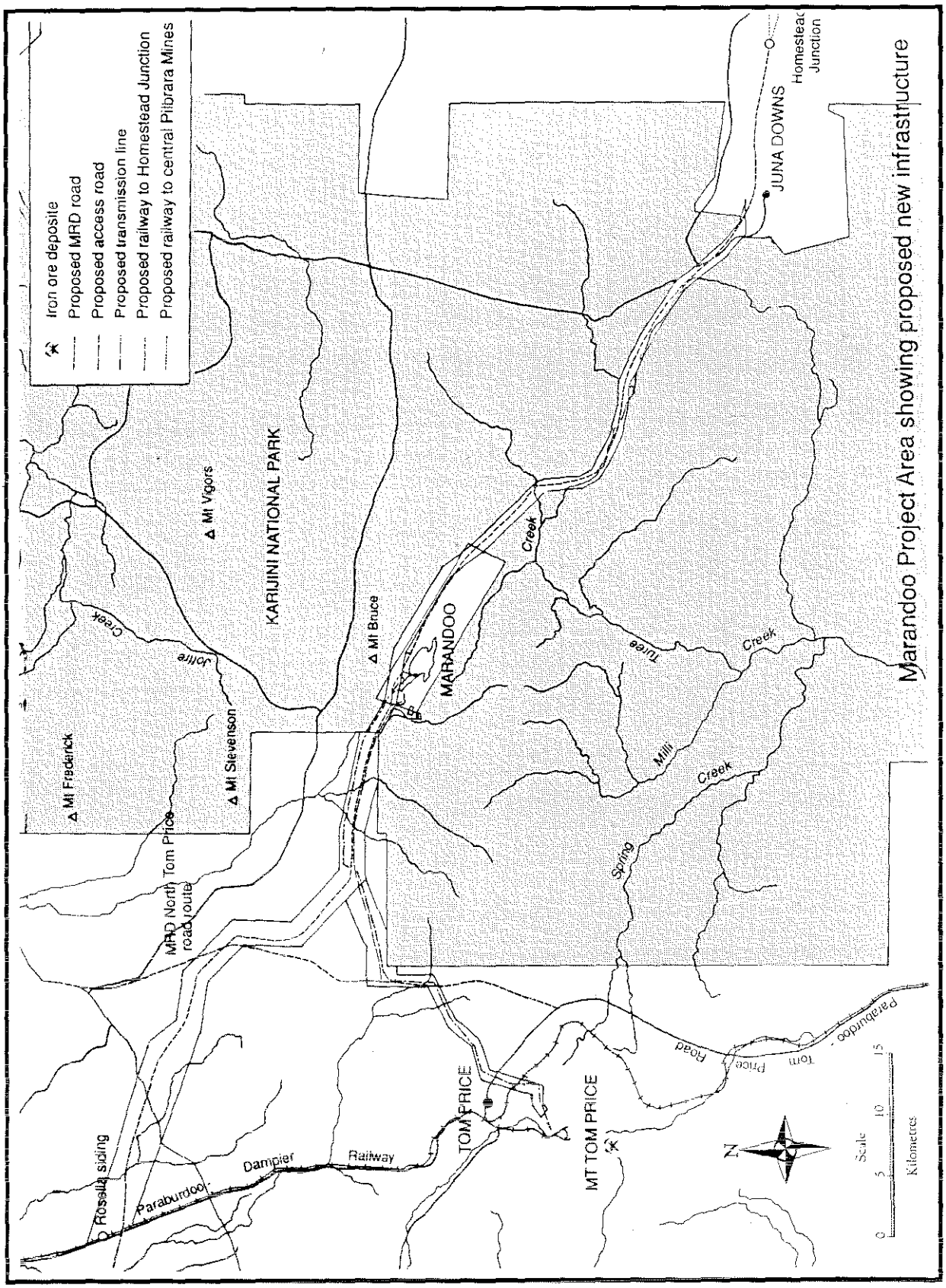

Figure 2: Location of Marandoo Tenement and Infrastructure Corridor

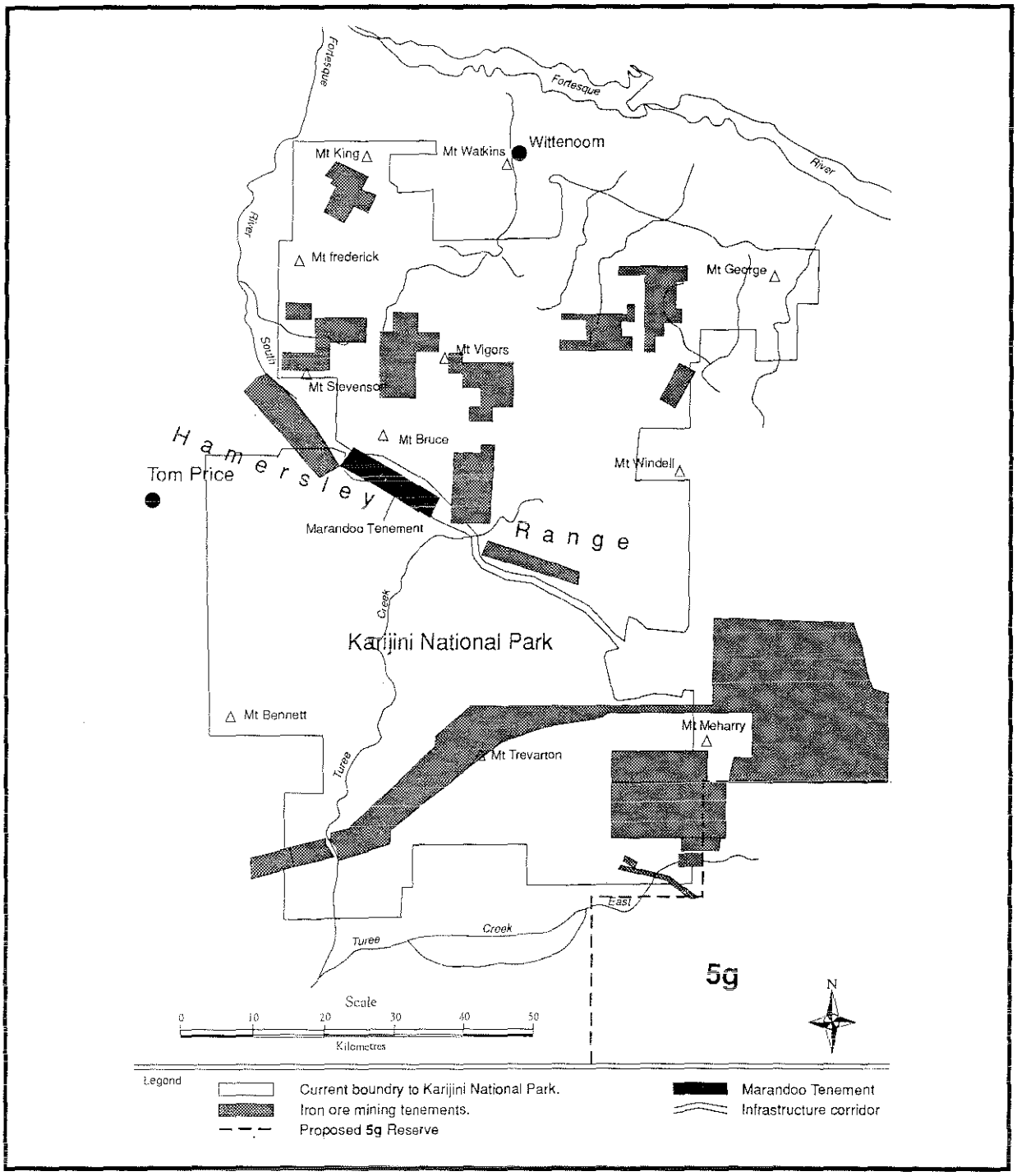

Figure 3: Iron Ore Mining Tenements in Karijini National Park

2.2 Review and Rationalisation of Tenements in Karijini National Park

In the case of Karijini National Park there are are a number of mining tenements held under State Agreement Acts throughout the Park (Figure 3). The process for implementation of the "Resolution of Conflict" policy, has developed detailed proposals for the review and rationalisation of these tenements as called for in the policy. There are a number of tenements where the Government is of a view that their conservation value is such that it would prefer that they were included in the Park wihtout further investigation. The remaining tenements would

undergo a period of non-ground disturbing exploration after which non-prospective areas would be relinquished.

Drilling programmes would then be conducted on the remaining prospective areas. These drilling programmes would require assessment by the Environmental Protection Authority prior to commencement. As a result of the drilling programmes, portions of tenement would be progressively dropped as areas are shown to be poor in iron ore resources. The remaining areas of high mining potential would be excised from the Park.

Infrastructure corridors to service the potential mines would not be excised from the Park until such time as individual mining proposals have received environmental approval.

There will be no new mining or exploration tenements allowed in the Karijini National Park.

2.3. Proposed Additions to Karijini National Park

The 'Resolution of Conflict' policy proposed that areas of high conservation value be added to the Park, to compensate for the excision of tenement areas with high mining potential. The process of implementing the policy has sought to achieve these compensatory additions by seeking to identify realistic final external boundaries for the Park required to achieve conservation and management objectives, and using the review and rationalisation process to progressively reserve these additions.

The additions would implement all outstanding Environmental Protection Authority recommendations (EPA 1975) for conservation reserves for the Park. These recommendations related to improved representation of mulga woodlands, grasslands on cracking clay soils and some vegetation components of the Ashburton Botanical District. Together the proposed additions will increase the size of the Park by some 35% and achieve sound and readily identifiable management boundaries.

3 Conservation Values of Karijini National Park

The interdependence of living resource conservation and sustainable development is emphasised in the definition of conservation formulated for the World Conservation Strategy. It has been adopted in both the Conservation Strategy for Australia and the Conservation Strategy for Western Australia. That definition is;

"The management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. Thus conservation is positive, embracing preservation, maintenance, sustainable utilisation, restoration and enhancement of the natural environment. Living resource conservation is specifically concerned with animals, plants and micro-organisms, and with those non-living elements of the environment on which they depend. Living resources have two important properties the combination of which distinguishes them from non-living resources: they are renewable if conserved; and they are destructible if not".

Accordingly conservation values of living resources are the values that the community ascribes to assemblages of plants, animals and micro-organisms as well as the non-living elements of the environment on which they depend. Continuation of natural processes is implicit in this. Conservation values are of two types:

- intrinsic values of biodiversity and natural processes on which humans depend for life support systems and natural resources as diverse as food and inspiration; and
- added values derived from commercial activities which depend on the quality of the natural environment. Tourism is an example.

One of the most important conservation strategies adopted by Western Australia is conservation through reserves, whereby conservation is the primary use ascribed to selected areas of land. Most conservation reserves are Nature Reserves or National Parks. Recreation (insofar as it is compatible with conservation) based on appreciation of the environment is an additional use of National Parks. The reserve system is designed to conserve a representative sample of the range of natural ecosystems found in the State as well as special or rare features (EPA 1975).

The conservation value of a species or ecological community is an intrinsic value. It is not enhanced simply by inclusion in a conservation reserve, although it can be protected in this way. Rather reservation is a recognition that the values of certain natural resources warrant protection by ascribing conservation as the principal land use for a site on which they occur. Thus the conservation value of reserves is likely to increase over time owing to the changes that many other land uses have on the ecology of non-reserved areas. This is particularly true of areas which are subject to land uses which can dramatically alter the ecology of large areas such as sheep or cattle grazing.

Karijini National Park is surrounded largely by pastoral stations for cattle grazing, with some vacant Crown land. Therefore, the continuing modification to the ecology of the region brought about by this form of land use makes the conservation value of the Park, now and in the future, of prime importance.

The Pilbara region is under represented in terms of area of land reserved for conservation compared to other areas of Western Australia. Approximately 7.4% of Western Australia is dedicated to conservation estate, including 15% of the South Coast region, 9% for the Goldfields and 5% of the Pilbara region (A Padgett pers comm.). The additions to Karijini National Park will increase the figure for the Pilbara but it will still be less than that for other areas of the State.

4. The Proposal

4.1 Location

The Marandoo iron ore deposit is located on a temporary reserve of 48 square kilometres held under a State Agreement Act, within Karijini National Park. The temporary reserve and infrastructure corridor were excised from the Park by Parliament in January 1991 to facilitate mining of the Marandoo deposit.

As part of the Agreement, Hamersley will be required to transfer the temporary reserve to a mining lease under the Mining Act within 14 days of approval of the Marandoo proposal by the Minister for State Development. Similarly, that portion of the infrastructure corridor required by Hamersley for the railway and an access road will be transferred to a title under the Land Act. The remainder of the corridor is proposed to be reserved under the Conservation and Land Management (CALM) Act, to facilitate management of the corridor to provide for infrastructure needs co-ordinated with Park management.

Construction camps for the railway would be located outside the present Park boundary. For the western portion of rail line the construction camp will be located at the existing camp used for the recently completed Brockman rail spur. The construction camp for the eastern portion of rail construction would be located near Juna Downs station. With the proposed boundary amendments this camp area may fall within the new Park boundaries.

The construction camp for the Marandoo mine site is proposed to be located in the south west corner of the mine area with accommodation for up to 800 personnel.

4.2 Mining and Processing

Hamersley proposes to produce approximately 12 million tonnes of iron ore per year, over a nominal 15 year period commencing in 1994. Mining would be carried out within a defined area of approximately 4 km by 2 km with all mining confined to above the water table. Conventional open cut methods would be used, employing drilling of the ore, followed by blasting to fracture the material for ease of loading by hydraulic excavators onto haul trucks.

The ore would be processed at Marandoo. This comprises crushing and screening to achieve the desired ore product, which will be stockpiled prior to loading on the rail wagons for transport to Dampier. Marandoo ore would be blended with ore from the other mines to achieve the strict chemical and physical parameters required by the market.

Overburden from the mining operation is proposed to be disposed of in the pit, however, in the initial 4 to 5 years of mining there will not be sufficient area available within the pit to dump overburden. Therefore, overburden dumping would utilise the shallow gullies to the south and west of the initial mining area for this period.

Water for dust suppression and domestic use would be pumped from an extensive groundwater aquifer below the valley floor. The proposed borefield design is a linear arrangement of five to eight production bores over a length of 4.5 to 7 km. The borefield would be located along the railway access road to the north of the mine pit.

5. Public Review

During the public review of the Marandoo ERMP 610 individual written submissions were received. The Authority noted that approximately a quarter of the submissions supported the proposal and raised issues of the economic importance of the Marandoo proposal particularly with regard to employment.

The topics raised in submissions were grouped according to Table 1 with the proponent's response to submissions set out in Appendix 2. The main environmental issues of concern raised in submissions were the environmental impacts associated with the siting of the railway through the Park, security of significant flora and fauna, and rehabilitation of the project.

Table 1: Issues raised in public submissions

Issue	Percentage	No. of times raised
Floral concerns	6.2%	121
Faunal concerns - eg extinction	8.1%	159
Surface aquifer effects - water supplies	5.3%	104
Rehabilitation	9.8%	192
Regional assessment inadequate	3.6%	71
Dust and noise pollution	2.1%	42
Erosion	0.4%	7
Waste management - how will it be done	1.1%	22
Human impacts	1.1%	22
Visual impacts	1.6%	31
National park - no mining within	4.5%	88
Tourism	5.0%	98
Employment opportunities	10.7%	209
Economic development .- support for regional development	12.4%	243
Salinity - problems in soils	1.4%	28
Aboriginal site recognition	2.6%	51
Banning of pets and firearms	0.6%	12
Health and safety management	0.4%	7
Water drainage - problems	1.5%	29
Management of environment - ie lack of it	1.0%	20
Lifestyle and lifespan of mining towns	5.0%	97
Railway - problems with the position in the park	8.8%	172
Road access - control of public access	1.0%	19
Power line - visual impact	0.5%	9
Restriction of off road vehicles	0.5%	9
Site allocation - other site possibilities	0.7%	13
Plant removal - after mining	1.2%	23
Fire - impact	0.6%	12
Overburden - management	1.0%	19
Legislation procedures - concerns	1.0%	19
Misleading - ERMP not adequate enough	0.4%	7
Total	100%	1959

Many of the issues raised were as a consequence of limited data in the ERMP. Some of these issues have been covered by additional information from the proponent, that was requested by the Authority, as a result of public submissions. There are, however, some outstanding issues which are covered by recommendations of the Authority in this report.

6 Environmental Impact and Management

6.1 Environmental Management Programme

The Environmental Protection Authority recognises that at the time of submitting an environmental review document, such as an ERMP, there are many elements of the proposal that have not been clearly defined to the point of final engineering design. If the proposal has sufficient information to allow adequate environmental impact assessment then the project approval should not be delayed whilst matters of detail are provided.

In order to allow projects to proceed as soon as possible, and also to ensure important details relating to environmental management are catered for, the Environmental Protection Authority may request that the proponent prepare environmental management programmes subsequent to project approval. These programmes are designed to provide the detailed information on environmental management of aspects of the proposal that was not available at the time of preparation of the environmental review document.

In the case of the Marandoo mine and Central Pilbara railway proposal the Authority has recommended that an environmental management programme be prepared for the Central Pilbara railway for public review. In addition, the Authority's recommendations to the Minister are of necessity wide ranging to compensate for the lack of some specific information provided in the ERMP.

For the Marandoo mine and Central Pilbara railway proposal the various elements of the environmental management programme should be prepared in consultation with the Park managers, namely the National Parks and Nature Conservation Authority (NPNCA), the Department of Conservation and Land Management and the Karijini Aboriginal Corporation.

Recommendation 1

The Environmental Protection Authority, from its own assessment and from comments during the public review phase has identified the key environmental issues requiring detailed consideration as:

- **protection of conservation values of Karijini National Park;**
- **environmental impacts associated with the eastern railway line;**
- **impacts of drainage;**
- **impacts of groundwater abstraction;**
- **impacts of construction, including both the activity and the workforce;**
- **impacts of weeds;**
- **rehabilitation of project area;**
- **impacts of fire;**
- **visual impacts of facilities; and**
- **impacts of waste disposal.**

The Environmental Protection Authority considers that these issues have been addressed and are manageable, either by the changes to the proposal made by the proponent during the assessment, by the environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations in this report.

Accordingly, the Environmental Protection Authority recommends that the project could be adequately managed from an environmental viewpoint and

they share extensive common boundaries and bisect the continuum of a natural landscape that was the National Park. Accordingly, assessment of the environmental impacts of the project on living resources needs to take into account the effects on the integrity and the effectiveness of Karijini National Park as a conservation reserve. Because recreation based on appreciation of the natural environment is an important additional use of the National Park, the assessment will also address the effect of the project on those recreational opportunities.

There is no doubt that the conservation values of the affected areas have the potential to be adversely impacted by the Marandoo mining development and the Central Pilbara railway. This will occur from the range of activities associated with the mining and railroad development such as clearing, excavating, noise and dust generation, potential for weed invasion etc. The responsibility for the proponent and regulatory authorities is to ensure that impacts are properly managed.

There are a number of other iron ore mining tenements within the Park which are the subject of State Agreement Acts. Under the rationalisation proposed in the Government policy on mining in national parks, these tenements are to be evaluated and rationalised. Those tenements that, after evaluation, are found to be not suitable for development will be relinquished by the holder. Tenements with mineable resources would then be excised from the National Park.

Prior to Government approval to mine, these proposals would require environmental impact assessment by the Environmental Protection Authority.

The Environmental Protection Authority is concerned with the potential cumulative environmental impacts associated with developing further mining proposals in Karijini National Park during the life of the Marandoo iron ore mining operation. The potential cumulative impacts include loss of wilderness value, groundwater drawdown, habitat destruction and impacts associated with construction camps. Therefore the Authority considers that should further iron ore mining proposals in the Park be put to Government they should not proceed until Marandoo has been decommissioned.

6.3 (i) Fauna.

The ERMP together with the specialist consultant's report provide comprehensive lists of vertebrates that occur on the Marandoo tenement. Extensive work carried out by Texas Gulf (the original tenement holders), in the 1970's contributed substantially to the completeness of the lists. There appear to be significant differences between the assemblages recorded by Texas Gulf in the 1970's and those on behalf of Hamersley Iron in recent studies. The reasons for the differences are not clear. They could reflect seasonal factors but structural change to vegetation caused by fire, particularly the loss of mature mulga woodland, may have been important.

Information provided for the rail corridors is much less comprehensive and information on vertebrates living on the access road and power transmission alignments from Tom Price are inferred from lists of species known from similar habitats elsewhere. There is no information on the rail corridor to the east of the National Park boundary with Juna Downs Station.

The ERMP records four species that are gazetted under the Wildlife Conservation Act on Schedule 1 ("fauna that is likely to become extinct or is rare) and two that are gazetted on Schedule 2 ("in need of special protection"). It also records two species that are subject to the Japanese/Australian Migratory Bird Agreement (JAMBA) and the Chinese/Australian Migratory Bird Agreement (CAMBA) treaties, one species that is listed as endangered by the International Union for the Conservation of Nature and Natural Resources (IUCN) but is not on the schedules gazetted under the State's Wildlife Conservation Act and two species that are noteworthy because they represent significant range extensions.

The ERMP suggests that none of these species will be affected by the project at a regional level but it notes that there will be some loss of habitat used by Pebble-mound Mice.

could proceed subject to the Environmental Protection Authority's recommendations in this report, and the proponent's commitments to environmental management listed in Appendix 1

The Authority's experience is that it is common for details of a proposal to alter through the detailed design and construction phase. In many cases alterations are not environmentally significant or have positive effects on the environmental performance of the project. The Authority considers that such insubstantial changes should be provided for within the assessment process.

The Authority also considers that any approval for the proposal based on this assessment should be limited to five years. Therefore, if the proposal has not been substantially commenced within five years of the date of this report, then such approval should lapse. After that time, further consideration of the proposal should occur only following a new referral to the Authority.

In order to ensure that environmental conditions, set by the Minister for the Environment, and the associated commitments are met, an audit system is required. The proponent should develop this audit system in consultation with the Environmental Protection Authority.

6.2 Regional Impacts

An assessment of future iron ore developments in the Pilbara carried out by the Department of State Development , at the request of the Environmental Protection Authority, predicts that the Central Pilbara region is likely to be the focus of future iron ore mining proposals for the next decade.

This is in line with the plans outlined by Hamersley in the ERMP for mining development options after the commencement of the Marandoo mine and beyond.

As more mining development occurs in the Central Pilbara region the potential for cumulative environmental impact increases. As can be seen from the Marandoo ERMP the biological resources of the region, particularly declared and priority species under the Wildlife Conservation Act and geographically restricted vegetation communities, have not been comprehensively studied. This can be attributed to a number of factors, including the size of the area and the relative lack of development in the region. However, it would appear that the Central Pilbara will be subject to increased exploration and mining activity in the next decade by the four main companies involved in the iron ore industry in Western Australia (Hamersley Iron, BHP Iron Ore, Robe River Mining Assoc and Hancock Resources).

The Environmental Protection Authority considers that these companies should begin as soon as possible to gather information on the biological resources of the area in a co-ordinated fashion. Given the relative proximity of the potential mining areas to each other it would be advantageous to pool funds and expertise to ensure a clear picture is formed of the regional biology and ecology.

The Environmental Protection Authority is of the view that there is a potential for cumulative environmental impacts on the biological resources of the region. Therefore, prior to any further iron ore mining development in the Central Pilbara region, an integrated biological survey should be carried out to determine the distribution of priority species of flora and fauna and geographically restricted vegetation communities. Data collection should begin without delay. The results of such a survey would allow future mining proposals to be more easily assessed.

6.3 Protection of Conservation Values of Karijini National Park

The Marandoo tenement and substantial portions of both corridors have been excised from Karijini National Park and will eventually be returned to the National Park. In the meantime

The Environmental Protection Authority agrees with this assessment for the majority of species and believes that their status in the National Park will not be significantly impaired but makes the following observations about:

- Grey Honeyeater. (Schedule 1)
- Bilby (Schedule 1)
- Pebble-mound Mouse (Schedule 1)
- Ghost Bat (IUCN)

Grey Honeyeater

The Pilbara appears to be important to this species. It breeds on the Mt. Bruce flat (Start pers. comm.1992 record) and has been recorded in the north-west rail corridor. It inhabits mulga woodland, a community that is susceptible to fire damage and to changes in surface hydrology. The risks from these factors to the communities in which this species lives are dealt with in section 14 of the ERMP. However it is necessary to be mindful of this species wherever there is potential for damage to mulga woodlands.

Bilby

This species is restricted to the northern half of the continent, including the Hamersley Range area (Ninox 1992). Burrows attributed to the mammal were recorded in the south-eastern section of the rail corridor in 1991 during the fauna survey for Marandoo. In response to an enquiry by the Authority, Hamersley has stated that evidence for their presence was based only on two burrows that may have been dug by Bilbies. However, there has been no evidence of tracks, scats, or sightings. Neither of the locations at which the burrows were found will be impacted directly by the railway (which is said to be half a kilometre away), roads or gravel pits.

Given this situation, Hamersley will make no further surveys specifically for the Bilby, but will include it on a search list for "on going regional studies and final alignment surveys".

The Environmental Protection Authority believes that in the absence of any other evidence of Bilbies in Karijini National Park in recent decades and in view of the unsubstantiated evidence in the original report, no further action is needed. However, should Bilbies be shown to occur in the tenement or rail corridor in future, the company should consult with the Department of Conservation and Land Management about appropriate management.

Pebble-mound Mouse

In response to enquires by the Environmental Protection Authority, Hamersley has reiterated a commitment to support research on this species. The commitment is to delineate the current range and distribution of Pebble-mound mouse in Western Australia for comparison with the known range of pebble mounds, and to provide material for taxonomic studies by taxonomists at the WA Museum.

Department of Conservation and Land Management scientists have discussed the requirements of the study with staff of Enviroscan (consultant to Hamersley), but contrary to the advice given by Hamersley Iron in its response to the Authority, the Department advises that it has not yet received a detailed research proposal from Hamersley .

Hamersley states that Enviroscan has carried out a range of projects in the Initial mining Area (IMA) and the vicinity of Marandoo during two field trips, one in October 1991 and one in May 1992. The proponent's statements of the results include:

- "Surveyed the IMA and logged the occurrence and distribution of mounds in the IMA";
- "Determined the level of activity of pebble mounds located in the IMA";

- "Determined the habitat characteristics of pebble mound areas, taking into account physiographic and vegetation characteristics and surface features"; and
- several biological and ecological attributes.

The proponent also reports that: "Numerous populations of Pebble-mound Mouse have been identified in the Project Area and mounds have been logged on favourable habitat in the Park wherever it occurs. The proportion of mounds demonstrated to be inhabited on the relatively disturbed area of the tenement indicates that large populations must exist in areas of relatively undisturbed habitat in the Park. Consequently the project is unlikely to have any regional impact on the Pebble-mound Mouse".

Hamersley also states that: "Long term monitoring sites for the Pebble-mound Mouse have been established at the eastern end of the tenement. Consideration is also being given to the establishment of monitoring sites within the Park and elsewhere as part of their on going research". Details of the monitoring program have not been made available to the Environmental Protection Authority.

The Environmental Protection Authority concludes that it is unlikely that the impact of the Marandoo mine, alone, will seriously adversely affect the Pebble-mound Mouse at the regional level. Nevertheless the cumulative effects of this project together with the railways and future mine developments are cause for concern. The Authority recognises the value of the commitment to research that will provide a better understanding of the status of this species.

Ghost Bat

The Environmental Protection Authority does not agree that the intermittent use of one known roost without any more knowledge of either movement patterns or alternative roost sites (Ninox 1992) can be interpreted as occurrence "only as a transitory nomad" (ERMP Table 10.2). Nevertheless, the Authority accepts that the possible loss of one small colony of this species is not likely to constitute a significant threat to the species status. However, there are very few other records from Karijini National Park. The Authority suggests that if any other roosts are located on the tenement and outside the area to be mined, the proponent should ensure that they are not disturbed and consult with the Department of Conservation and Land Management to develop a strategy for ensuring their protection.

6.3 (ii) Flora

In their report to Hamersley, Mattiske and Associates identified two plant species from the Marandoo project area which are on the Department of Conservation and Land Management 'priority list'; both occur on the IMA. They are *Brachychiton acuminatus* and *Eremophila magnifica 'velutina'* (m.s.). Mattiske and Associates identified a further 37 species from the Marandoo area or the rail corridors that are not on the Department of Conservation and Land Management's 'priority list' but which they considered 'geographically restricted or habitat restricted and poorly known'. Some of them are undescribed.

After reviewing the list the Environmental Protection Authority requested Hamersley to show for the following species:

"**either** the existence of genetically self sustainable populations outside the tenement and the corridors"

"**or** the existence of genetically self-sustainable populations within the tenement and/or corridors that will not be directly or indirectly affected by operations (in which case it would be useful to indicate how populations will be identified and protected from inadvertent destruction. eg they might be flagged, fenced, mapped for handouts at induction of staff etc.)"

"**or** the actions that Hamersley Iron will take to ensure that taxa are not threatened with extinction."

Brachychiton acuminatus

Eremophila magnifica velutina

Cynanchum spp 1(MET 2302)

Dicladanthera glabra

Eucalyptus aff coolabah 9MET 10362)

Flaveria spp 1

Josephina spp aff. imperatricis

Polymera spp (MET 10594)

Rottboellia formosa

Sida (14) (MET 2256)

Solanum ferocissimum (MET 2273)

Triumfetta spp 1

"It would also be desirable to show from survey, Herbarium records or Hamersley plans the likely extent of impact to species from cracking clays and volcanics that the Mattiske and Associates report highlighted"

In response the proponent commissioned additional botanical survey work. Results of the first additional survey were available to Hamersley in time for them to include more data in the responses to Public Submissions. (Response 10), but the results of a second survey are still not available.

For most species the proponent has demonstrated that there are additional populations outside the project areas or that the known populations will not be affected directly by project development. Additional populations were found for many but not all of them.

The proponent has also stated in its response document that: "Site specific surveys along the routes of the railway and roads, and at the location of the proposed borrow pits, laydown areas, roads, construction camps and other areas likely to be disturbed through construction activities will be undertaken in advance of the commencement of site construction work. The location of the above species in the Marandoo project area will be recorded. Identified populations will be clearly designated in the field to enable personnel to recognise areas to be avoided." (Response 10).

The Authority understands the difficulty of ascertaining the conservation status of plants in regions where there has been little botanical survey work. It also recognises that the effectiveness of surveys is strongly influenced by seasonal factors, particularly rainfall interacting with the ephemeral life history strategies of many plants. Nevertheless the Authority considers that until further survey work is carried out these taxa should be treated as though they are rare although it recognises that there will be a loss of some individuals of some species.

This year has been exceptional for the abundance of winter rainfall. It is therefore an ideal time to undertake the additional survey work identified by the proponent and quoted above. The Authority is still concerned for communities on cracking clays in the rail corridor. They are often ephemeral, grow on a restricted soil type and consequently are poorly known but potentially rare. For reasons associated with climatic conditions the original surveys for the ERMP may be expected to have under-recorded the species present on them.

Uplands and hilltops in the Hamersley ranges are frequently characterised by the presence of plants that are endemic (either entirely eg *Thryptomene wittwerii* or regionally eg *Eucalyptus kingsmillii)* to such sites. Many of them are rare.

The Authority therefore considers that Hamersley survey the flora of all upland sites prior to final planning for all installations such as radio repeater sites. The surveys should include access alignments. Furthermore the company should prepare installation and maintenance plans in conjunction with the Park managers before any work is carried out.

Recommendation 2

Rare, priority and geographically restricted species of flora and fauna in the project area should be treated with special consideration. Accordingly, the Environmental Protection Authority recommends that the proponent provide details of the results of all flora and fauna surveys to be carried out, on all areas likely to be disturbed through construction and operational activity, to the Environmental Protection Authority and the National Park managers, prior to approval for those areas to be disturbed. Should it be deemed necessary specific action may be required to manage impacts so as to protect particular species.

6.3 (iii) Park Management

Management of the Karijini National Park is carried out jointly by the Department of Conservation and Land Management and the Karijini Aboriginal Corporation, on behalf of the National Parks and Nature Conservation Authority in which the Park is vested. Although the Marandoo tenement and the infrastructure corridor have been excised from the Park, owing to the fact that they are surrounded by Park, there exists the potential for significant impact on Park management and values.

The presence of the Marandoo project within the boundaries of the Park will require a high degree of additional management from Park staff. It is generally during the period of construction that the potential for impact is greatest. Many thousands of people will be working on the project during its two year construction period, thereby placing a heavy load on the management resources of the Park.

Hamersley has outlined a number of strategies to manage the use of recreational time for workers, emphasising the provision of facilities at the camp to ensure workers will stay at the site during their recreation time.

Recommendation 3

The Environmental Protection Authority recommends that the proponent should take responsibility for the supervision of construction workforce impacts on the Karijini National Park and to assist the National Park managers in reducing the impacts on National Park values from such activities.

6.4 Central Pilbara Railway

A number of submissions commented upon the lack of detail provided on alternative routes for the rail route from the proposed Central Pilbara area to the port at Dampier. The Environmental Protection Authority is concerned that this issue was not adequately addressed in the ERMP or the proponent's response to public submissions. It is understood that the proponent has a preferred route but this should not mean that alternative routes should not be made explicit and the costs and benefits discussed.

The Central Pilbara railway from Marandoo to Homestead Junction on the eastern side of the Park is a significant part of the proposed development. It stretches for a distance of approximately 60 kilometres, most of which has common boundaries with the Park.

Aside from the direct physical disturbance associated with the railway construction there are a number of indirect disturbances, including interruption to drainage, borrow areas for gravel, laydown areas, temporary workshops and other support facilities. These can often be more widespread in the effect on the environment than direct disturbance to habitats.

The level of information provided in the ERMP for many aspects of the Central Pilbara railway was insufficient to allow the Authority and the public to make an assessment of the adequacy of

the proposed management of the potential environmental impacts associated with this aspect of the development at this time. It is recognised that the proponent's response to public submissions provides new information on the alignment of the railway and drainage design, but does not specify the environmental management for this alignment or method of drainage management. This makes it difficult to assess the management of potential environmental impacts of the railway line in its conceptual form. Consequently, the Authority considers that while sufficient information is available to support the conclusion that the environmental impacts from the Central Pilbara railway should be manageable, further specific information on **how** the environmental impacts are to be managed for this part of the project is required to be provided to enable Ministerial clearance, upon advice from the Environmental Protection Authority following public review.

Recommendation 4

The proponent should construct and operate the Central Pilbara railway (from Marandoo to Homestead Junction) so as to minimise environmental impacts. The Environmental Protection Authority recommends that prior to construction of the Central Pilbara Railway the proponent prepare, and subsequently implement, a separate and specific environmental management programme for the Central Pilbara railway line, in consultation with the Environmental Protection Authority, and the National Park managers to meet the requirements of the Minister for the Environment upon advice from the Environmental Protection Authority. The programme would be made available for public review by the Environmental Protection Authority.

Indicative guidelines are provided in Appendix 5 outlining the type of information required for the environmental management plan for the Central Pilbara railway. These will be finalised after appropriate consultation.

6.5 Drainage Management

Activity associated with the mining project will be located on the north facing slope of an east-west ridge. Numerous small water courses drain water from the ridge into the broad drainage line to the north of the mine and thence to the Mt. Bruce Flats, a basin occupying about 270 square kilometres. A good quality stand of Mulga exists in the drainage line and the Mt Bruce Flats contain woodlands of Coolibah (*Eucalyptus coolibah*) and Coolibah -Mulga *(Eucalyptus coolibah-Acacia aneura)* . Both of these vegetation communities are regarded as significant because they are the only examples of these woodlands in an undamaged state in the region (Mattiske 1992). Also the water courses themselves are often rich in both flora and fauna species (Mattiske 1992, Ninox 1992).

Development of the proposal such as, the excavation of the pit, placement of overburden, and construction of roads, powerline and the railway will directly impact on the water courses. In order to reduce this impact, the siting of facilities needs to be carefully considered at the detailed design stage and, important watercourses, (in terms of species richness), should be avoided wherever possible.

Indirect impacts of the development on drainage include the interruption of flow to downstream vegetation communities, upstream flooding, indirect flow from redirected drainage and, the pumping of pit water into existing water courses. It is recognised that the impact of reducing the water available to vegetation communities downstream from the development is not well understood and therefore, further investigation is required. Similarly, the disposal of pit water from heavy rainfall events into the natural drainage system requires management to reduce impacts on vegetation communities associated with the drainage lines.

A further issue associated with surface water management is that of sheet flow, as distinct from flow in defined water courses. On relatively flat country, water movement is often by sheet

flow over a wide area, which can be impeded by roads and railways. On broad drainage areas vegetation such as Mulga depends upon overland sheet flow of water for survival and the impediment to this flow by roads and railways can have a significant impact. Particular attention needs to be given to the maintenance of sheet flow regimes. The proponent has discussed this issue in the ERMP but it is considered further information is required as detailed design proceeds.

Recommendation 5

The important vegetation communities in the area, in particular the coolibah and mulga woodlands, should be protected from drainage impacts associated with the development and operation of the project. Accordingly, the Environmental Protection Authority recommends that prior to construction the proponent prepare and subsequently implement a drainage management plan, in consultation with the Environmental Protection Authority and the National Park managers. The plan should include a monitoring component to determine its effectiveness and should comply with Recommendation 14.

6.6 Groundwater Management

It is proposed to utilise groundwater to supply water for dust suppression, ore processing and camp supplies. A borefield is proposed to be developed in the valley within the tenement to the north of the mine, utilising 5 to 8 production bores to satisfy a projected peak demand of 8,000 cubic metres per day.

The valley area above the aquifer comprises important vegetation which is within the National Park namely:

- woodlands of coolibah (*Eucalyptus coolibah*) and coolibah -mulga *(Eucalyptus coolibah-Acacia aneura)* on the Mt Bruce Flats which are the only examples of these woodlands in an undamaged state in the region; and
- stands of mulga in the drainage line to the north of the Initial Mining Area.

Modelling of groundwater drawdown associated with the operation of the borefield suggests that the drawdown will be less than 5 metres for the deep aquifer beneath the Coolibah woodland. The water table in this area is approximately 20 metres below ground level. Whilst the ERMP states that it is unlikely that the Coolibah trees have roots to a depth of 20 metres and therefore utilise the groundwater, unless there is definitive evidence to show this is the case caution must be exercised to protect the woodland. Therefore, a monitoring programme should be put in place to determine the effect on vegetation in the area from the operation of the borefield. A contingency plan should be prepared to remedy any deleterious impact on vegetation.

The water table in the area of the mulga stand north of the mine is approximately 40 metres below ground level. Observations from the nearby Southern Fortescue borefield, which supplies Tom Price, suggests that mulga is not adversely affected by groundwater drawdown. It is inferred that mulga utilises stored soil moisture rather than underlying groundwater for survival.

Recommendation 6

There should be no unacceptable impact on the conservation values of the Karijini National Park from groundwater abstraction associated with the project, particularly the coolibah woodlands, to the east of Mt Bruce, where groundwater drawdown should not be detectable. Accordingly, the Environmental Protection Authority recommends that prior to commissioning

of the Marandoo borefield, the proponent prepare and subsequently implement a groundwater monitoring programme, to comply with recommendation 14, in consultation with the Environmental Protection Authority, the National Park managers and the Water Authority of Western Australia.

The issue of mining below the water table was raised in a number of submissions. The proponent has clearly stated that the proposal which is the subject of this ERMP is for mining above the water table only. However, given that a high proportion of the ore reserve is below water table it is logical that in the future the proponent would seriously consider mining this ore. The environmental impacts associated with dewatering are often significant. Therefore, the Authority recommends that the proponent should consider alternative methods of mining at an early stage so as to allow integration of planning for an alternative method into the mine planning for Marandoo. The Authority is concerned that should consideration of alternative methods be left until later, then dewatering may be the only option available if the decision is made to mine below the water table.

The Environmental Protection Authority considers that any proposal to mine below the water table would require referral to the Authority for environmental impact assessment.

6.7 Weeds

Weed invasion can have a significant effect on the health of native vegetation communities. There are many exotic plant species that are now established in the Pilbara. The ERMP identified 12 within the project areas. At least one more (Kapok bush - *Aerva javanica* . A. N.Start pers. comm.) is present on disturbed areas at Marandoo. Three of these 12 species of weeds are aggressive colonisers of disturbed areas: kapok bush, buffel grass (*Cenchrus ciliaris*) and ruby dock (*Rumex vesicarious*). Kapok bush and buffel grass have been widespread for many decades in pastoral areas, particularly along water courses as well as roads and railway lines. Ruby dock is a more recent arrival but it has been spread along the railway line from Paraburdoo to Dampier. It is also seen along many roads and it has started to follow water courses.

Kapok bush and buffel grass occur sporadically in the more frequented parts of the National Park but ruby dock is restricted to a a small number of sites. All three species occur at Marandoo, notably on areas disturbed by previous exploration work.

All three species can be introduced to new areas with dirt on vehicles, particularly earth-moving equipment that has been working in infested areas. Having been introduced they are readily spread along roads and railway lines by maintenance vehicles like graders. Once introduced to watercourses they are spread downstream rapidly by floods.

The Environmental Protection Authority believes that there is a serious potential risk that construction or maintenance work on the new road, rail and power transmission lines could introduce these and other weeds to areas that are at present weed-free.

The proponent has recognised the need to control the introduction of weeds and has outlined the following measures in the ERMP:

- no exotic species to be used in any site gardens, or in rehabilitation;
- all seed and plant material to come from approved suppliers;
- co-operation with CALM on relevant weed management programmes that are consistent with those used for the National Park.

The Authority acknowledges the intention of the proponent's methods outlined above, but it is concerned that serious and, perhaps uncontrollable, introductions could be made with the initial construction activity such as blazing utility alignments. Accordingly the Authority makes the following recommendation:

Recommendation 7

The spread of weeds resulting from the development and operation of the project should be minimised. Accordingly, the Environmental Protection Authority recommends that prior to the commencement of construction, the proponent prepare and subsequently implement a weeds management plan, in consultation with the National Park managers and the Agricultural Protection Board. The plan should prescribe hygiene, monitoring and control measures. The plan should include a monitoring component to determine its effectiveness and comply with Recommendation 14.

6.8 Fire

Fire has been an integral factor in the shaping of the Pilbara's environment. North of the Fortescue River hummock grasses dominate the landscape. Hummock grass is "fire-friendly" and organisms living in these communities are relatively tolerant of fire. Fire sensitive communities are generally restricted to fire-safe situations such as gorges and steep screes where hummock grasses can't grow. South of the Pilbara extensive mulga woodlands grow over ephemerals and woody shrubs. Mulga itself is usually killed by fire and regeneration is slow, however, except after good years, there is generally inadequate fuel to carry extensive wildfire in these woodlands.

The Hamersley Range and hence the whole of the project area, is situated in the zone where hummock grasslands progressively give way to mulga woodlands. Since this zone is geomorphologically very complex it is characterised by a complex pattern of fire tolerant hummock grasslands and fire sensitive mulga woodlands.

Some of the mulga dominated associations have understories of hummock grasses which make them vulnerable to fire. Indeed many areas of hummock grassland, including in the Marandoo tenement have been mulga woodlands. Areas of mature mulga have been killed by fire and some of the other plant and animal species that inhabited the woodland may be unable to survive in the altered environment. Fire damage to mulga communities is a serious problem which is subject to a major research project (Start et al 1991).

Recently, most of the very extensive fires in Karijini National Park have started from lightning strikes. However, experience has shown that numerous wildfires originate along road, railway lines, and pipelines from human intervention.

The Authority believes that on the one hand the developments associated with the project, particularly within the road, rail and power transmission corridors, pose a substantial risk to plant and animal communities within those corridors and within Karijini National Park. On the other hand access within these corridors may be used to advantage by the Department of Conservation and Land Management in fire management and wildfire control.

Recommendation 8

The development and operation of the project should not lead to a significantly increased fire risk within the Karijini National Park. Accordingly, the Environmental Protection Authority recommends that prior to the commencement of construction, the proponent develop a comprehensive fire management plan in consultation with the National Park management for the range of activities to be undertaken during construction and operation. The plan should integrate fire management with the overall fire management requirements of the Karijini National Park. The plan should include a monitoring component to determine its effectiveness and comply with Recommendation 14.

6.9 Rehabilitation

In comparison to other sectors of the mining industry the iron ore industry has not been as thorough in rehabilitating the disturbance to the natural environment at its mine sites and associated infrastructure areas in the Pilbara. Hamersley has been operating in the Pilbara for over 25 years and it is only in recent times that serious efforts towards environmental management including rehabilitation have been attempted. However, it would appear that the proponent has recognised the need to ensure that the mining activities it undertakes are environmentally acceptable and has began to plan accordingly.

The location of the Marandoo mine and the Central Pilbara railway in an enclave within the Karijini National Park means that the rehabilitation will be required to achieve the highest possible standard. It is the expectation of this Authority that at the end of mine life the area of the mining tenement will be returned to the National Park. Therefore the minesite and other disturbed areas will need to be rehabilitated to a standard fit for re-inclusion into the Park.

There will be a range of areas of the natural environment disturbed as a result of the development of the proposal. They include areas for the construction camps, the pit, the plant site, overburden and waste disposal areas, borrow pits, roads, powerline and railway. All of these areas will require rehabilitation, with the possible exception of the railway.

The proponent has noted in the ERMP the importance of minimising the area disturbed and planning for rehabilitation. The Authority endorses the need for careful planning prior to construction, to ensure both the extent and the methods used for ground disturbing activity are consistent with sound environmental management. Accordingly, detailed rehabilitation plans should be prepared in consultation with the manager of the National Park.

Recommendation 9

Rehabilitation of the project area should achieve a standard consistent with the values for return to the Karijini National Park. Accordingly, the Environmental Protection Authority recommends that prior to the commencement of construction, the proponent prepare and subsequently implement rolling rehabilitation plans, in consultation with the National Park managers, the Environmental Protection Authority and the Department of Minerals and Energy. The plan should include a monitoring component to determine its effectiveness and comply with Recommendation 14.

Rehabilitation of disturbed areas will involve work at numerous sites in the road, rail and power transmission corridors as well as at the mine site. Considerable quantities of seed from a range of species will be required. It is inevitable that successful rehabilitation will result in the spread of the progeny of plants imported to the site as seed. Where there are genetically compatible individuals in the adjacent undisturbed communities interbreeding will occur and genes from the imported stock will flow into the community.

At present knowledge of the genetic and taxonomic status of many Australian plants is poor. For example Randell (1992) has recognised at least ten species, subspecies and varieties in the complex hitherto known as *Acacia aneura*, ie "Mulga". Within the tenement and utilities corridors there are many morphs of "mulga" which are likely to differ genetically and warrant recognition as distinct taxa.

"Mulga" is a dominant species complex over a large proportion of the project area including the mine site. While knowledge of the taxonomy and genetics of the complex is rudimentary there is a significant risk that genetic races or even species could be introduced to Karijini National Park if "mulga" seed is imported from elsewhere. This would be akin to introducing a weed to the national park.

"Mulga" is used here as an example and similar situations may apply to other plant groups that would be important to rehabilitation. The effect of accidentally introducing species that turned out to be extralimital and thus, by definition weeds, particularly species that are dominant in

communities, would be to seriously impair the integrity of Karijini National Park as a conservation reserve.

The total length of the railway line is expected to be 115km, approximately half being in the Fortescue River catchment and half in the Turee Creek (Ashburton River) catchment. The botanical surveys recorded 37 distinct plant communities within the project area. Neither the ERMP nor the specialist botanical report details the floristics of each community. Nor do they discuss changes in species composition from east to west. However research by the Department of Conservation and Land Management's scientists suggests that significant differences are likely in some if not all communities.

Given the variety of communities and the likelihood of changes in species composition from one end of the railway line to the other, there is a need for care in selecting species for rehabilitation. Failure to plan aspects of the rehabilitation on a site by site basis could result in the introduction of species to areas in which they do not occur naturally. This could also impair the integrity of the National Park as a conservation reserve.

In relation to seed source the proponent has made the following commitment (No 21).

"Hamersley will wherever possible use seed derived from local sources during rehabilitation works. If local seed is not available Hamersley will consult with CALM prior to determining alternatives".

The Authority believes that all plant material used for rehabilitation should be sourced locally and that the species used at any one site must have been present at that site or immediately adjacent. Accordingly the Authority makes the following recommendation:

Recommendation 10

The Environmental Protection Authority recommends that all plant material used for rehabilitation should be sourced locally. The National Park managers should determine the acceptability of plant material used for rehabilitation. Sources of seed and species proposed for planting during rehabilitation should be included in the rehabilitation plan.

6.10 Visual Impact

The Marandoo mine site and the Central Pilbara railway line will be clearly visible from a number of high points within the National Park, including Mt Bruce, the most prominent peak within the Park, which overlooks the minesite. It is important that the visual impact of the development is considered when planning for the location and scale of facilities. Therefore, the Authority makes the following recommendation.

Recommendation 11

The visual impact of the proposed development should be minimised. Accordingly, the Environmental Protection Authority recommends that strategies to manage visual impact of the development during construction and operation need to be developed. Therefore, prior to the commencement of construction, the proponent should prepare and subsequently implement, in consultation with the National Park managers, a plan to mitigate the visual impact of the development to comply with Recommendation 14.

6.11 Waste Management

The ERMP outlines a number of strategies for solid waste disposal. Where practicable solid waste material such as metal will be recycled. Bulky non-toxic waste will be disposed of by

burial underneath overburden dumps. Other non-toxic waste will be disposed of in landfill sites to be established at each of the three construction camps.

Liquid waste generated at the site will include domestic sewage and waste liquid from industrial processes. Domestic sewage will be treated to a form acceptable to the Health Department of Western Australia.

Industrial liquid waste such as washdown water, laboratory chemicals, and waste oil, that is not recycled, will be subject to a licence, with appropriate pollution control conditions, issued under Part V of the Environmental Protection Act. An example of the types of conditions applied to mine sites is included in Appendix 4.

Recommendation 12

Domestic and industrial waste material from the project should be contained to prevent scavenging by animals and should not pollute groundwater. Accordingly, the Environmental Protection Authority recommends that prior to the commencement of construction the proponent prepare and subsequently implement, in consultation with the National Park managers, the Health Department of Western Australia and the Water Authority of Western Australia, a plan to manage the waste disposal sites to prevent scavenging by animals including birds, and contamination of groundwater. The plan should include a monitoring component to determine its effectiveness and comply with Recommendation 14.

6.12 Dust, Noise and Blasting

The generation of dust is an inevitable by-product of mining. The important issue is to minimise dust generation as far as possible, so as to minimise the impact on worker health and impact on vegetation. The main sources of dust are the pit, from blasting, loading and vehicle movement, the plant from crushing screening and ore transport, and stockpiling of ore and overburden.

The use of water for dust suppression is the most widely used method of managing dust at mine sites and this method will be used at Marandoo. There is a balance required between dust suppression and excessive use of a valuable water resource. The sealing of the access and major plant roads at Marandoo will serve to reduce dust generation and also save water use.

Noise generation can be managed by the use of exhaust mufflers, protective covering and rubber lining on equipment likely to cause excessive noise. The regular maintenance of equipment is also important in reducing noise levels from machinery.

Control of dust and noise will be carried out under the Mines Regulation Act, the Occupational Health Safety and Welfare Act, and Part V of the Environmental Protection Act. An example of the types of conditions applied to mine sites under Part V of the Environmental Protection Act is included in Appendix 4.

Blasting will be carried out on a regular basis at Marandoo as part of the mining operation. Where blasting does take place, the Mines Regulation Act provides regulatory control for the blasting operation.

6.13 Construction

It is during the construction phase of large mining developments that the potential for environmental impact is greatest. The combination of a large and constantly changing workforce, and a range of activities occurring at a number of locations results in difficulty in supervising personnel at the site to ensure sound environmental management.

The construction period at Marandoo will last for approximately two years with several thousand individuals working at the site over that period.

Hamersley has stated in the ERMP that the construction workforce will be required to undertake an induction programme at the commencement of employment that will include components on environmental protection and rules for use of the Park.

It is the responsibility of the proponent to ensure that all the workforce, including contractors and sub-contractors, carry out their work with due regard to the minimisation of environmental impact. To this end company personnel should regularly inspect construction operations to promote environmental management measures and ensure they are being carried out.

6.14 Community Considerations

6.14 (i) Regional Development

While the project operational workforce will come mainly from existing Tom Price residents there will be a considerable number of new job opportunities during the construction phase. Concerns were raised about the fly-in/fly-out nature of the construction workforce and there is a need for the proponent to undertake a regional skills survey.

The Environmental Protection Authority acknowledges the strong regional employment and economic arguments presented in the ERMP and has concluded that perhaps the ERMP is not the appropriate forum for arguing the merits or otherwise of fly-in/fly-out and the need for a skills survey. The Environmental Protection Authority notes that there is growing resentment to fly-in/fly-out in some Pilbara townships and that a community group has been established to inter-alia approach all companies in the district (on-shore and off-shore) utilising this method of employment. This issue is the responsibility of the Department of State Development.

6.14 (ii) Cultural Issues

The Environmental Protection Authority noted submissions from organisations and individuals on archaeological and ethnographic matters and that the loss of culturally important sites and other environmental impacts could have a social impact on the contemporary Aboriginal community, its culture, leadership and cohesion.

The Karijini Aboriginal Corporation represents the project area and the Authority supports its continued involvement in matters concerning the areas impacted by the project. The proponent has included the Karijini in its community consultation programmes before and after the preparation of the ERMP. The Authority notes the company's commitment to liaise, on an ongoing basis, with the Karijini and other Aboriginal organisations.

Recommendation 13

The Environmental Protection Authority recommends that the proponent should establish a consultative mechanism, involving the local authorities, the community and the National Park managers, to monitor the impact of the project on local communities, as contained in the proponent's commitments, to comply with Recommendation 14.

6.15 Environmental Management

The proponent has made a number of commitments to monitor and manage the environmental impacts of the proposal (Appendix 1). The Environmental Protection Authority considers that the proponent's commitments and the Authority's recommendations based on its assessment of

the proposal should be drawn into an overall environmental monitoring and management programme for all aspects of the development.

Hamersley is required, as part of its reporting requirements under its State Agreement Act, to provide proposals for environmental management and monitoring to the Minister for State Development for approval. It would be appropriate, if possible, to produce a joint document(s) to meet the requirements of the Minister for the Environment and the Minister for State Development.

Recommendation 14

The Environmental Protection Authority recommends that the proponent prepares an Environmental Management Programme, which draws together the proponent's commitments and the previous recommendations in this report to meet the requirements of the Minister for the Environment on the advice of the Environmental Protection Authority and the National Park managers.

The programme should contain, but not necessarily be limited to, the following elements:

- **protection of significant flora and fauna (Recommendation 2);**
- **drainage management (Recommendation 5);**
- **management and monitoring of the impact of groundwater drawdown (Recommendation 6);**
- **management of weeds (Recommendation 7);**
- **management of fire (Recommendation 8);**
- **rehabilitation of the project area (Recommendations 9 and 10);**
- **management of visual impact (Recommendation 11);**
- **waste management and monitoring (Recommendation 12); and.**
- **monitoring of impacts on the community (Recommendation 13).**

The Environmental Management Programme should be prepared in stages. The first stage, prior to construction, should address the management of those parts of the environment requiring protection during construction, and should be approved prior to the commencement of site works to meet the requirements of the Minister for the Environment.

The second stage, prior to commissioning, should address the management of the other issues, and should be approved prior to commissioning of the operation to meet the requirements of the Minister for the Environment.

Subsequent stages should be prepared and submitted as necessary to meet the requirements of the Minister for the Environment.

The implementation of the approved Environmental Management Programme and on-going investigation and reporting should meet the requirements of the Environmental Protection Authority in consultation with the National Park managers.

In the event that monitoring shows any unacceptable impacts, the proponent should prepare and subsequently implement a plan to mitigate these impacts to meet the requirements of the Environmental Protection Authority in consultation with the National Park managers.

7 Conclusion

The Environmental Protection Authority considers that the environmental impacts associated with the Marandoo mine and Central Pilbara railway proposal are manageable and that it could proceed subject to the recommendations made in this assessment report, and the commitments provided by the proponent.

8 References

AGC Woodward-Clyde 1991, *Marandoo Iron Ore Project Initial Assessment of Environmental Hydrogeology*, Report prepared for Hamersley Iron Pty. Limited.

Department of State Development 1992, *Future Iron Ore Developments in the Pilbara*, Submission to the Environmental Protection Authority.

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Hamersley Iron Pty. Limited 1992, *Marandoo Iron Ore Mine and Central Pilbara Railway*, Environmental Review and Management Programme.

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IUCN/UNEP/WWF 1980, *World Conservation Strategy: Living Resource Conservation for Sustainable Development*, International Union for Conservation of Nature and Natural Resources, United Nations Environment Programme and World Wildlife Fund, Gland, Switzerland.

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Ninox Wildlife Consulting 1992, *Report Marandoo Project Area - Vertebrate Fauna Assessments (1975-1991)* , Unpublished Report prepared for Enviroscan.

Randell, B.R 1992, 'Mulga. A Revision of the Major Species'. Journal of Adelaide Botanical Gardens, vol. 14, pp. 105-132.

Start, A N et al 1991, 'Mulga and Fire', *Landscope* 6(4): pp. 20-27.

Western Australian Government Policy Report 1990, *Resolution of Conflict - A Clear Policy for Nation Parks.*

Appendix 1

Proponent's Commitments

COMMITMENTS

Some of the issues dealt with in this ERMP have the potential to result in identifiable environmental impacts. The previous chapter dealt with their management so that impacts will be avoided, minimised or mitigated and the environment protected.

This chapter presents a summary of those commitments made by Hamersley which address these potential impacts. Each commitment is numbered to assist with referencing during the period of review and EPA assessment.

The commitments are also grouped according to broad commonality of their purpose towards environmental protection. They are first described and then listed in Table 15.1. It will be appreciated that a significant number of these commitments are listed largely as a matter of information for the community, to indicate that Hamersley plans to take various management actions internally on a variety of issues that may be of interest to those participating in the ERMP process. Matters such as encouraging appreciation of the Park (No. 7) and research into land units (No. 14) are clearly internal issues for Hamersley, yet because they are consistent with Hamersley's environmental policy and relevant to this ERMP, they are enunciated and listed. The "auditor" for such issues is properly Hamersley (HI), but Hamersley will routinely include such matters in its regular reports to the Department of State Development.

In other instances, the listed "auditor" may be an appropriate Government instrumentality under a regulation or statute, or by arrangement, such as with CALM in the co-operative research programme on the Pebble-mound Mouse.

GROUP 1—SOCIAL FACTORS

Environmental Care and Understanding

1 Educational and environmental induction courses for Marandoo personnel will be instigated, prior to the construction phase, to address the broad issues of conservation of flora and fauna. As a condition of employment, employees will attend an induction programme designed to create an environmental awareness. CALM will be consulted during the development of the courses.

Recreational Care

2 The expertise and knowledge gained from the Channar construction camp will be applied in minimising environmental impacts of construction workers at Marandoo during their leisure hours.

Aboriginal Heritage

3 Part of the induction course (see No. 1) will address Aboriginal heritage issues to increase awareness of Aboriginal cultural heritage.

4 The views of Aboriginal people in Onslow and Roebourne who claim traditional affiliation with the Project Area will be sought by Hamersley's Aboriginal Liaison Officer who will:

- assist in preparation of inductions (see above)
- advise Hamersley on any Aboriginal cultural matters.

5 Employees and contractors at Marandoo will be made familiar with any applicable requirements of the *Aboriginal Heritage Act 1972–1980*.

Community Needs

6 Tom Price needs in terms of housing, services and facilities are already considered adequate. Any additional needs identified during the project feasibility study stage will be minimal and will be addressed at that time.

7 Hamersley will assist protection of the Park values by encouraging amongst its local employees an understanding and awareness of the importance of the Park.

Employment

8 Hamersley will continue to give careful consideration to the employment needs of women, Aboriginal people and young people.

9 Hamersley will continue to support opportunities for Aboriginal employment through its Ieramugadu programme.

10 Hamersley will develop a programme through its Aboriginal Liaison Officer presently stationed at Onslow, to explore, trial and implement practicable and effective training and employment projects, in close co-operation with responsive individuals and groups of Aboriginal people.

GROUP 2—ENVIRONMENTAL RESEARCH AND MANAGEMENT

Protected and Rare Species

11 Hamersley will support research with CALM on the range, distribution and taxonomy of the Pebble-mound Mouse, as outlined in this ERMP.

12 Special attention will be given to the occurrence of any Bilby habitats in future fauna surveys.

13 Hamersley will include in its induction programme (see No. 1), information to assist in protection of rare and significant species of fauna and flora.

14 Hamersley will continue to progress its regional land-unit work, and to continue to research its environmental predictive capabilities for future mines.

15 Hamersley will, as far as practicable, avoid damage to significant vegetation communities in the Project Area and where appropriate will consult with experienced botanists to achieve this aim. Where mining operations will remove a particular community locally, Hamersley will consult with CALM prior to taking appropriate action.

Rehabilitation

16 Construction activities will be conducted so as to minimise any necessary disturbance to the environment. Areas disturbed for construction purposes will be rehabilitated as soon as practicable after they are no longer required for the project.

17 Rehabilitation of disturbed areas will be undertaken in accordance with the guidelines set out in the ERMP. Monitoring of rehabilitated areas will be undertaken and the findings reported. Remedial work will be undertaken if required.

18 Final landforms will be designed to be safe and stable.

19 At the end of the construction period, the construction camp will be removed and the servicing areas and evaporation ponds will be ripped and revegetated.

20 A fire management policy for the Marandoo Project Area which is compatible with the management objectives for the Park will be developed in consultation with CALM.

21 Hamersley will wherever possible use seed derived from local sources during rehabilitation works. If local seed is not available Hamersley will consult with CALM prior to determining alternatives.

Protection Against Weeds

22 Measures to prevent and restrict the introduction and spread of weeds will be investigated and managed after consultation with CALM.

Protection of Fauna and Interruption of Habitats

23 Possession of pets and firearms by project personnel will not be permitted in the Project Area. The induction courses will provide information on the conservation of fauna and their habitats.

Pollution Control and Monitoring

24 Appropriate dust suppression measures, including water sprays and dust collector systems, will be implemented to ensure that acceptable ambient and occupational dust levels are achieved, as required by the *Mines Regulation Act Regulations 1976*.

25 Dust monitoring programmes will be established to assess ambient dust levels for environmental purposes and respirable dust levels and fibre sampling for occupational health and safety purposes. The monitoring programmes will be developed and conducted in accordance with the *Mines Regulation Act Regulations 1976*.

26 Monitoring of occupational noise levels will be undertaken in accordance with the *Mines Regulation Act Regulations 1976*.

27 Hamersley will develop a "closed" system for the treatment of contaminated waters from service areas.

28 Toxic wastes will be removed from Marandoo and disposed of at existing approved sites.

29 Used oil will be collected, stored in bunded above-ground tanks and transported to Dampier for use in the power station.

30 Sewage effluent will be dealt with in accordance with the requirements of the *Health Act 1911*.

31 Licences will be obtained under the *Poisons Act 1964* for relevant materials.

32 Waste disposal will be in accordance with an EPA licence.

Water Conservation and Management

33 Hamersley will undertake further detailed hydrological, geological and mining engineering studies during 1992–1993 to provide inputs into the study of end-use options.

34 Hamersley will continue to refine computer simulation of the groundwater systems.

35 Hamersley in conjunction with CALM will monitor Bandjima Pool and Mindi Spring to develop a more complete understanding of their hydrology.

36 Selected monitoring bores will be established to assess groundwater levels and quality on a routine basis.

37 Where practicable and as appropriate, surface water samples will be collected from major discharge points of the open water system to test for contamination.

38 Hamersley will continue its weather observations at Marandoo, to maintain a regional meteorological data base.

39 Design and location of the borefield for the long-term operation will take into account the need to limit vegetation impacts to an acceptable level. Monitoring of groundwater and vegetation will be undertaken and appropriate remedial action taken as required.

GROUP 3—AESTHETICS AND VALUES OF THE PARK

40 Under the Statement of Mutual Understanding, Hamersley will work with CALM to refine and implement an agreed end-use plan for the mine site after decommissioning.

41 The location, design and colour of surface facilities will be chosen as far as practicable in sympathy with the landscapes.

42 Hamersley will sign its roads as far as practicable in sympathy with CALM's management practices.

Appendix 2

Proponent's Response to Submissions

MARANDOO MINE AND CENTRAL PILBARA RAILWAY

PUBLIC SUBMISSIONS ON THE ERMP -
RESPONSES
TO THE EPA SUMMARY OF 26TH MAY, 1992
by
HAMERSLEY IRON

27 July 1992

Hamersley Iron Pty. Limited
GPO Box A42
PERTH WA 6000

Table of Contents

Introduction

Hamersley's consultation with the community on this project, which is documented in the ERMP (Chapters 12 and 13), continued after the ERMP was printed.

More than 2,000 individuals attended a total of over 60 Community Briefings on the ERMP in the Pilbara and Perth. Those who attended represented a wide cross-section of the community, including business and conservation groups. A Hot-line was established, phoned or faxed by more than 180 members of the public. Hamersley gave many media interviews and organised site visits. In addition, Hamersley distributed information about the project via 7,000 copies of the Marandoo Overview, more than 800 copies of the ERMP, 250 copies of a Marandoo Video and 73 copies of specialist reports or ancillary information.

About 610 substantive submissions were made to the EPA. From the summary provided by the EPA, 60 issues were identified, and responses prepared by Hamersley are included in this Appendix. Although not ranked in priority, the issues which were of most common or broad interest are generally treated first, with some grouping of related interests to assist the reader. However, many issues have common points of interest or overlap. An index is included for easy cross-reference.

Since the ERMP was published in February, 1992, Hamersley has carried out further research on flora, fauna and hydrogeology, as foreshadowed in the ERMP. It also had useful discussions with the EPA, Australian Heritage Commission and other government officers from several agencies. Where appropriate, such additional information has been included in these Responses.

Thus the Responses contain several significant new items of information. Several arise from continued progress by Hamersley in engineering design, for example in refining the provisional railway alignment to give much more detail about management of possible effects on flora (Response 3). Others arise from new environmental research, for example in flora surveys (Response 10) and in the Pebble-mound Mouse study (Response 7), both of which show, as expected, that there are viable and extensive communities in areas that will not be disturbed by the project.

Some new information arose simply from requests in the public submissions, such as the different numbers of people in the construction workforce over 2 years (Response 41).

The majority of the responses clarify issues which were treated in the ERMP, but perhaps not in as much detail or on a particular aspect of interest to the person who made the corresponding submission. Several broad, strategic issues are also dealt with in these responses, highlighting matters raised in some submissions.

The additional field research and discussions with agencies have further confirmed Hamersley's confidence in the ERMP. They have validated the conclusion that the Marandoo iron ore mine and the Central Pilbara railway will have minimal and acceptable environmental impact on the Karijini National Park, arguably the most important environmental issue. The project will be managed so that, where practicable, any other environmental impacts will be mitigated. Hamersley has given 42 Commitments in the ERMP, summarised in Table 15.1.

In summary, the project, which has greatly advanced knowledge and understanding of the Pilbara environment, which is essential to the future of the towns of Tom Price, Paraburdoo and Dampier, and which helps to ensure that Hamersley continues to contribute to community prosperity in Western Australia, is also environmentally acceptable.

because most large industrial developments, such as Marandoo, proceed under the terms of a Government Agreement Act (ERMP Sections 1.4 and 1.5).

There are various options available to Hamersley, commensurate with market and other commercial considerations, in the development of future mines in the Central Pilbara (ERMP Section 2.4). Associated with any Hamersley plan for future development of deposits in the Central Pilbara, is the medium to long term plans of other iron producers in the region, details of which are unknown to Hamersley. For this reason, it is impossible to assess completely the cumulative impacts of future unspecified development plans being considered in the Central Pilbara as part of the assessment of the Marandoo mine and Central Pilbara railway. Instead, the environmental assessment of each proposed mine (when plans are developed following detailed feasibility studies) will address the cumulative impacts of that new proposal. On this basis, proposals for future mines will be assessed on their own merit and will need to take into account their cumulative impacts, if any, on other operations in the region, such as Marandoo.

The overall Hamersley strategy is to maximise use, where practicable, of existing infrastructure (ERMP Sections 1.3, 1.4, 2.6 and 4.2). This also minimises the cumulative environmental impact of each project (ERMP Section 1.1), because it minimises the amount of new construction.

An important environmental advantage in combining the Marandoo Mine and the Central Pilbara Railway in the single ERMP is that any cumulative environmental impact of the two on the KNP was assessed in this one study. As the EPA guidelines stated (ERMP Appendix One) "protecting the environment means that the natural and social values associated with Hamersley Range National Park are protected. Where they cannot be protected, proposals to mitigate the impacts are required." Any environmental impact of the Central Pilbara Railway on the Park itself will come not so much from the trains on it, or their origin, but from the actual construction and then the continued existence of the railway.

The Australian Heritage Commission (AHC), in its submission, accepts that the Project Area may be more degraded from previous activities than the Park itself, and that it does not suggest that the Park itself is pristine or necessarily of high wilderness quality. It states that any evaluation of impact on the Park must be subjective.

The corridor concept south of Mount Bruce broadly in a NW-SE alignment was accepted by the National Parks Authority in 1978. It was included in the Draft Management Plan by CALM in May 1989 after extensive public participation. The recent analysis in the ERMP and the evaluation by the AHC, together with extensive community participation in the ERMP, result in the most comprehensive environmental overview that can be possibly made. Further environmental research with Hamersley support as presented in the Commitments, further research and management by CALM, and continued detailed engineering design by Hamersley, will refine matters of detail, but they remain only details.

The important substantive environmental issues have thus been examined and the assessments made and evaluated under extensive scrutiny. The overwhelming majority of more detailed environmental issues have also been resolved as far as practicable, and management processes delineated for any further refinements, if necessary.

Therefore, the decision by the EPA for the ERMP to consider any environmental impact of the mine and the railway together has ensured that the community has been able to assess any cumulative impact at the same time. The development of any future mines in the Central Pilbara, as discussed in the ERMP Sections 2.4 and 2.5, will have negligible additional environmental impact on the Park, which is the focus of environmental and tourist interest in the region.

The mining companies active in the Central Pilbara in the late 1970s supported a corridor on a NW-SE alignment as it provided the most suitable grades for railway operations. South of Mount Bruce topographical trends in the Hamersley Range plateau are oriented NW-SE and tight geological folding places many physical constraints on a cross-Park alignment. Mine development feasibility studies were in progress by:

- Texasgulf - the Marandoo and Rhodes Ridge projects with a railway linking the projects; and

- Cliffs Robe River Iron Associates - the West Angelas project, including a rail link to Cape Lambert.

Both indicated that higher capital and operating costs made going around the Park impractical.

In October 1983, Government released the report "The Pilbara Iron Ore Industry" that reviewed issues affecting the industry to the year 2000. The report predicted significant development of the Pilbara, as the world was recovering from recession and strong growth was forecast for iron ore sales associated with the growth of the Japanese steel industry. A rail link from the Central Pilbara deposits using the National Park corridor was included in the report.

In May 1989, CALM released a draft management plan for the National Park for public review. This draft plan was compiled after considerable consultation including briefing meetings, public meetings, workshops and solicited submissions. The plan includes the corridor for mining infrastructure on the same alignment as agreed by the NPA in 1978. The MRD completed a detailed study of road options in the Park, as a submission for this management plan. The study report is a public document and was released in August 1990.

The Government of Western Australia, on 13 November 1990, released the policy document, *Resolution of Conflict - A Clear Policy for National Parks*, providing guidelines for exploration and mining within National Parks. It includes provision for the rationalisation of infrastructure corridors within the Park and the excision of these from the Park.

Thus there is a long history of acceptance of the necessity of the rail corridor. In summary, the concept might appear attractive that the Central Pilbara iron ore deposits can be developed efficiently without the railway across the Park, but it was accepted as incorrect by the NPA in 1978 and by CALM in 1989. The necessity for this corridor does not depend on the staging or choice of the mines in the Central Pilbara.

Furthermore, both during the public consultations and in some submissions members of the community expressed the view that railways are the least intrusive forms of transport, and that Western Australia already has railways in such National Parks as Millstream, Chichester, Walyunga and Avon Valley. Furthermore, railways operate with less impact than other forms of transport would have.

The ERMP also makes the point (Section 6.7), supported to by some submissions, that the railway's distance from the gorges (more than 30km) means it will have no significant adverse effect on the natural and social values of the Park. The responses of community groups at 19 workshops (ERMP, Appendix Four) appear to give further support to this view.

Thus alternatives to both the mine and the corridor have been well documented, and the case for choosing the option of a corridor across the Park has been accepted both by the former statutory

Area 1 contains a large snakewood community which cannot be avoided by the railway within the existing corridor. The provisional railway route will dissect the snakewood community such that extensive stands are located to the north and to the south of the railway. The culverts in this area will be designed to reduce drainage shadows in the northern snakewood community and in areas of sheetflow on either side which are dominated by mulga.

Area 2 (10.5 km and 11.7 km) - refer Figure 2
These locations along the railway contain two small snakewood communities which cannot be avoided by the railway due to terrain constraints within the corridor. Extensive snakewood communities exist 2km south of the railway alignment. Appropriate sized culverts will be located to reduce the drainage shadows downstream of the alignment.

Area 3 (14.4 km) - refer Figure 2
The provisional railway alignment has been routed as far as possible northward to avoid major disturbance to the volcanic formation which supports a poorly collected species of grass (*Rottboellia formosa*). As stated in the ERMP, this grass is located in the protected rock crevices on this volcanic hill supporting low shrubland of mixed Acacia species (ERMP mapping code 7c). The railway will be routed along the lower slopes on the north side of the hill and therefore result in a limited (300m) incursion into the volcanic formation with virtually no disturbance to the 4-5 km^2 shrubland community.

Area 4 (21 - 29 km) - refer Figure 3
This area contains a restricted mixed Acacia shrubland on volcanics (ERMP mapping code 7c) similar to that described in Area 3. The provisional railway alignment has been routed to the northeast to avoid this shrubland. This alignment will result in:

- two limited incursions into the shrubland, each of similar size as that at Area 3;
- a reduction in the potential impact on localised pockets of plants and plant groupings at the base of the northeast slopes of the volcanic hills;
- intersection with 3 small areas of snakewood community which will require the same drainage considerations as described for Area 2.

Area 5 (33 km) - refer Figure 4
The provisional railway alignment will result in a single 700m incursion through a snakewood community which is in excess of 4 km^2. The railway cannot be re-routed within the existing corridor alignment to avoid this snakewood community. The appropriate use of culverts will reduce the impact on the main surface drainage system and the snakewood community.

Area 6 (68.9 - 73.7km) - refer Figure 5
This area contains plant communities on the Oakover Formation (ERMP mapping codes 6d, 6e and 6f) which are not well represented in the Karijini National Park, but which are not threatened. Avoidance of these plant communities within the corridor is not possible. The provisional railway alignment has been routed to the south side of the corridor as far from the watercourse as possible to reduce the direct impacts on these communities.

Area 7 (73.4 km) - refer Figure 6
This area contains Turee Creek which is the main watercourse that the railway will need to negotiate. The design and location of the crossing has not yet been finalised. Design to take into

reached a specified condition or met established criteria is not practical as it does not take into account site-specific and seasonal conditions. These conditions relate to weather conditions (such as prolonged drought) and type of area being rehabilitated (overburden stockpile, borrow pit, road, mine, etc). Given favourable conditions, successful rehabilitation and revegetation of disturbed areas is generally apparent within 3-5 years, with the likelihood of long-term success evident within 10-12 years.

Monitoring of rehabilitation where appropriate will be undertaken by Hamersley (or its consultants) and reported annually to the State in accordance with the Agreement Act. In the unlikely event that rehabilitation and revegetation do not achieve the stated objectives, then remedial action will be undertaken by Hamersley to ensure that successful rehabilitation is achieved.

Through the Department of Mines, the State will determine to what extent rehabilitation has been successful. The State has the authority to require remedial work to be done on rehabilitated areas, although it has been Hamersley policy to initiate such remedial work as the need is identified.

General Design Principles
Before the railway alignment is finalised, it will be reviewed by Hamersley's flora consultants.

The choice of alignment is determined by the nature of the topography. Of considerable importance is the position of drainage lines. In an overall sense, where the proposed railway and access road will follow valleys, the alignment will be routed along lower slopes rather than in valley floors. This approach will reduce the need for borrow areas and the impact on water flow regimes.

Hamersley recognises the importance of designing appropriate drainage line crossings to reduce the impact upon vegetation. There are essentially two types of drainage crossing: defined creek or river lines, and relatively flat flood plain areas where sheet flow can occur during periods of heavy rainfall.

Defined drainage lines are relatively easy to deal with. Crossings will use either pipe culverts or box culverts (as single or multiple depending on the width of the crossing) or open span bridges. [Examples of these crossing layouts are provided in Figures 4.3 and 4.4 and Plates 2 and 3 of the ERMP]. Figure 6 of this document shows examples of where the major defined-line crossings will be and section 8.6.3 (p. 132) of the ERMP outlines the process that will be undertaken to analyse each specific watercourse crossing.

Sheet flow is more difficult to deal with and construction activities will inevitably produce changes in flow patterns and drainage shadow effects. The objective of drainage design will be to reduce these effects on adjacent vegetation.

Areas where sheet flow problems may present themselves are indicated in Figure 1. Surface water flows from south to north in this area. Where sheetflow is parallel to the rail alignment, normal design will be adequate. Where sheetflow is at an angle to the alignment, regular culverts combined with sill drains - as evidenced in Figure 4.4 of the ERMP - will be required to adequately redistribute water flow.

Thus the continued engineering design has provided much more detail and detailed discussion of possible environmental impacts along the corridor. However, all such findings are entirely consistent with the assessment and conclusions of the ERMP. Such processes of progressive

balance of the Pilbara regions the Park generally appears to have suffered a lesser magnitude of impact from pastoralism and large-scale mining operations.

In the 1978 listing of the Park, the AHC Register recorded that the Condition of the Park is such that its *integrity* [is] *altered by cattle grazing, iron ore mining*. (ERMP Section 6.9).

When the Academy of Sciences committee made the recommendation in 1962 to reserve the Park, they commented that *it is not considered to be good pastoral country*. (ERMP Section 6.5).

What is clear is that the Marandoo Project Area, which is dominantly the land of the Mount Bruce pastoral station abandoned in 1946, is marginal arid land that was grazed unsuccessfully for many decades. It is arguable that the Project Area, being relatively flat in many places, would have been prone to more intensive sheep and cattle grazing than, say, the more rugged portions of the Park itself. It is also arguable that portions of the Park that were degraded in 1978 and/or 1962 might be partly rehabilitated with the passage of time, albeit to somewhat different vegetation communities from those that prevailed prior to grazing. The changes that occur due to natural dynamic forces were discussed in the ERMP Section 11.5.1, 11.5.2 and elsewhere.

The AHC does recognise that the site of the proposed mine may coincide with areas more degraded from past activities, and also that the area to be impacted by the Marandoo mine is a small proportion of the total area listed in the register.

The AHC suggests that *any statement on the level of impact of the proposed mine on the condition and integrity of the whole Park with respect to* [its] *value as a largely unmodified sample of the Hamersley ranges environment will necessarily be subjective.*

Indeed the ERMP clearly states that the community has different opinions on the impact of views from Mount Bruce (Section 6.12 and Section 13.8.1). During the social impact studies, workshops and discussions for the Marandoo ERMP, a variety of community views were revealed.

The high regard in which the community holds the Park was found compatible with development of the Marandoo mine and Central Pilbara railway provided certain management arrangements were assured, as they have been through the Statement of Mutual Understanding with CALM, the managers of the Park. Compare, for example, the Summary of Concerns (issues) of Section 13.8.1 which arose out of discussions of 54 groups at workshops, with the management arrangements listed in the ERMP in Chapter 14 and Appendix 2.

These arrangements are fortified by the Commitments which Hamersley put forward in the ERMP in Chapter 15.

Chapter 6 also reflects the variety of community views ("social values" of the EPA guidelines). Some people would regard being able to see the Marandoo mine from Mount Bruce as intruding on the visual, aesthetic values of the Park itself, while others would view it with interest. The ERMP points out that fewer than about 0.3% of Park visitors are currently climbing Mount Bruce. It is not unreasonable to expect that more will climb it in the future, in part for general interest and in part to view the mine, just as some 8,000 visitors annually pay to view the mine at Mount Tom Price.

However, what is objective reality is the following:

- the ERMP research has materially contributed to the National Estate understanding of the Park itself;

- the future research, eg on the Pebble-mound Mouse and the hydrogeology, will significantly assist the work of CALM in understanding and managing the Park;

- the Statement of Mutual Understanding sets in place management arrangements so that any environmental impact of the project on the Park itself is minimised;

- the significantly more extensive Statement of Significance of the Park itself, endorsed by the AHC in May 1992, came about because of the Marandoo project, and largely derived new flora and fauna information from the findings of the ERMP which the AHC applied to the Park itself;

- the wide-ranging analysis of Chapter 6 validly concludes that any environmental impact of the project on the values of the Park will be negligible or mitigated;

- the net economic benefits of the project to the community are very extensive as well as essential to the future of the towns of Tom Price, Paraburdoo and Dampier;

- the Project Area is largely an old pastoral lease, degraded and abandoned as uneconomic in 1946;

- the Marandoo ore has a present market value of $4.5billion in an area that formerly might have supported a limited number of cattle in a good season.

The conclusions of the ERMP about the possible impact on the Park itself have sometimes been criticised as being subjective. But the AHC itself agrees that its own evaluation is this way.

Under such an array of arguments, any subjective, and challenged, consideration that the project may or may not have negligible impact on some National Estate values of the 600,000 hectare Park itself can be easily put into perspective.

It is appropriate that both the Marandoo mine and the Central Pilbara railway were considered together in the ERMP, because it is their combined impact that needed to be exposed to the ERMP process and the very extensive review by the community. Hamersley appreciates the high regard in which the KNP is held, and the values placed on it. The Marandoo mine and the Central Pilbara railway will not diminish that regard or those values.

Fauna

ISSUE 6:

The fauna studies for the project are not sufficient to give a clear picture of the regional status of species particularly endangered species. Conservation and development need to be viewed on a regional basis. It is not possible to sustain our ecology by looking at development on a case by case basis.

RESPONSE 6:

Hamersley has been a strong proponent of the need to perform environmental studies in a regional context. The regional significance of the Marandoo fauna and flora surveys are discussed in Sections 10.8 and 11.5.2 of the ERMP, respectively and illustrated in Table 6.1 of the ERMP. Both of these sections compare Marandoo results with those of other Pilbara surveys. Gradually, a better understanding of regional ecology is being developed as a result of case-by-case studies. However, there is likely to be continued controversy over such complex issues as the optimum number, sizes, location and management of reserves to conserve particular ecosystems in perpetuity.

Two organisational and logistical challenges must be recognised.

The first challenge is that no one Government agency or private developer has the resources to undertake an ecological survey of the whole Pilbara at a fine level of detail. An understanding of regional ecology will therefore always depend on aggregating the results of case-by-case studies, most often undertaken by resource development companies. To be able to aggregate these studies requires the development of consistent data bases. Hamersley has addressed this problem with CALM to ensure that future field survey methods provide comparable results. The ongoing research into the Pebble-mound Mouse (Response 7) is a practical proof of this approach.

Such regional considerations are also the reason behind the development of Hamersley's "land unit concept" which is outlined in Chapter 9 of the ERMP. The land unit concept can be used as a predictive tool and in environmental planning because it integrates land processes and the interactions between the physical, biological and social spheres over time. In theory it allows fauna habitats to be predicted and judgements to be made about the possible existence of endangered species.

The second challenge is that the populations of rare species are often the result of historical circumstances and their existence cannot always be determined by association with land units. The only certain method of determining the existence of rare species is by ground survey and no private companies have the resources to study an area the size of the Pilbara to such a degree of detail. As the ERMP discusses for the long-tailed Dunnart, further studies can also indicate that a species may not be as rare as previously thought (ERMP Section 10.3.1).

The collective flora and fauna research efforts associated with iron ore projects such as at Mount Tom Price, Channar, Paraburdoo and Marandoo are major contributors to the data base essential to understanding the ecology of the Pilbara.

Work undertaken to date as part of the first phase of the research programme has concentrated on the Marandoo tenement area. This work has already indicated the extent of *P. chapmani* in the tenement and has resulted in the development of preliminary data on their distribution and activity. Further work will be undertaken to provide an understanding of the local range and distribution of *P. chapmani*, by study of the location, density and occupancy of mounds in the Park.

The findings of the research programme have already shown that the project will not threaten the species and therefore no relocation plan is required.

Long term monitoring sites for the Pebble-mound Mouse have been established at the eastern end of the tenement. Consideration is also being given to the establishment of monitoring sites within the Park and elsewhere as part of the ongoing research programme.

Hamersley has committed to contributing to the CALM State-wide recovery programme by carrying out work on the range and distribution of the species. This work might be considered in effect the first phase of CALM's recovery programme. This is being supplemented by the provision of live specimens to the WA Museum, which is undertaking the taxonomic work on the species. This work will continue during Hamersley's regional field studies over several years.

The Pebble-mound Mouse population in the Marandoo area must be put into regional perspective.

Numerous populations of Pebble-mound Mouse have been identified in the Project Area and mounds have been logged on favourable habitat in the Park adjacent to the Project Area. The proportion of mounds demonstrated to be inhabited on the relatively disturbed area of the tenement indicates that large populations must exist in areas of relatively undisturbed habitat in the Park. Consequently the project is unlikely to have any regional impact on the Pebble-mound Mouse.

It is becoming apparent that the pattern of distribution along upper and lower slopes of the hills in the Marandoo region is reproduced in many other areas of the Pilbara where surveys have been made. Hamersley is correlating all the available data as part of its range and distribution studies.

The evidence so far supports the view that the species is not rare in the few locations in which it has been studied (eg. Marandoo). However the full extent of the favourable habitat and distribution within that habitat are not known.

ISSUE 8:

The timing of the fauna survey was not optimum, to take into account migratory birds in the period November-April, and it appears not to be a comprehensive mammal study.

RESPONSE 8:

In addition to actual measurements at Marandoo, the Ninox Wildlife Consulting analysis also used WA Museum records for the region, including review, for example, of CSR data for Yandicoogina. The list of vertebrate species recorded in the Marandoo project area, (provided in Appendix Five of the ERMP), was derived from a detailed review of the historical data involving some 3,400 Texasgulf fauna observations between October 1975 and June 1981, together with 147 personnel days spent in the field by Ninox Wildlife Consulting in September 1990 and in June, August and October 1991.

Flora

ISSUE 10:

THE ERMP does not sufficiently address all the potentially rare species of flora identified in the consultant's report. Will Hamersley be carrying out further studies into the flora of the region, particularly priority flora species in the project area?

RESPONSE 10:

Hamersley will monitor for priority listed species in the project area. Methods will include the following:

- use of suitably qualified botanists who are familiar with the flora in the region;
- identification of likely habitats in which search effort for priority listed species will be concentrated;
- botanical surveys in the habitats considered likely or possible to contain specific priority listed species (refer Section 11.5.4 of the ERMP) will be undertaken.

Hamersley will consult with CALM to ensure mutual agreement on the proposed methodology to monitor for priority listed species.

Further botanical information has been collected by Hamersley which updates the ERMP flora information. For ease of reading, the information is also put into context in the following discussion.

As indicated in Section 11.1 of the ERMP, a number of flora surveys have been undertaken in the Marandoo area. The first survey was conducted in September 1974 by the Western Australian Herbarium (Trudgen, 1975) and was followed by further detailed collections (eg Weston 1977, Texasgulf 1977, Trudgen 1978). By 1982, a total of 306 recognised species had been recorded.

Following a review of previous work in the Marandoo area it was recognised that further work was required to update the flora studies and to extend the information to cover the railway corridor. A major flora survey was commissioned by Hamersley and undertaken by Mattiske and Associates (1992). This survey extended the recorded number of species from 306 to 462. Chapter 11 of the ERMP summarised the findings of surveys undertaken during late 1990 and in May, June and August 1991. The terminology (eg Priority 2, Priority 5, etc.) is given in the same Chapter of the ERMP.

The report on the survey of the flora and vegetation of the Marandoo project area identified a number of "species of interest". After further study of potential impacts, 12 species were identified as requiring specific assessment. Details of each of the 12 species and the proposed action to be undertaken by Hamersley are provided below:

- ***Brachychiton acuminatus*** This is a priority 5 listed species which, under the present classification, means that it is considered to have been adequately surveyed and which whilst being rare (in Australia), is not currently threatened.

  The Western Australian Herbarium holds specimens from six localities: Depuch Island, Wittenoom Gorge, Dampier, (Fortescue River) Balmoral Station, Tom Price and

The Marandoo project is likely to result in the loss of the 31 individuals from the Manganese gully area. One individual plant adjacent to one of the overburden dumps may also be threatened, but could probably be avoided. The project will therefore affect approximately 30% of the known number of individuals. Knowledge of this species and its distribution is presently limited but is expanding rapidly. In view of this expansion of knowledge the project is not considered to represent a major impact on the regional distribution and abundance of the species, and the figure of 30% will inevitably decrease.

The species will be included in the search list for any future surveys, with particular attention to known habitats (gullies and gorges). Further recordings of the species will be reported to the Herbarium. The species will also be included in rehabilitation and revegetation of the minesite and overburden dumps.

- ***Dicladanthera glabra*** This is a well defined species which is uncommon and probably rare with a restricted habitat. It is a small perennial shrub which occurs in gorges on cliffs and steep slopes and may be restricted to white shale outcrops.

Known localities include Bee Gorge, Wittenoom Gorge, Robe River and Hamersley Gorge (2 populations, one with 31 individuals and one with 4 individuals). There are no known populations in the tenement or railway corridors; furthermore, based on habitant preferences, the species is unlikely to occur in these areas. Therefore, the project will have no impact on the species.

The species will be included in the search list for any future surveys in the region. Any sightings of the species will be reported to the Herbarium.

- ***Eucalyptus aff coolabah var. rhodoclada*** This is a probable new species. The taxon is considered to be poorly collected and probably rare.

The species occurs as isolated individuals on the flood plain and in the bed of a medium sized creek. Only two individual trees have been reported: one in the southeast corridor where the creek intersects with the Marra Mamba ridge southeast of Mindi Springs, and the second further up the same creek.

Recent surveys along the railway corridor have indicated that the two known individuals are more than 500m from the railway alignment and will not be affected by it. Similarly, the species is not located in or near any proposed borrow area. Therefore the project will not threaten the survival of any of the known individuals.

As this species is expected to be readily germinated, seed will be collected when it becomes available and then used in the rehabilitation and revegetation of disturbed areas adjacent to railway creek crossings. This species will also be included in the search list for any future surveys.

- ***Flaveria sp*** **(1)** This is a distinct and apparently undescribed species. It is currently a very poorly known species with fairly restricted distribution and possibly rare. It is an annual herb which occurs on plains.

Two localities are known: one at Millstream (population not counted, but not large), the second at the western end of the northwest corridor on Hamersley Station flats. Because it is an annual, it is only evident during good seasons.

region, this species appears to be reasonably common. Its preferred habitat is gullies and under breakaways.

Known locations of the species include Manganese gully, Marandoo Hill (a very large population in excess of 1000 plants), adjacent to the road to Hamersley Gorge, in several gorges south of the orebody on Marandoo ridge, and north of Juna Downs. The population in Manganese gully will be lost due to mining activities. Those located in the gorges south of the Marandoo ridge will not be affected by mining, although the position of the overburden dumps may affect some of these. The current good season has enabled a better understanding of the population levels of this species to be gained. The population in Manganese gully is a relatively small component of the known populations. Due to the known location of other populations, the regional impact on this species is not expected to be significant.

This species will be added to the search list for any future surveys in the region. Any recorded sightings will be reported to the Herbarium.

- ***Triumfetta sp.1*** This species has been confirmed as *Triumfetta leptacantha F. Muell.* It was first collected in 1878 by John Forrest and not recollected until 1974 at Marandoo. It occurs in narrow heads of gullies and slopes below cliffs in gullies. It is currently a rare species with few small populations, and is restricted to the Hamersley Ranges.

  Known localities include: Manganese gully (2 populations, 65 and 10 individuals), Marandoo Hill (unknown), Mount Bruce (2 populations, unknown number of individuals), Hancock Gorge (unknown number of individuals), Marandoo Ridge (2 populations, 3 and 39 individuals) and Mt Pyrton (unknown number of individuals).

  The 75 individuals in Manganese gully are situated over the orebody and will be lost due to mining activities. Although the Manganese gully population is the largest known, there are other populations in Karijini National Park and surrounding areas which will not be threatened. The extent of regional impact on the species is uncertain because the population sizes at a number of localities is not known.

  This species will be included on the search list for any future surveys in the region. The populations located on Marandoo Ridge will be marked such that they are not disturbed by mining activities.

The updated information on the specific assessment of these 12 species complements the information in the ERMP and the specialist report by E M Mattiske & Associates.

Thus the further botanical studies since the ERMP was published have expanded the data base and have confirmed its conclusions that any environmental impacts will be minimal or mitigated. The wider geographical distribution of such species outside the Project Area is confirmed. The additional data above now make it possible to complete management programmes as described.

Site specific surveys along the routes of the railway and roads, and at the location of proposed borrow pits, laydown areas, roads, construction camps and other areas likely to be disturbed through construction activities will be undertaken in advance of the commencement of site construction work. The location of the above species in the Marandoo project area will be recorded. Identified populations will be clearly designated in the field to enable personnel to recognise the areas to be avoided.

catchments resulting in an elevated drainage system totally at variance with the visual and topographic standards required for return of the land to park use after mining.

Therefore, any proposal to retain the area of floral interest would be neither environmentally nor economically viable.

ISSUE 13:

Modifications to surface drainage and watertable levels may affect rare mulga stands and the unique coolabah woodland which depend on soil moisture levels. The evidence presented in the ERMP is inadequate to show that this vegetation would not be affected by drainage modification or lowering of the water table.

RESPONSE 13:

The mulga stands at Marandoo are not rare. They are typical of the region. Similarly, as discussed in Section 11.4 of the ERMP, "the extensive stands (of Coolabah) on the Mount Bruce Flats are not unique but are the only known examples in an undamaged state".

Nevertheless, Hamersley is concerned to minimise or mitigate environmental impact on such vegetation, and has carried out extensive hydrogeological studies, including some foreshadowed in the ERMP and carried out since its preparation..

Sections 4.3 and 8.6 of the ERMP discuss the potential impact of the mine and railway on surface drainage patterns. These sections present the design options that will be chosen to reduce the impact on drainage patterns.

Section 8.4 of the ERMP discusses the potential impact of groundwater development on Marandoo vegetation.

At Marandoo, the existing borehole data has been used to predict the depth and areal extent of the cone on depression around each bore over the expected life of the mine (about 15 years). The result of this prediction is based on assumptions about how much of the rainfall runoff to the basin actually reaches the aquifer as recharge.

Under worst case assumptions (zero recharge of the aquifer from rainfall) the area around the borefield is predicted to have its water table reduced from about 40m below groundlevel to about 55m (ie by 15m) over the life of the mine. Under the same conditions the area of mulga/eucalypt woodlands east of Mount Bruce would experience a reduction in its watertable from about 20m below groundlevel to about 25m (ie by 5m) over the mine life.

If a more realistic assumption of 7mm/year equivalent rainfall recharging the groundwater is adopted, the borefield drawdown is predicted to be 10m, (i.e. from the existing watertable depth 40m down to 50m). The woodland drawdown would be nil. As the ERMP reports, 7mm would correspond to about 2% of the average annual precipitation, and is a figure from earlier studies (Section 8.4.1).

More data are being collected to enable more accurate predictions to be made based on much better estimates of vertical infiltration. These new predictions are expected to confirm that there will be no long term vegetation impacts from the borefield. It will also provide the data needed to

ISSUE 14:

Will Mindi Spring and Bandjima Pool be effected by the lowering of the water table through groundwater pumping? How will this be monitored? If a problem occurs what action will be taken to correct it? Will effects be felt on the water supplies of Tom Price and other communities?

RESPONSE 14:

The regional impacts of groundwater abstraction at Marandoo were simulated using a two-dimensional finite difference groundwater model which was later upgraded to provide a more realistic simulation of likely changes in the watertable near the borefield. The groundwater model was used to simulate the regional impact of groundwater abstraction on vegetation and springs.

The ERMP indicates that on the basis of the groundwater simulation model, neither Mindi Spring nor Bandjima Pool is likely to be affected by groundwater abstraction associated with the project. Specifically, Section 8.4.3 (page 129) of the ERMP states that "Mindi Spring is remote from mining and well beyond the predicted zones of influence of the groundwater abstractions".

Although Bandjima Pool is closer to the mining area than Mindi Spring a study of the geological environment of Bandjima Pool shows that it located in a different geological structure from that in which the orebody and the groundwater aquifers lie. There is no groundwater path from the Marandoo aquifers to this water hole. Thus the project is unlikely to have an effect on the quantity or quality of water present in it. Observations over the approximately 20 years since Hamersley or Texasgulf have had a presence at Marandoo indicate that during extended dry periods and without any significant groundwater abstraction, Bandjima Pool has on occasion become dry.

The recently initiated hydrogeological studies and the new three dimensional groundwater modelling will provide a better understanding of the hydrogeology in the area which will facilitate better predictions of potential impacts on expressions of surface water, particularly Mindi Springs. As indicated in the ERMP (Section 8.4.3 and Commitment 35) the springs will be monitored by regular visual inspection and, in the case of Mindi Spring, by nearby boreholes, to study changes in water level. In the unlikely event that groundwater abstraction affects the springs, changes will be made to borefield management to alleviate the problem.

Section 14.8 of the ERMP indicates that the localised drawdown which may result from groundwater abstraction at Marandoo is not expected to affect the Tom Price water supply sourced at the Southern Fortescue borefield. The Water Authority of Western Australia submission concurs with this assessment, stating that "the proposed use of groundwater for minesite operations [at Marandoo] is not likely to impact on the Tom Price wellfield."

Hamersley is of the view that the work undertaken along the powerline corridor was appropriate and adequate for the purposes of the ERMP.

The detailed design for the powerline between Tom Price and Marandoo will be developed once the project proceeds to the detailed design phase. Section 4.6 of the ERMP describes the principles that will be used. Adherence to these principles will ensure that the powerline is built in accordance with the best engineering practice to reduce any adverse environmental impact on the area.

ISSUE 16:

What effect will dust have on the vegetation?

RESPONSE 16:

Dust is a natural part of the Pilbara environment and the flora is well adapted to the arid and dusty conditions. During the dry months of the year (refer Figure 7.1 of the ERMP), prevailing winds generate significant amounts of atmospheric dust. The flora in the region is able to tolerate the accumulation of dust until the next rainfall event washes it away. However, prolonged dry periods, during which winds generate high dust levels, may have the potential to affect the health of less tolerant plants.

Section 4.10.2 of the ERMP outlines the dust suppression measures to be adopted to minimise the amount of dust generated in the Marandoo area. A significant source of dust is from vehicles travelling over unsealed roads. The sealing of the Marandoo access road and roads in the plant area will ensure that little dust will be generated from these areas.

Chapter 15 of the ERMP outlines the commitments made by Hamersley in relation to the project. The 42 commitments cover the following areas:

- environmental care and understanding
- recreational care
- Aboriginal heritage
- community needs
- employment
- environmental research and management
- protected and rare species
- rehabilitation
- protection against weeds
- protection of fauna and interruption of habitats
- pollution control and monitoring
- water conservation and management
- aesthetics and values of the Park.

All of these are management issues, and constitute collectively a management programme. Because detailed design is not complete, consultative and reporting programmes and commitments are included as part of the programme. Hamersley has committed to undertake additional research and management work in the following areas:

- the predictive capabilities of the regional land-unit approach
- Pebble-mound Mouse research
- hydrological and geological studies
- computer simulation of groundwater systems
- weather observations
- development of an end-use plan.

Hamersley will undertake further work on the conservation status of the Pebble-mound Mouse and flora species of special interest, including ground surveys within the tenement and corridor and in the Park. Much of this additional work is underway, to the extent that it can validly be justified before approvals give confidence for further investments and expenditure.

Such work will provide additional information. Together with existing information, it will be used to further develop specific management actions in consultation with CALM in accordance with the Statement of Mutual Understanding (see ERMP Appendix Two).

Such management will also provide responses to the requirements for annual and tri-annual reporting under the Agreement Act. These management programmes will build upon those general principles outlined in the ERMP and their scope will include the following:

- fauna - surveys and rare species
- flora - distribution of rare or restricted species
- groundwater
- rehabilitation
- landscape strategies
- fire
- weeds
- feral animals
- construction workforce

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Examples that are documented include:

- Department of Mines (1988) *Guidelines for Environmental Management of Mining in Arid Areas*;
- Main Roads Department (1989) *Guidelines for Planning, Operation and Rehabilitation of Borrow Pits*;
- Main Roads Department (1982) *Conservation and Regeneration Techniques*.

Rehabilitation is dealt with in Section 11.8.2 and management of rehabilitation is addressed in Section 11.8.3 of the ERMP.

Because borrow pits will be dealt with early in the project and are a major part of the rehabilitation programme, their rehabilitation is discussed in detail below.

No borrow areas will be established within the boundaries of the National Park. Borrow areas will be progressively rehabilitated during the construction phase of the project and not "left to natural forces". Prior to the establishment of borrow pits, rehabilitation planning will consider the following:

- delineation of the shape and extent of the pit (the optimum shape is elongated);
- identification of optimum location for topsoil and vegetative stockpiles;
- identification of the need for and locations of vegetative islands in larger pits.

The rehabilitation and revegetation of borrow pits will then involve the following general principles:

- configuring the pit sides and floors to a shape which will facilitate rehabilitation;
- incorporation of material stored in "work material" stockpiles;
- installation of diversion drains and contour banks where appropriate;
- deep-ripping along contours where appropriate;
- spreading pre-mixed seed obtained from local native plants where possible;
- application of appropriate fertiliser with seed;
- limiting vehicular and pedestrian access;
- monitoring and reporting progress of rehabilitation.

This rehabilitation and revegetation prescription has been demonstrated to be effective for borrow pits at Channar and is expected to be equally successful at Marandoo.

More generally, rehabilitation of other disturbed areas, where appropriate, will follow the same general principles. The establishment of a set time frame by which rehabilitated areas must have

appropriate sections of the *Bush Fires Act 1954*. In addition all personnel are instructed in fire prevention measures and in the use of equipment and basic fire-fighting techniques.

Maintenance crews will be prohibited from lighting unnecessary fires.

The presence of the Marandoo operation, together with the personnel and fire-fighting and earthmoving equipment, will help minimise the risk of natural wildfires in the Karijini National Park or adjacent areas, such as those which have occurred in the past. The new Marandoo access road will also improve the availability of fire fighting equipment and fully trained personnel from Mount Tom Price.

ISSUE 20:

The ERMP does not address the issue of servicing, repairs etc of construction equipment. How will this be handled to minimise (environmental) impact?

RESPONSE 20:

Section 4.9.3 of the ERMP describes the waste management measures to be adopted for the servicing of heavy earthmoving equipment during the construction phase.

Hamersley trials using bioremediation at Dampier for on-site treatment of the oil fractions of washdown water from workshop areas have been very successful, resulting in equipment being commissioned at Paraburdoo. Subject to satisfactory performance at Paraburdoo, similar facilities may be installed at Marandoo during operations.

ISSUE 21:

No liquid waste should be allowed to flow untreated into the environment. What is to be the design of traps, ponds etc for the management of liquid waste? Are they to be lined?

RESPONSE 21:

Section 4.9.3 of the ERMP indicates that there will be two types of liquid waste generated - domestic sewage and industrial waste, and describes how they will be managed. No toxic chemicals are used in the process plant and industrial waste will consist of fine soil particles suspended in water with a small amount of oil contaminants.

All industrial waste likely to be contaminated by oil will report to watertight interceptor pits where the oil will be separated and collected for disposal off-site. Effluent from the interceptor pits will report to unlined settlement ponds together with uncontaminated water from other areas containing fine particles in suspension. The settlement ponds will be designed to dispose of the water by infiltration and evaporation except during periods of rainfall when there may be some discharge of water to water courses which would already be in flood due to rainfall in the area. The settlement ponds will be divided into separate compartments so that silt build up in the ponds can be removed from each compartment in turn. This system has been in general use in the Park for many years and has proven to be effective.

The effect of noise from blasting on fauna will be similar to that which occurs in areas adjacent to similar mines in the Pilbara region. Experience at other Hamersley minesites has suggested that fauna generally become familiar with the noise associated with periodic blasting, and their normal activities are not significantly disrupted.

ISSUE 24:

The possible presence and management of asbestos at Marandoo is of concern because of the history of Wittenoom.

RESPONSE 24:

Hamersley appreciates that there is sensitivity about asbestos because of Wittenoom and included the subject in the ERMP although it was not explicitly one of the key issues in the guidelines.

Section 4.10.3 of the ERMP indicates that no asbestos fibre-types have been found in ore zones at Marandoo or in any of the other Marra Mamba deposits tested. Exploration drilling has indicated narrow crocidolite veins in BIF beneath the Marandoo ore deposit, but these occur some 6-8m beneath the orebody and will not be mined. Traces of asbestiform minerals - mainly crocidolite - have been detected in some scree/surface material. Similar material has not given rise to hazardous airborne fibre levels at any iron ore mine in the region.

Hamersley will implement a comprehensive dust monitoring programme based on both personal and positional dust sampling devices. Samples will be collected from each hole and shaft and every major lithological unit traversed during the infill evaluation work over the entire IMA prior to the commencement of mining. Dust counts will be carried out and fibres identified to determine their mineral composition.

Hamersley has established procedures and standards for control of dust for its preconstruction drilling programme (refer Section 4.10.3 of the ERMP). Where potential exists for exposure to fibre minerals above designated action levels during construction and mining operations, similar procedures and standards will be applied.

In the unlikely event that hazardous fibres are encountered during construction and mining operations, the Mines Department's "Protocol for the Management of Asbestos Associated with Mining Operations" will be invoked. In addition, induction procedures will inform employees about the origin and effects of fibrous minerals, procedures for use of personal dust samplers and correct use of respirators.

Furthermore, Commitment 25 of the ERMP states that "dust monitoring programmes will be established to assess ambient dust levels for environmental purposes and respirable dust levels and fibre sampling for occupational health and safety purposes. The monitoring programmes will be developed and conducted in accordance with the *Mines Regulation Act Regulations 1976.*"

It should also be understood that iron ore processing at Marandoo will not involve the production of any tailings.

weed control measures for the Karijini National Park (KNP). Furthermore, Section 14.9 of the ERMP indicates that workforce education during the induction programme will include the importance of preventing the introduction and spread of exotic species. Regular monitoring for weeds in the project area will be undertaken by Hamersley.

Measures used for control of weeds need to be site specific. Hamersley recognises the sensitivities associated with the introduction of weeds at Marandoo and procedures will give regard to the weed control measures in use in the KNP.

ISSUE 27:

Culverts need to have rocks, logs etc. placed in them to provide shelter for small fauna endeavouring to cross the rail line or access road.

RESPONSE 27:

Drainage culverts will be provided which will facilitate access for small fauna from one side of the railway or access road to the other (ERMP Section 14.10). Some culverts will also be placed in some areas subject to sheet flow, outside clearly defined drainage lines, and thus such movement of small fauna will be assisted. The placement of logs, rocks etc. in culverts will not significantly help small fauna but may block efficient water movement through the culvert. However, minor debris that collects naturally in culverts will be left, to provide adequate cover for most small fauna.

ISSUE 28:

Contingency plans for accidents such as fuel spills and discharges do not appear to have been addressed even though such issues were included in the EPA's guidelines.

RESPONSE 28:

Hamersley will establish containment structures around the fuel storage areas at Marandoo in accordance with statutory requirements. Figure 3.3 of the ERMP depicts in stylised form the bunding around the fuel storage area adjacent to the security complex. Vehicle fuelling sites will be sealed to reduce dust and enable spillages to be contained.

The Water Authority has recommended that any significant spillage of toxic or hazardous materials should be reported with minimum delay to the Regional Services Engineer at the Karratha office of the Water Authority, and that approved remedial action be undertaken. These requirements for notification and remedial action will form an important component of the emergency procedures to be developed and implemented by Hamersley for handling accidents involving toxic or hazardous substances, as referred in Section 14.8 of the ERMP.

ISSUE 31:

What are the environmental safeguards to protect the Park during water exploration and operation of the bores? Does the water exploration licence have conditions for the protection of the park? If so what are they? How is access gained to the bores and wells used for the project? Does the company have to pay for the use of the water resource?

RESPONSE 31:

The proposed production borefield is not in the Park (see Fig. 4.5, ERMP).

However, portion of the hydrogeological work will be carried out in the Park. The hydrogeological investigations permit granted by CALM for this part of the work includes conditions for the protection of the Park. They include:

- Hamersley must comply with the provisions of the *Conservation and Land Management Act 1984*, the *Wildlife Conservation Act, 1950-1979* and *Wildlife Conservation Regulations 1970, National Parks Authority Regulations* and any notices that are in force under these Acts and Regulations;

- locations of drill sites, access, movement of rigs, disposal of cuttings and construction and testing of bores within the Park are to be supervised by a CALM ranger.

Vehicles will use existing formed tracks whenever possible. A minimum of new permanent tracks will be created by Hamersley and all new access tracks in the Park will be closed and rehabilitated to CALM's satisfaction.

Hamersley will pay normal charges which are associated with the granting of a groundwater abstraction licence issued by the Water Authority.

The hydrogeological research carried out by Hamersley for its operational requirements will provide CALM with additional information that could be of considerable value in understanding the total ecology of the Park. The cooperative process on this issue is given in Clause 7 of the Statement of Mutual Understanding (ERMP Appendix Two).

ISSUE 32:

What is done with the drilling fluid from the drilling programme? How is soil compaction from drilling rigs, both in the park and in the project area, minimised?

RESPONSE 32:

Drilling fluids will only be required if the hydrogeological conditions encountered during drilling warrant their use.

Where drilling mud is required during the drilling programme it will be contained within an earth bund or pit. When these pits are dry they will be backfilled and covered with topsoil material.

Significant compaction of soil around drill sites is not expected to occur. Bores will be drilled quickly and drill rigs will be rubber tyred.

ISSUE 35:

Overburden should not be dumped in the two gullies to the south of the Initial Mining Area due to the presence of rare and restricted flora. Out of pit storage should be minimised by maximising in-pit storage and using overburden as aggregate for road and railway construction.

RESPONSE 35:

There are no rare or priority flora in these gulleys.

The provisions made for mitigation of impacts on flora are described in the ERMP and further, updated details are provided in responses to the EPA.

Out of pit storage is minimised as described in the ERMP (Section 3.7). The suggested use of mine overburden as aggregate for road and railway construction is impracticable because of construction sequencing. Haul distances and unsuitability of overburden for construction purposes also preclude its use in construction activity.

Response 10 gives details of other, special-interest flora, some of which occur in these gulleys. It also outlines appropriate action to be taken by Hamersley for each of the species.

ISSUE 36:

Overburden design appears to reflect typical insensitive Pilbara mining standards in that a flat plateau-like feature is formed by the ongoing dumping over the edge of an advancing face. There appears to be no intent to progressively shape the dump area to create a landscape sympathetic with the surroundings.

RESPONSE 36:

Hamersley supports the principle of progressive rehabilitation.

When sections of overburden dumps become no longer operational, they will be stabilised to facilitate rehabilitation and revegetation. Rehabilitation will involve shaping of the sides of the overburden dump to create a landscape which is as far as possible sympathetic with the surroundings. Figure 3.5 of the ERMP shows an artist's impression of the mine site and overburden dumps after rehabilitation work has been completed. The ERMP states that care will be taken to minimise the visual impacts, for example, by varying the height of the dumps (Section 3.7).

Hamersley will consult with CALM landscape architects in relation to the final landscape of the minesite and the overburden dumps. There is variety as well as uniformity in various portions of the natural landscape.

in the ERMP, the policy stated that the boundaries of the Park would be rationalised because of conflicting land use claims.

The decision to excise the Project Area from the Park was made in December 1990 by both Houses of State Parliament, and it is consistent with the policy.

It is not appropriate for the proponent to comment on this decision or the need for it to have been preceded by an environmental impact assessment. However, it is apparent that if there was to have been a separate assessment of the actual excision, it could only have been discussed and more fully debated when the excision had a purpose which could be explained and discussed in full. The present situation, this ERMP for Marandoo and the Central Pilbara Railway, in effect is an environmental assessment of the potential impacts of the now decided use for the excision. It has the advantage that it can give specific purpose to it, and hard data.

There is no claim in the ERMP that the excision of the Project Area in some way ensures that the environmental impacts of the project on the excised area will not have any impact on the ecology of the National Park as a whole, although that might be argued. Instead, the potential impacts of the new use of the excised land are identified in the ERMP, particularly in Chapter 6, and plans for their mitigation are given. It is concluded that there will be minimum impact on the natural and social values of the Park.

The proponent has continually endeavoured to plan the project and its management to achieve the minimum environmental impact. To this end Hamersley sought and developed a Statement of Mutual Understanding with CALM (Appendix Two).

Indeed, the ERMP research on the natural and social values of the Park, reported in Chapter 6 and elsewhere, has been a very significant and positive contribution, even though the Project Area is not part of the Park.

ISSUE 39:

There should be clarification of the issue of replacement land.

RESPONSE 39:

The State Government made the excision of the Marandoo tenement and the railway corridor and is therefore the appropriate responsible authority to address the issue of land replacement, not Hamersley. This was pointed out in the ERMP (Section 1.5.3) and discussed in Section 6.3, with the Bandjima Pool excision cited.

Hamersley understands that the State Government is establishing procedures under its *Resolution of Conflict* policy for resolving this issue. The Ministerial Council on Mining and Conservation is developing a strategy for all existing tenements under Agreement Acts that are in or near the Park.

However, it is understood that arrangements are being made for O'Brien's Block to be incorporated into the southern section of the Karijini National Park (KNP). Additional amendments to the boundaries of the KNP in the Mt Windell and Mt Meharry areas are also being considered by the State Government. Such areas were included in recommendations by the EPA in its first "Red Book" in 1975. Consultations are being held between the State Government,

Construction camps

ISSUE 41:

What will be the on-site manning levels for each month during the period of construction?

RESPONSE 41:

Based on the development programme provided in the ERMP, the estimated on-site manning levels for the expected duration of the construction phase is as follows :

October 1992 - June 1993	20 increasing to 150
June 1993 - October 1993	150
October 1993 - June 1994	150 increasing to a peak of 800
June 1994 - early 1995	800 decreasing to 0

ISSUE 42:

Hamersley should provide funding and/or bonds to CALM to cover costs incurred by the Department in repairing any direct and indirect impacts/damage to the Park by construction workers, and for additional rangers to monitor and manage these potential impacts.

RESPONSE 42:
Arrangements for Park rangers are a matter for CALM. It is both unnecessary and inappropriate for Hamersley to commit to funding additional CALM rangers.

Hamersley has management plans which inter alia will minimise environmental impact of the construction workforce on the Park (see extensive details in Section 13.4 of the ERMP) and will incur considerable costs in making such provisions. The actual camps will be removed and the sites rehabilitated when construction is completed. Commitment 19 of the ERMP states "At the end of the construction period, the construction camp will be removed and the servicing areas and evaporation ponds will be ripped and revegetated."

Hamersley had also committed to provide funding for an extensive research programme on the Pebble-mound Mouse and hydrogeological studies which will directly assist CALM and which would not have occurred in the foreseeable future without Marandoo.

ISSUE 45:

The mine and construction areas should be fenced off to prevent workers causing damage to the Park.

RESPONSE 45:

Hamersley is of the view that fencing the mine and construction work areas is not the most practical or necessarily the environmentally-optimum means of preventing incursions by the workforce into the Karijini National Park (KNP). Fencing will be less effective than the implementation of the following preferred options:

- provision of appropriate recreational facilities;
- establishment of induction programmes;
- making the workforce aware of potential impacts.

It should be appreciated that the mine workers during long-term operations will be Tom Price residents. The general sensitivity for the Park which is evidenced by Tom Price residents having a "proprietorial sense of care" was discussed in the ERMP (Section 6.7).
Hamersley is familiar with "people management" methods such as those used by CALM with regard to access to the Park see, for example, the CALM Draft Management Plan for the Hamersley Range National Park, May 1989, Section E2. CALM has not established fencing adjacent to roads within the KNP to prevent the public from entering conservation areas.

ISSUE 46:

What alternative construction camp sites were identified and investigated, what is their location, and why have alternative sites not been included in the ERMP?

RESPONSE 46:

The criteria for location of the main construction camp are essentially proximity to the project site but not so close that construction activities adversely affecting the quality of life in the camp. It is also desirable for the camp to be located as close as possible to existing transport infrastructure to minimise the requirement for additional infrastructure.

The option of a construction camp at Tom Price was not considered due to distance from the project site and the potential social impacts of the existing residents.

The area located to the west of the western boundary of the Karijini National Park was considered. The evaluation of this area did not identify any suitable location that was in reasonable daily travelling time of the project site. A construction camp located outside the Park would have involved large volumes of daily traffic along the transport corridor.

The proposed site of the construction camp (refer Figure 1.4 and 1.6 of the ERMP) to the southwest of the project site is the preferred site as it meets the requirements of the established criteria.

Roads and tourism

ISSUE 47:

What will be the volume of road traffic moving to and from the construction camp, and how will this impact on public use of the Tom Price-Marandoo road?

RESPONSE 47:

Most of the construction workforce will reside at the main construction camp at Marandoo. This camp will contain a wide range of commercial and recreation facilities (refer Section 13.4.1 of the ERMP) so that there will be little incentive for construction workers to travel to Tom Price.

As the vast majority of the construction workforce will fly into Paraburdoo airport and travel by company transport to Marandoo, it is expected that there will be a limited number of private vehicles in the construction camp. Thus the major impact on traffic in the area will be company vehicles travelling between Paraburdoo Airport and Marandoo, which could be in the order of twenty movements each way per day, and approximately thirty heavy goods vehicles per week delivering goods to the site at the peak of construction. During periods of peak activity there may be additional traffic movement of approximately 60 trips per day each way between Marandoo and Tom Price.

All construction traffic that uses public roads will be required to comply with all statutory regulations which include procedures for the protection of other road users. Movement of construction traffic will be carried out in accordance with these procedures with particular regard to oversize vehicles and equipment.

Once the new access road between Tom Price and Marandoo has been completed, the amount of construction traffic on the existing public roads between Tom Price and Marandoo will be greatly reduced.

ISSUE 48:

What will be the impact of the project on tourism and will Hamersley contribute facilities and the construction camp to tourism developments?

RESPONSE 48:

The project will have negligible adverse impact on tourism. At present less than 0.3 percent of visitors to the Park visit the Marandoo area (ERMP Section 6.12).

Potential visual impact from area lighting at Marandoo will be managed by directing lighting inward from the plant area. It is inevitable that a light haze will occur in the vicinity of Marandoo. This light haze may be visible some distance from Marandoo; however, it is unlikely that the light haze will be visible from the major tourist areas around the northern gorges, 30km to the north of Marandoo. The extent to which any light haze will diminish the experience of visitors to the Park is expected to be negligible.

public crossing through the Park following feasibility studies of various road options undertaken by the MRD. As stated in the ERMP, the proposed roads associated with the Marandoo project will not prejudice the current MRD plans for a public crossing of the Park. In fact, the construction of the Tom Price North road and the Marandoo Access road will facilitate tourist access to existing and future roads in the Park. Discussions are taking place between Hamersley and the MRD as to the extent to which it is practicable to minimise duplication by rationalising the two routes in the western sector outside the Park.

Regional Employment:
Hamersley has long been concerned about the issue of regional employment and has evidenced this concern through several initiatives. The support given by the company to local contractors and businesses was recognised during the course of the ERMP by the Chamber of Commerce in Tom Price and the business community in Karratha who indicated their serious concerns about the viability of their businesses in the future if the Marandoo project did not go ahead. Other support includes the apprenticeship and trainee schemes for a limited number of youth (male and female) resident in the Pilbara, the initiatives relating to women detailed above and through the initiatives relating to the Aboriginal people detailed below.

Although Hamersley advertises in regional newspapers, it should be noted that 75% of the people appointed as Hamersley employees do not respond to advertisements but contact the company on their own initiative either in person, by phone or mail. Of the remaining 25%, who are appointed as a result of advertisements in the paper, 75% are appointed to staff and/or professional positions. Because Hamersley is sensitive to the needs for regional employment it is common practice that Pilbara applicants have a higher probability of being personally interviewed than do metropolitan and inter-state applicants for Hamersley jobs.

Local sub-contractors have usually been involved in Hamersley projects in the past and it can be expected that this will be the case with the Marandoo project. Past experience has also shown that there will be a significant flow-on for local businesses for the provision of goods and services to the construction contractors and personnel (ERMP Section 13.4.2).

The Hamersley projects continue to support the bulk of the livelihood of the townships of Tom Price, Paraburdoo and Dampier and in the absence of significant alternative industries appear likely to continue to do so. The townships will collapse without the Hamersley iron ore industry, and the Hamersley iron ore industry will collapse without the assurance of Marandoo and the Central Pilbara mines. Whether the region will then collapse can be debated (ERMP Section 1.1).

Fly-in fly-out:
With regard to the possibility of a fly-in fly-out program of employment for the construction workforce, while it may be questioned whether such an issue properly belongs in an ERMP, Hamersley remains alert to the most effective and efficient methods of putting together a construction project workforce (ERMP Sections 13.4.1 and 13.4.2). Hamersley will engage 15 - 20 contractors who in turn will engage specialist and non-specialist sub-contractors. Experienced teams, used to working together, are an essential part of any such undertaking.

The bulk of jobs during the operating phase will be filled by the proponent's existing workers, and, as stated in the ERMP Section 13.2.2 and 13.3 the permanent workforce in Tom Price will expand by about 40-50 with the majority of these jobs filled by people already living in Tom Price.

Skills survey and social needs:
The Company will not undertake an employment skills survey of unemployed persons in the Pilbara to be matched with its employment needs for the Marandoo Project. It considers that the measures outlined above serve well to maximise regional employment.

It should be noted, of course, that as stated in the Chamber of Mines discussion paper *A Guide to Aboriginal Employment*, mining companies are commercial operations and not social change agencies. Hamersley initiatives in the area of Aboriginal employment are broadly in line with the guidelines of the Chamber as discussed below. Hamersley is well aware that by encouraging and

employment by Hamersley or other companies, or by Aboriginal enterprises providing commercially viable contractual services (ERMP page 211). As pointed out in the ERMP (page 211), Hamersley's approach has some common elements with *Karijini's Vision.*

An Equipment Operating Training Programme based on a railway rehabilitation project will commence on the existing railway before the end of the year. To this end more than $1million worth of dedicated equipment (including a range of dozers, a 926 FEL, a low loader, tip trucks and a service/fuel truck) is being purchased. This equipment will also be used in a long-term rehabilitation project. The Equipment Operating Programme is designed to give people the skills to enter the workforce on the basis that a vacancy exists and the skills do also. The initial identification of Aboriginal candidates is through the Driver Training Programme and then an interview which can result in inclusion in the railway rehabilitation project. This programme will also include induction to familiarise Aboriginal people with the sociological aspects of working in the company if the individuals involved require such induction.

In addition, where appropriate, Hamersley may assist in provision of logistics support for such programmes which may lead to the economic development of the Aboriginal people in commercially viable and self-sustaining programmes of work. However, it should be noted that any contemplated provision of tourism enterprise in the Karijini National Park is a matter for the Manager of the Park, not Hamersley.

Hamersley has commissioned a consultant to develop action initiatives to facilitate future Hamersley-job-related-training Aboriginal people in the Pilbara. The consultant is to also identify ways in which the company can appropriately assist the Aboriginal people in developing industry initiatives that are designed around their existing expertise and that can be developed in ways appropriate to the Aboriginal culture and the aboriginal community responsibilities of prospective employees of these schemes. A series of problem census meetings and interviews with individuals were held with Aboriginal people in Roebourne and Onslow to identify the issues that need to be addressed. These meetings and discussions clearly indicated that the communities at Roebourne and Onslow, whilst regarding the problem census talk as good, wanted to see tangible problem solving actions put in place.

Accordingly, active planning is proceeding during the months of July and August with an emphasis on practical outcomes (rather than theories) and a focus on the needs and aspirations of individuals within the Aboriginal community. Hamersley recognises that there is a broad spectrum of both needs and aspirations as is the case with all communities. For example, the success of the Ieramugadu (ERMP Section 13.5 and Commitment 9) is widely recognised; however, it is also apparent that while this programme meets the needs of a sector of the Aboriginal community it does not meet the needs of other Aboriginal community members.

The information gathered by the consultant is being widely disseminated. Hamersley Iron liaison officers in Roebourne and Onslow are working with local communities to identify individuals and small groups interested in particular opportunities identified during the problem census. It is anticipated that in August/September the implementation of specific problem solving actions should be underway.

The issue of botanical identification of flora was discussed informally between Aboriginals, social impact consultants and Hamersley in August 1991 and discussions are proceeding. The extent to which reliable botanical identification, perhaps seed collection and then possibly some rehabilitation work can proceed with Aboriginal groups and individuals is a complex matter under further discussion.

Social impact

ISSUE 51:

Economic cost benefit analysis as a technique for the project is questioned because it is not possible to quantify the impacts on, for example, the landscape aesthetics of the Park.

RESPONSE 51:

Hamersley did not carry out an economic cost-benefit analysis, nor was it required to do so. However, because of the nature of the project, a net benefits analysis was provided in the ERMP.

The Net-Benefits Analysis given in Section 13.10 of the ERMP rests on the position that all clearly identifiable negative environmental impacts of the project can be managed within acceptable limits. Hamersley also recognised the fact that the project is located in an area that is surrounded by, and was excised from, a National Park, and that such effects are not so quickly analysed in such a manner.

Therefore, Chapter 6 and Appendix Four demonstrate that the proponent is aware of, and sympathetic to, the unquantifiable values of National Parks in general and the Karijini National Park in particular. Furthermore, the ERMP has greatly increased understanding of such values, as for example in recording Aboriginal viewpoints (Section 6.8.2), commissioning analysis of colour values (Section 6.11 and Appendix Four) and other analyses.

The net result of the analysis of Chapter 6 is that the project will have minimum impact on the social and natural values of the Park and even that impact will be mitigated.

The Section on Net Benefits is simply one more informative section of the ERMP, as is the Section on Value-Adding written in response to public questions during ERMP preparation.

The economic benefits brought to the Pilbara, State and Australian communities by Hamersley iron ore operations are valid and important considerations in government approval processes. It is important to recognise, for example, that the payroll taxes alone that Hamersley gave to the Western Australian government in 1990 were enough to support the entire operations of the EPA to protect the State environment in that year.

Similarly, royalty payments to the State Government of over $64 million, export earnings of over $1billion and payment of almost $200 million to the Federal Government are facts.

The economic benefits of the project are of importance to much of the community of WA - a view supported by submissions received on the ERMP. To overlook and/or omit the economic analysis would have meant that the first objective of the review, as set down by the EPA, would not have been completely fulfilled and many of the issues raised by groups and individuals during the public participation and consultation exercise would not have been addressed.

Aboriginal issues

ISSUE 54:

Why has the Karijini Aboriginal Corporation (KAC) or other Aboriginal people not been recognised in the ERMP by the proponent (as some Aboriginal people have been by other groups) as having traditional affiliation with the Project Area.

RESPONSE 54:

The ERMP followed guidelines set down by the EPA, which included as a key issue *cultural impact on Aboriginal people with traditional affiliation to the land* (ERMP Appendix One).

Representatives of the proponent have had extensive discussions with Aboriginal people, including discussions at meetings organised by the KAC, on a wide variety of issues discussed in the ERMP. As a result, it has been possible to recognise their views by including them in the ERMP document for the entire community to read. This is preferable to having an isolated comment later on a published document.

Thus Aboriginal views about the land were quoted verbatim (Section 6.8.2), Aboriginal values were cited in Section 6.10, and one of the references cited was the publication *Karijini's Vision (1991)*. Aboriginal cultural issues were treated in Section 12.4. Social impacts on the Aboriginal communities were analysed in Section 13.9.1. Management of Aboriginal sites was discussed in Section 14.4. Commitments 3,4 and 5 deal with Aboriginal heritage and its recognition.

Three Commitments (8, 9 and 10) were also made in regard to employment of Aboriginal people.

The ERMP page 102 states "No Aboriginal people have lived in the area of the Park for at least 40 years until rangers were appointed by CALM." This is an accurate statement not contradicted by any of the submissions. Aboriginal people who lived on pastoral stations, of course, lived outside the Park after Mount Bruce station was abandoned in 1946, as can be seen from Figure 6.3 of the ERMP. Further details are given in the ERMP Section 12.2.2 page 196, and in Palmer (1975).

The ethnographic and ethnohistoric studies since 1974 and those which cover the project area have identified people who have traditional affiliations with the land. Neither the proponent nor its consultants used genealogies which were prepared by Government Anthropologists "in consultation with and at the direction of the Karijini Aboriginal Corporation Inc." (Green & Rumley, 1991).

However, there are legal issues on which Hamersley reserves its rights to comment, and these do not diminish the stature or efficacy of the ERMP. An ERMP is not the appropriate venue to decide who speaks for country, or these legal issues.

ISSUE 56:

With regard to archaeological and ethnographic matters, more details are requested concerning the consultants who worked on the ERMP, the reporting of the work of consultants, and the number and type of studies undertaken. One effect of such work may be disempowering Aboriginal elders.

RESPONSE 56:

Hamersley accepts comments by some consultants on Aboriginal issues that they carried out professional work individually rather than as a team, and regrets that any misunderstanding might have arisen through the heading of Appendix Three as being "Consultant Teams". References given in the text of the ERMP and in the References themselves made the individual contributions clear.

The Aboriginal Heritage material reported in the ERMP and in the specialist reports is considered adequate for the purposes of the ERMP and no new material is presently being prepared by or on behalf of Hamersley. Hamersley has no present plans to fund future archaeological research work or management plans in the Corridor. However, discussions are proceeding with the Museum to consider some additional research in the IMA.

The ERMP was completed in draft form in December 1991 and sent to the printer in February 1992. It therefore does not include more recent reports but is considered comprehensive for the purposes of the ERMP.

With regard to archaeological studies, the majority of archaeological studies in the past has not usually involved consultation on each and every archaeological survey with Aboriginal communities. It is understood that there may be limited interest by such communities in such items as flakes, chips etc that may require professional archaeological attention.

As discussed in the ERMP (for example Section 12.4.1) anthropological studies have been commissioned by Hamersley and other companies by various independent researchers for several projects. In the case of Marandoo, early discussions (circa 1975) with officers of the Western Australian Museum gave confidence that the most thorough efforts were made to contact relevant Aboriginal people who were further consulted in later independent anthropological studies. Those discussions up to 17 years ago are still considered of fundamental importance in helping identify Aboriginals with traditional affiliations with the Project Area.

Hamersley commissioned an investigation of the road, rail and power corridors for archaeological sites (ERMP page 200). The advancement of additional ethnographic studies which Hamersley sought to commission did not proceed because it was overtaken in time by the action of the State Government, through the Department of Aboriginal Sites, to commission an Anthropological Report to be undertaken in consultation with and at the direction of the Karijini Aboriginal Corporation (KAC) in September 1991.

With regard to the availability of Aboriginal reports, Kingsley Palmer lodged all his reports with WA Museum, as Hamersley lodged the archaeological reports prepared by Quartermaine. Further, each of the relevant reports as listed on the Section 18 application made by Hamersley with regard to the Marandoo Project Area was lodged with that application where those reports were not already in the hands of the Aboriginal Sites Department. It should be noted that when Dr Kingsley Palmer's 1991 communication was received (it was not a formal report) the KAC

cultural impacts until all discussions with Hamersley about employment and training programmes had been completed. However, it has been well known for about 17 years that approval had been given by the WA Museum to destroy one site central to the Mining Area. The Green report cited in the ERMP (Section 12.4.2) identified two sites in the project area not clear of cultural concerns, and the ERMP provided such information as appropriate and available. The *Aboriginal Heritage (Marandoo) Act 1992* recognised and excluded four sites including Bandjima Pool and the foot of Mount Bruce.

With regard to future projects, Hamersley Iron will continue to liaise with relevant Aboriginal people and properly constituted Government Agencies and will abide by laws of the day.

ISSUE 59:

Why are there no Aboriginal people from the Pilbara residing in Tom Price, Paraburdoo and other mining towns? Will Hamersley formulate a policy on Aboriginal housing and the integration of Aboriginal people in Pilbara mining towns?

RESPONSE 59:

A number of families with Aboriginal lineage reside at Tom Price and Paraburdoo (see also ERMP Section 13.5).

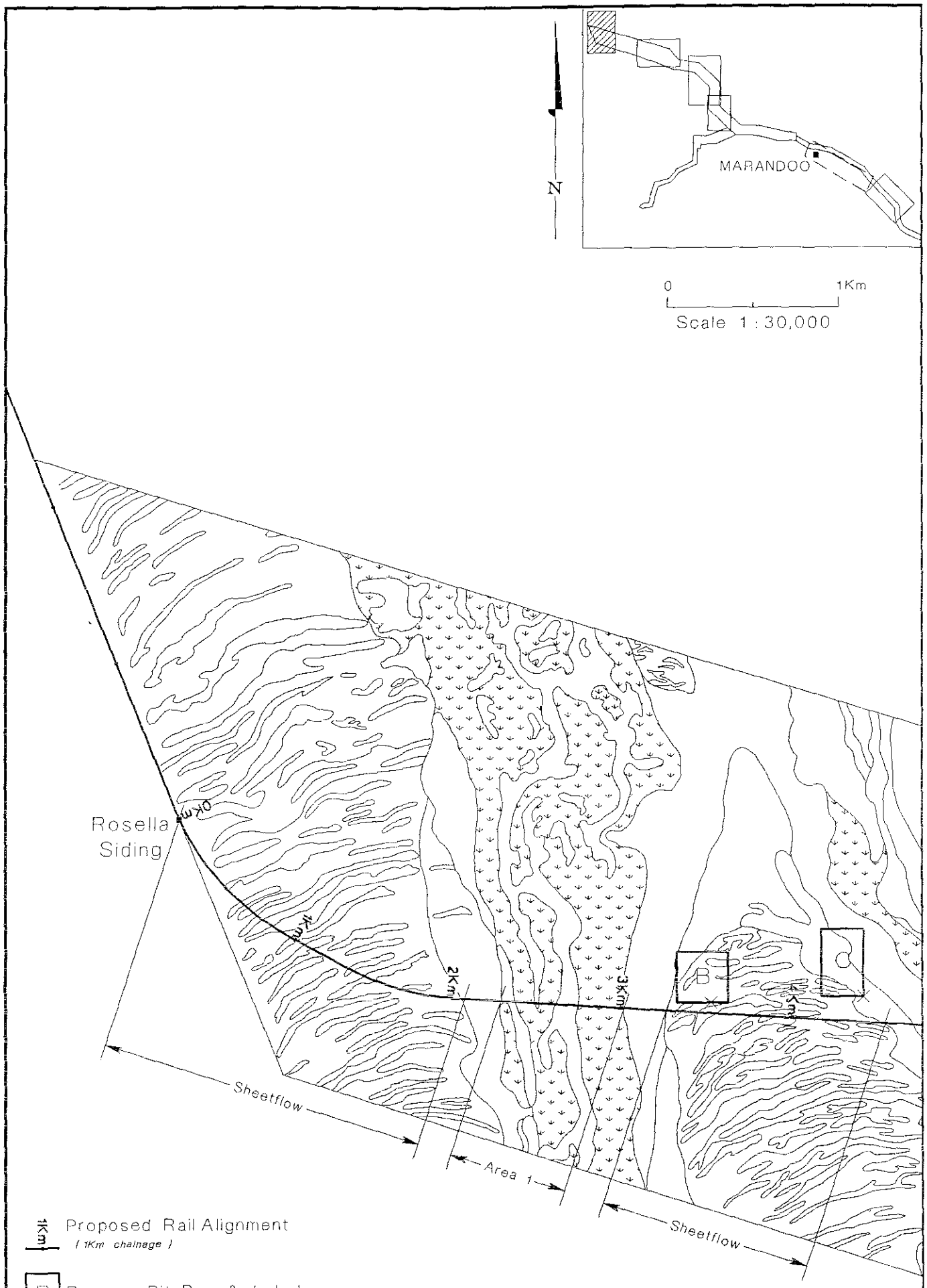
Social issues such as those nominated which affect the communities of Pilbara mining towns are more properly issues of responsible State Government instrumentalities and Local Government Authorities in conjunction with the communities of those towns. Although Hamersley was instrumental and initially responsible for setting up the towns of Tom Price, Paraburdoo and Dampier, for the past decade it has not carried such a management responsibility directly for the first two towns.

ISSUE 60:

What steps will the proponent take to have the recommendations of the Royal Commission into Aboriginal Deaths in Custody implemented? Does the proponent need a briefing on the possible applicable recommendations?

RESPONSE 60:

It is expected that such matters as any implementation of recommendations of the Royal Commission into Aboriginal Deaths in Custody are more properly an issue for deliberation in the first place by the State Government.



Note : Refer ERMP document re. other communities.

Fig. 1

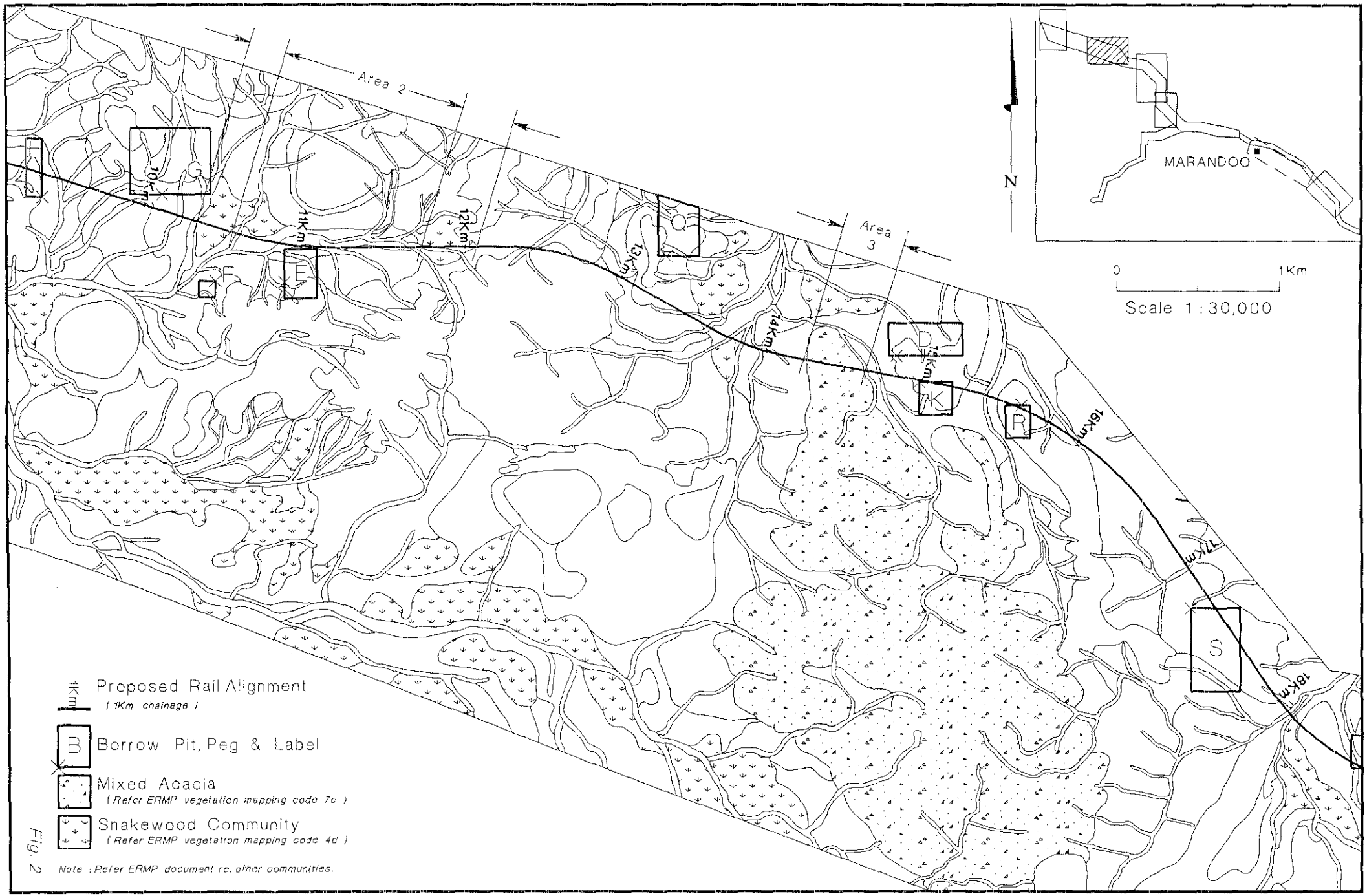
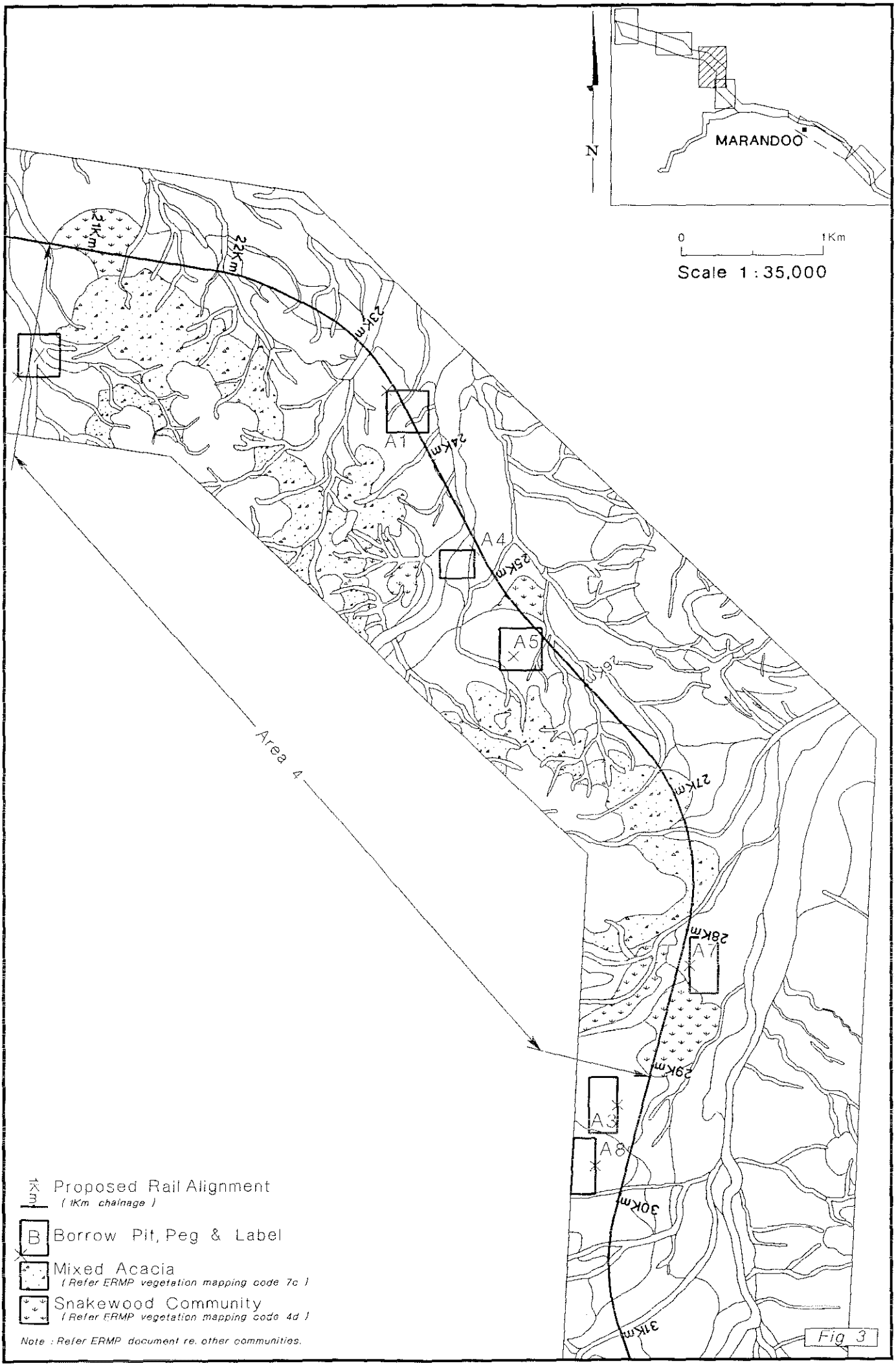
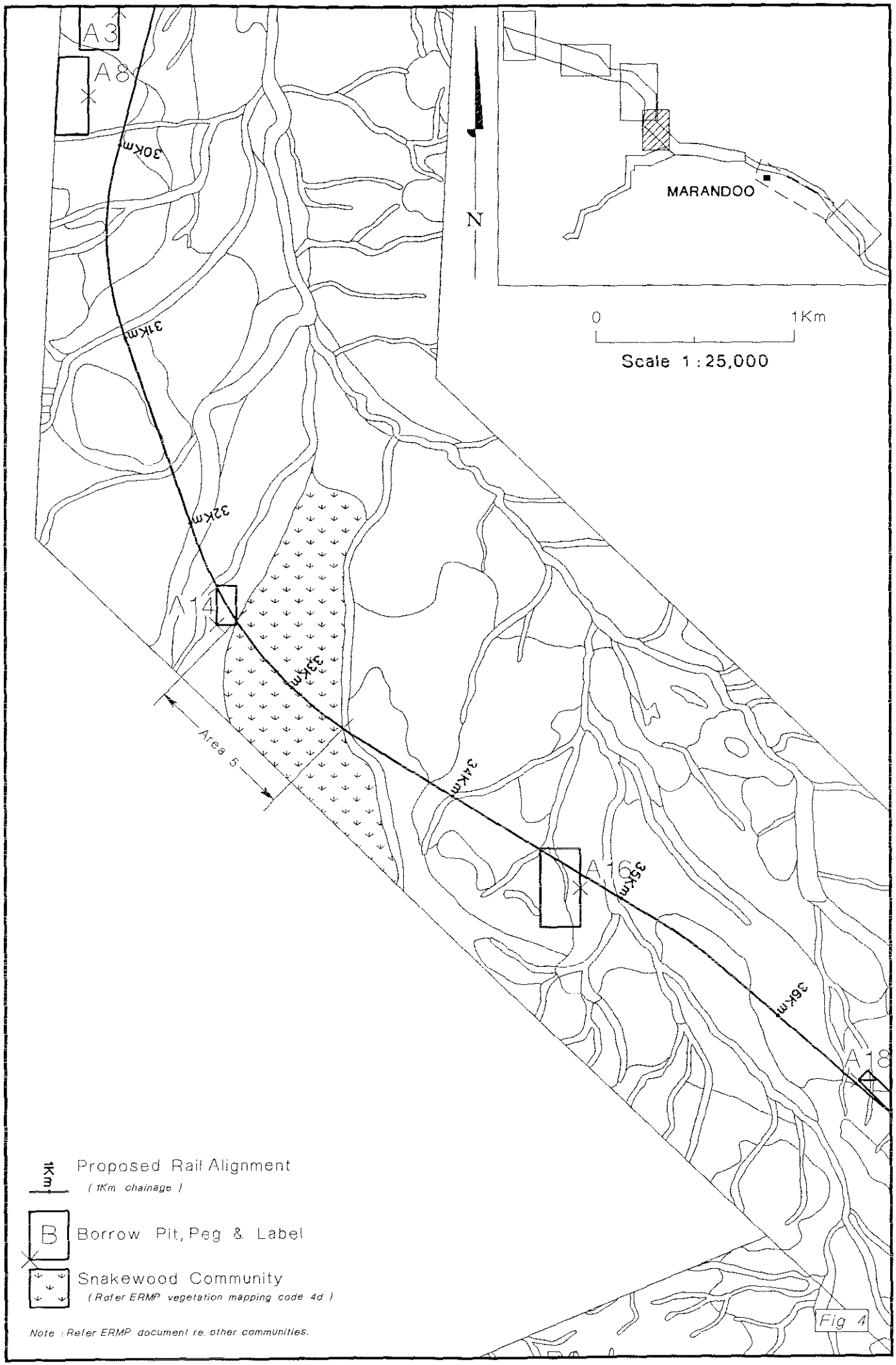

Area 2
Area 3
N
MARANDOO
0
1Km
Scale 1 : 30,000
10Km
11Km
12Km
13Km
14Km
15Km
16Km
17Km
18Km
E
F
R
S
1Km
Proposed Rail Alignment
(1Km chainage)
B
Borrow Pit, Peg & Label
Mixed Acacia
(Refer ERMP vegetation mapping code 7c)
Snakewood Community
(Refer ERMP vegetation mapping code 4d)
Note : Refer ERMP document re. other communities.

Fig. 2


MARANDOO
N
0
1Km
Scale 1:35,000
21Km
22Km
23Km
24Km
25Km
26Km
27Km
28Km
29Km
30Km
31Km
A1
A3
A4
A5
A7
A8
Area 4
Proposed Rail Alignment
(1Km chainage)
B Borrow Pit, Peg & Label
Mixed Acacia
(Refer ERMP vegetation mapping code 7c)
Snakewood Community
(Refer ERMP vegetation mapping code 4d)
Note : Refer ERMP document re. other communities.
Fig 3


A3
A8
30Km
31Km
32Km
A14
33Km
Area 5
34Km
A16
35Km
36Km
A18
N
MARANDOO
0
1Km
Scale 1 : 25,000
1Km
Proposed Rail Alignment
(1Km chainage)
B
Borrow Pit, Peg & Label
Snakewood Community
(Refer ERMP vegetation mapping code 4d)
Note : Refer ERMP document re. other communities.
Fig 4

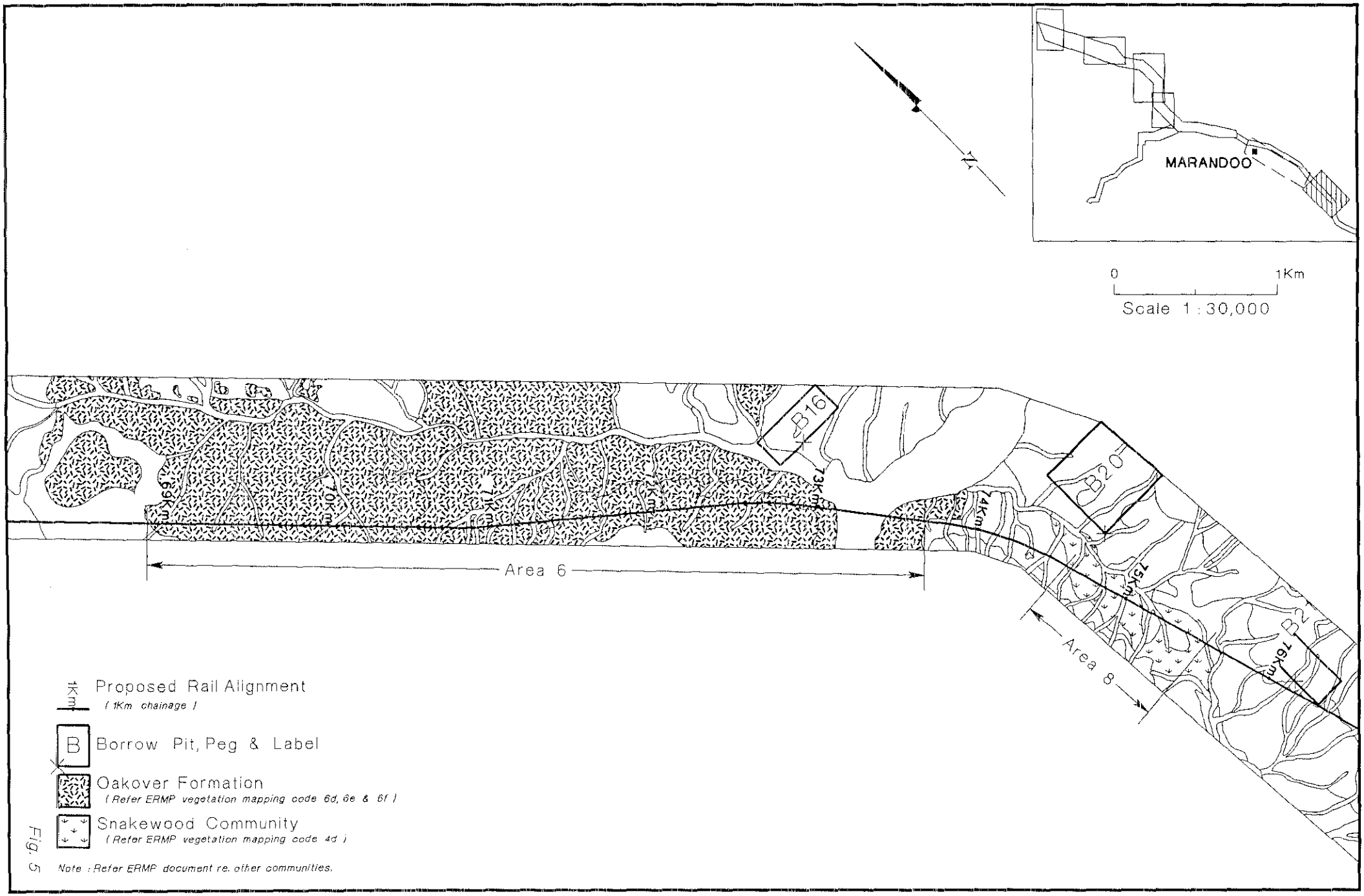

MARANDOO
0
1Km
Scale 1 : 30,000
B16
B20
B2
69Km
70Km
71Km
72Km
73Km
74Km
75Km
76Km
Area 6
Area 8
Proposed Rail Alignment
(1Km chainage)
Borrow Pit, Peg & Label
Oakover Formation
(Refer ERMP vegetation mapping code 6d, 6e & 6f)
Snakewood Community
(Refer ERMP vegetation mapping code 4d)
Note : Refer ERMP document re. other communities.

Fig. 5

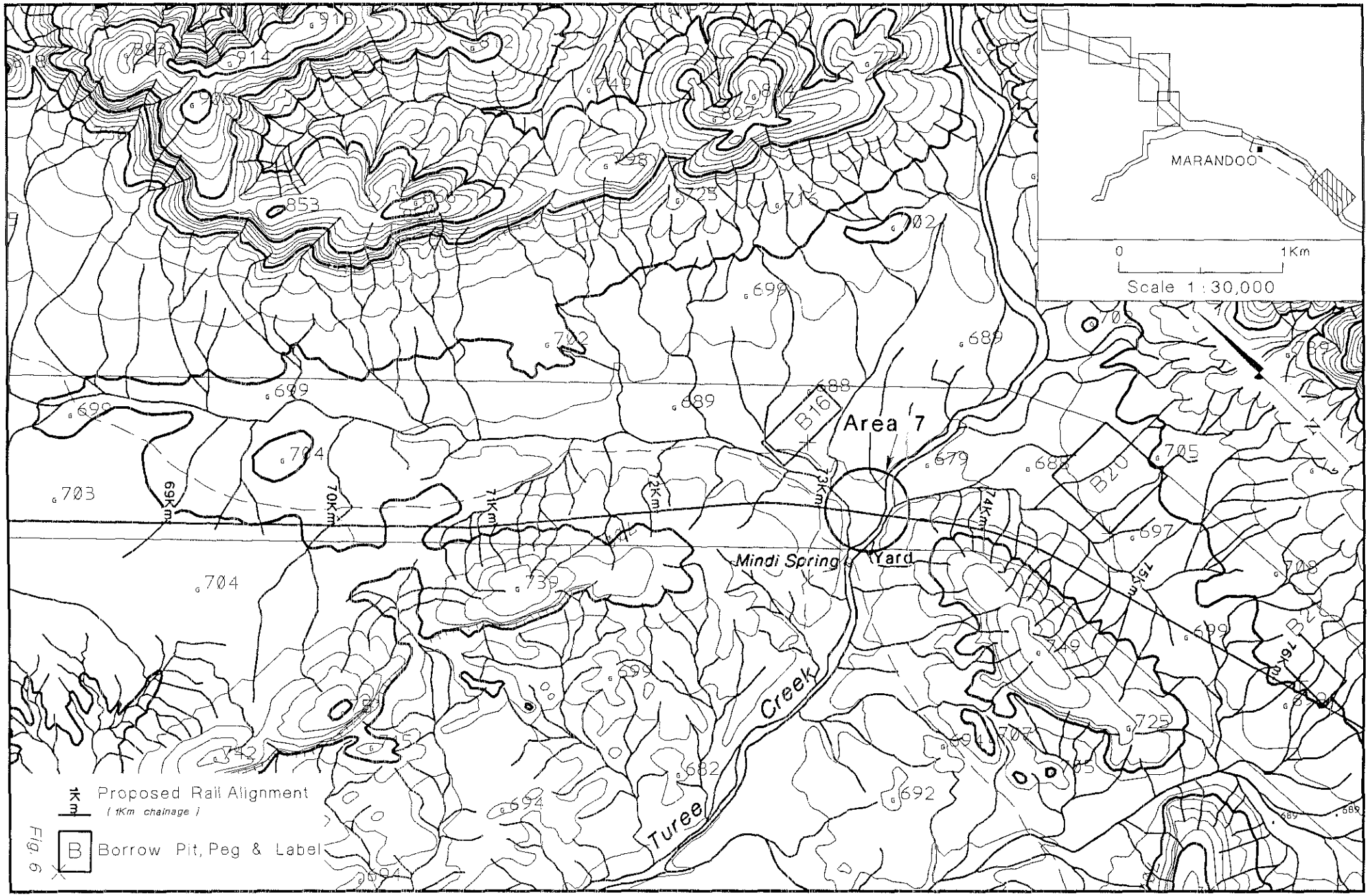

MARANDOO
0
1Km
Scale 1 : 30,000
Area 7
B16
B20
B21
B22
Mindi Spring
Yard
Turee Creek
69Km
70Km
71Km
72Km
73Km
74Km
75Km
76Km
Proposed Rail Alignment
(1Km chainage)
B Borrow Pit, Peg & Label

Fig. 6

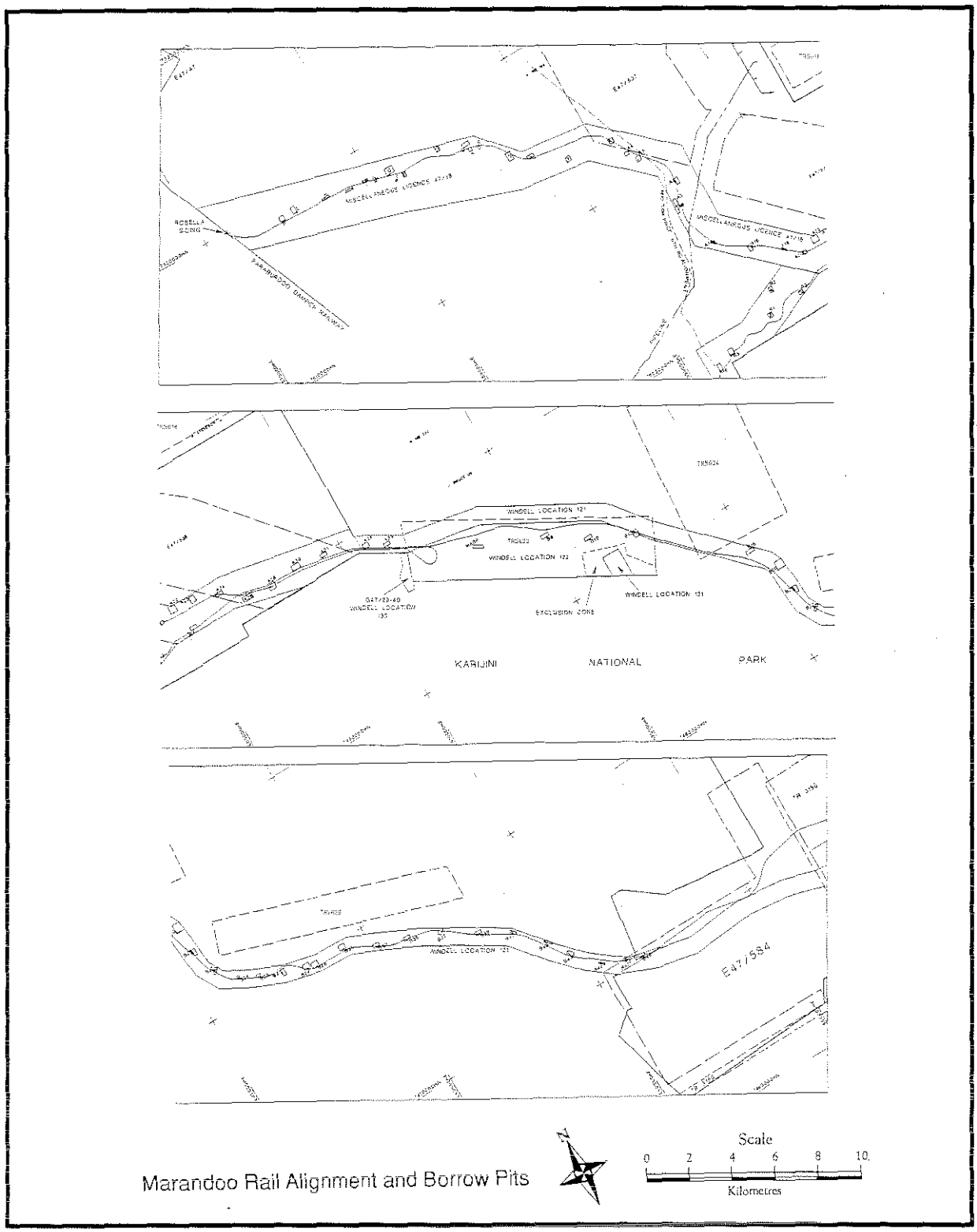

KARIJINI NATIONAL PARK
WINDELL LOCATION 121
WINDELL LOCATION 122
WINDELL LOCATION 131
EXCLUSION ZONE
E47/584
Marandoo Rail Alignment and Borrow Pits
Scale
0 2 4 6 8 10
Kilometres

Figure 7:

Appendix 3

Department of State Development Report on 'Future Iron Ore Developments in the Pilbara'

FUTURE IRON ORE DEVELOPMENTS IN THE PILBARA

DEPARTMENT OF STATE DEVELOPMENT

19 March 1992

1.0 Introduction

This paper has been prepared by State Development to provide a view of the possible future pattern of iron ore development in the Pilbara and the broad infrastructure requirements and developments that are implied by this pattern. It is made available to the EPA at the same time as the Marandoo ERMP, to place this project in perspective with other likely developments in the Pilbara iron ore industry.

Information is provided for projects expected to be operating by 1995 and those expected to come into operation in the period 1995-2005. No information is provided beyond 2005, as this would be highly speculative and was not seen as providing useful information for this paper. The predicted timing of developments and infrastructure requirements are based on iron ore production projections made in the "Iron Ore Industry" chapter of the Pilbara 21 document released in September 1991, "Pilbara Region, Economic Development, Overview".

2.0 Existing and Proposed Iron Ore Projects (to 1995)

2.1 Background

In recent years four iron ore companies have operated in the Pilbara : Hamersley Iron Pty Ltd (HI) with 46 Mt/a capacity, BHP Iron Ore Ltd (BHP) with 42 Mt/a, including Goldsworthy 5 Mt/a, Robe River Iron Associates (RRIA) with 24 Mt/a and Hancock Mining Ltd (Hancock) with 2.5 Mt/a. Since 1988 iron ore shipments from the region have totalled over 100 Mt/a, with an annual export value of over two billion dollars. Past iron ore production is shown in Figure 1. It is worth noting that 1.5 billion tonnes have been produced since 1966.

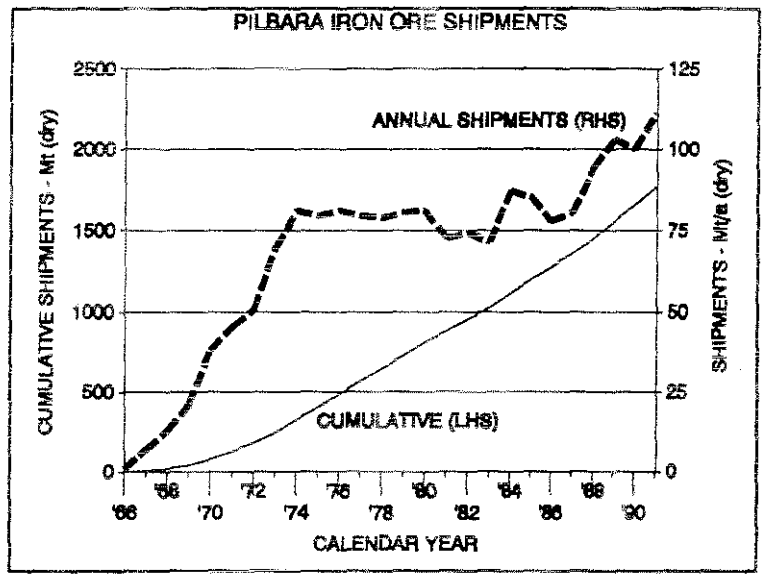


Figure 1

The industry is presently diversifying its operations in the region to maintain production levels as ore reserves are depleted at existing mines, and to be in a position to meet any future increases in demand. The Marillana Creek (Yandicoogina), Brockman No 2 Detritals and Mesa J projects are all in the development stage and other projects, such as Marandoo and Fortescue Scree (TR5616 near Wittenoom), are under detailed investigation. In addition, BHP has committed to a major upgrade of the materials handling and port facilities at Nelson Point, and Robe River is expanding its facilities at Cape Lambert.

Existing and proposed iron ore projects are summarised in Tables 1 and 2,and locations are given in Figure 2. More detail of the industry, on a company basis, is given in Appendix 1, which is taken from the Pilbara 21 document.

2.2 Existing and Proposed Infrastructure

No new towns are planned for the proposed iron ore projects shown in Table 2. The workforces for the new Mesa J and Marandoo projects will commute from Pannawonica and Tom Price respectively, with new roads planned to the mine sites. The existing State road system is illustrated in Figure 2. For the other proposed projects, workforces will be accomodated at minesite villages.

Power is supplied to many of the towns and mining operations in the region by a system of generation plants and transmissions lines known as the North West Interconnected System (Figure 3).

The system is owned and operated in part by SECWA and in part by the mining companies. Unlike the South West of the State, SECWA does not generate power (although the Redbank station at Port Hedland is maintained on a stand by basis) and purchases power from Robe River for transmission to SECWA customers.

The first major transmission line of the system was a 370km 220kV line, constructed in 1978 by HI, to connect Tom Price and Paraburdoo to the Company's Dampier power station. Dampier, Karratha and Cape Lambert were interconnected by SECWA in 1983 with a 132kV line. In 1985, a 200km 220kV transmission line was built by SECWA between Cape Lambert and Port Hedland to interconnect the two main population centres of Karratha and Port Hedland. In 1988, a 132 kV line was constructed by RRIA between their Cape Lambert power station and Pannawonica.

The most recent addition to the system, a 66kV line between Port Hedland and Goldsworthy, was commissioned by SECWA in 1989 to interconnect with BHP's 66kV transmission line between Goldsworthy and Shay Gap.

RRIA plan to construct a 33kV transmission line extension from Mesa K to the Mesa J project. For the other projects in Table 2, on-site diesel generation facilities will provide power.

The established railways have adequate capacity for the transportation of iron ore from the existing and proposed projects. Spurlines have recently been constructed from the HI mainline to the Brockman No 2 Detritals minesite and the BHP mainline to the Marillana Creek minesite. A 13km extension to the RRIA mainline is proposed for the Mesa J Project.

Adequate water is available from aquifer reserves for the existing projects for the period of this review. Local borefields will be utilised for the proposed projects.

The environmental assessment of the Marandoo project is in progress. Associated with this development are the following major infrastructure works :

- A 220kV power transmission line from Tom Price to the mine.

- A 115 km railway from Rosella Siding on the Hamersley Iron mainline to Homestead Creek, east of the Karijini National Park, with a short spur line at 55km to the Marandoo load-out loop. The portion of this railway that traverses the Park is located within the Park infrastructure corridor.

- A new road from Tom Price to Marandoo. Part of this commute road will be a planned State main road running between Tom Price and Rio Tinto Gorge. A 23 km long Company road will access the minesite from this new main road.

3.0 Future Projects to 2005

3.1 General Considerations

Future projects will be predominantly developed in the two areas containing the largest resources of low phosphorus ore; the **Central Hamersley Range**, extending from West Angelas in the west to Rhodes Ridge in the east, and the **Deepdale** area, which includes Mesa J and Bungaroo Creek. Small resources, where accessible to railways, will be developed either as adjuncts to existing operations (e.g. detrital/scree ore bodies in the Tom Price and Newman areas) or as stand alone operations (e.g. Fortescue Scree, McCamey's Monster). The Pilbara also has large resources of high phosphorus ore that may be viable in the long term as reserves of low phosphorus ore are progressively run down, or as changes in steel making technology enables their economic use.

The **Central Hamersley Range** has measured and indicated resources of low phosphorus ore of greater than 2,000 million tonnes and inferred resources of greater than 8,000 million tonnes. The four Pilbara iron ore producers own major deposits in this area, either in their own right or in joint ventures with other parties. All the major ore types of the Pilbara (i.e. Brockman, Marra Mamba, pisolite and detrital) are present (see Appendix 3).

Measured and indicated resources of low phosphorus ore in the **Deepdale** area, all owned by RRIA, are over 1,000 million tonnes and inferred resources, a further 2,000 million tonnes. All ore is of the pisolite type (see Appendix 3).

Two scenarios for future iron ore production in the Pilbara were developed for the Pilbara 21 Study; a base case, which reflects the general consensus of the future of world steel production, and an optimistic scenario, which is based on a re-emergence of strong growth in steel demand.

Under the base case scenario, iron ore production from the Pilbara will increase at 1.4% per annum, reaching 140 Mt/a by the year 2005. The principal assumptions for this case are continued growth in Asian steel production at 3.5% per annum, static steel consumption in other regions, and the Pilbara to maintain its market share.

Under the optimistic scenario, the demand for Pilbara iron ore could reach 200 Mt/a by the year 2005. The principal assumptions are that a strong underlying demand for effective steel strength will continue on a trend that has been apparent since 1974, and that Brazilian production from the Carajas mine will be limited to 50 Mt/a for the decade, due to infrastructure development constraints.

TABLE 1 - EXISTING PROJECTS

Project: Mine Site *Port*	Owner	Reserves	Ore Type (see Appendix 3)	Infrastructure	Expected Life (Base Case)
Mt. Newman: Mt Whaleback Orebody 29 Orebody 25 *Port Hedland*	BHP Iron Ore 85% C. Itoh & Co 8% Mitsui & Co 7%	 850 Mt 110 Mt 10 Mt	 Brockman Marra Mamba Detrital	• Workforce accommodation: Newman and Port Hedland • Ore transportation: A 426 km railway linking Newman to Port Hedland. • Port facilities: A single 220,000 dwt carrier, or two 160,000 dwt carriers can be loaded simultaneously. • Power: Port Hedland - 220 kV (SECWA) transmission line from Karratha and Wickham. Newman - 50MW BHP owned power station • Water source: Port Hedland - Borefields at Yule River and De Grey River (State) Newman - Local borefield and Ophthalmia Dam. (BHP)	35 yrs
Goldsworthy: Shay Gap *Finucane Island*	BHP Iron Ore 85% C. Itoh & Co. 8% Mitsui & Co. 7%	 250 Mt	 Cleaverville	• Workforce accommodation: Shay Gap, Finucane Island and Port Hedland. • Ore transportation: 180 km railway linking Shay Gap to Finucane Island. • Port facilities: Carriers of 18,000 to 185,000 dwt. • Power: 66 kV (SECWA) transmission line from Port Hedland to Goldsworthy. Then connected to Shay Gap by a BHP owned 66 kV line. • Finucane Island - Borefield at Yule and De Grey Rivers (State). • Water source: Shay Gap - Local borefield (BHP) Finucane Island - Borefield at Yule and De Grey Rivers (State)	15 yrs
Hamersley: Tom Price and Paraburdoo *Dampier*	Hamersley Holdings Ltd 100% (owned 100% by CRA)	 350 Mt	 Brockman	• Workforce accommodation: Tom Price, Paraburdoo, Dampier and Karratha. • Ore transportation: 386 km railway link from Paraburdoo via Tom Price to Dampier. • Port facilities: East Intercourse Island, vessels up to 250,000 dwt, and Parker Point, vessels up to 140,000 dwt. • Power: 132 kV (SECWA) transmission line connects Dampier, Karratha and Wickham. 220 kV transmission line to Tom Price and Paraburdoo owned by HI. 120 MW power station at Dampier. 20 MW auxiliary power station at Paraburdoo both owned by HI. • Water source: Dampier - Borefield at Millstream and Harding River Dam (State). Tom Price & Paraburdoo - Local borefield (HI)	10 to 20 yrs + (Dependent on other developments)
Channar: Channar *Dampier*	Hamersley Holdings Pty Ltd 60% China Metallurgical Import & Export Corporation 40%	 200 Mt	 Brockman	• Workforce accommodation: Paraburdoo. • Ore transportation: 20 km conveyor linking the mine to Paraburdoo. • Port facilities: Dampier. • Power: Transmission line from Paraburdoo owned by Joint Venturers. • Water source: Channar - Local borefields (JV).	20 yrs
Robe River: Pannawonica *Cape Lambert*	Peko Wallsend 35% Robe River Mining 30% Mitsui Iron 20% Pannawonica Iron Associates 10% Cape Lambert Iron Associates 5%	Mesa J - 600 Mt. (Existing deposits have 2 yrs lifespan remaining)	Robe Pisolite	• Workforce accommodation: Wickham and Pannawonica. • Ore transportation: 190 km railway linking Pannawonica to Cape Lambert. • Port facilities: Carrier size 238,000 (dwt) and 300,000 (dwt). • Power: 105MW power station at Cape Lambert and 132 kV transmission line to Pannawonica, both owned by RRIA. • Water source: Wickham - Borefield at Millstream and Harding River Dam (State). Pannawonica - Local borefield (RRIA).	20 yrs +
McCamey's Monster: McCamey's Monster *Port Hedland*	Hancock Mining Limited 100% (now BHP Iron Ore)	Stage II 6 Mt	 Brockman	• Workforce accommodation: Newman. • Ore transportation: 30 km railway to Newman - Port Hedland mainline. • Port facilities: Port Hedland • Power: On site generation sets. • Water source: Borefields at minesite	Stage II - 2 years

TABLE 2 - PROPOSED PROJECTS TO 1995

PROJECT	PROPONENT	RESOURCE (See Appendix 2)	ORE TYPE (See Appendix 3)	PRODUCTION t/YEAR	PROBABLE START DATE OF MINING	INFRASTRUCTURE				
						ORE TRANSPORTATION	WORKFORCE ACCOMMODATION	CONSTRUCTION WORKFORCE	POWER	WATER
Brockman 2 Detritals	Hamersley Iron	20 Mt proven	Detrital	4M	1992	46 km railway spur to HI Mainline	Minesite village	Near completion	2 MW On site diesel generation sets	Local Borefield
Marillana Creek	BHP Iron Ore	320 Mt measured	Pisolite	10M	1992	32 km rail spur to BHP Mainline	Minesite village	Completed	2 MW On site diesel generation sets	Local Borefield
Newman 23	BHP Iron Ore	<1 Mt proven	Detrital	200,000	1992	4 km road to existing OB25 railway spur	Newman	Small	Existing OB25 facilities	Local Borefield
Mesa J	Robe River Iron Associates	600 Mt probable	Pisolite	25M	1993	13km mainline extension	Pannawonica Existing workforce	Period 24 month Peak 100 people	33kV Transmission line from Mesa K	Local Borefield
Marandoo	Hamersley Iron	180 Mt proven	Marra Mamba	10M	1994	115 km railway from Rosella Siding to Juna Downs	Tom Price Existing workforce	Period 24 month Peak 800 people	220 kV Transmission line from Tom Price	Local Borefield
Fortescue Scree (TR5616)	Hancock Resources	212 Mt indicated	Detrital	3M	By 1995	95km road from Wittenoom to HI Mainline	Minesite village	Period 12 month Peak 40 people	2 MW On site diesel generation sets	Local borefield
McCamey's Monster Stage III	Hancock Mining (now BHP Iron Ore)	40 Mt indicated	Brockman	5M	By 1995	9 km railway exterior to existing rail spur	Newman, plus minesite village	Period 12 month Peak 40 people	2MW onsite diesel generation sets	Local borefield

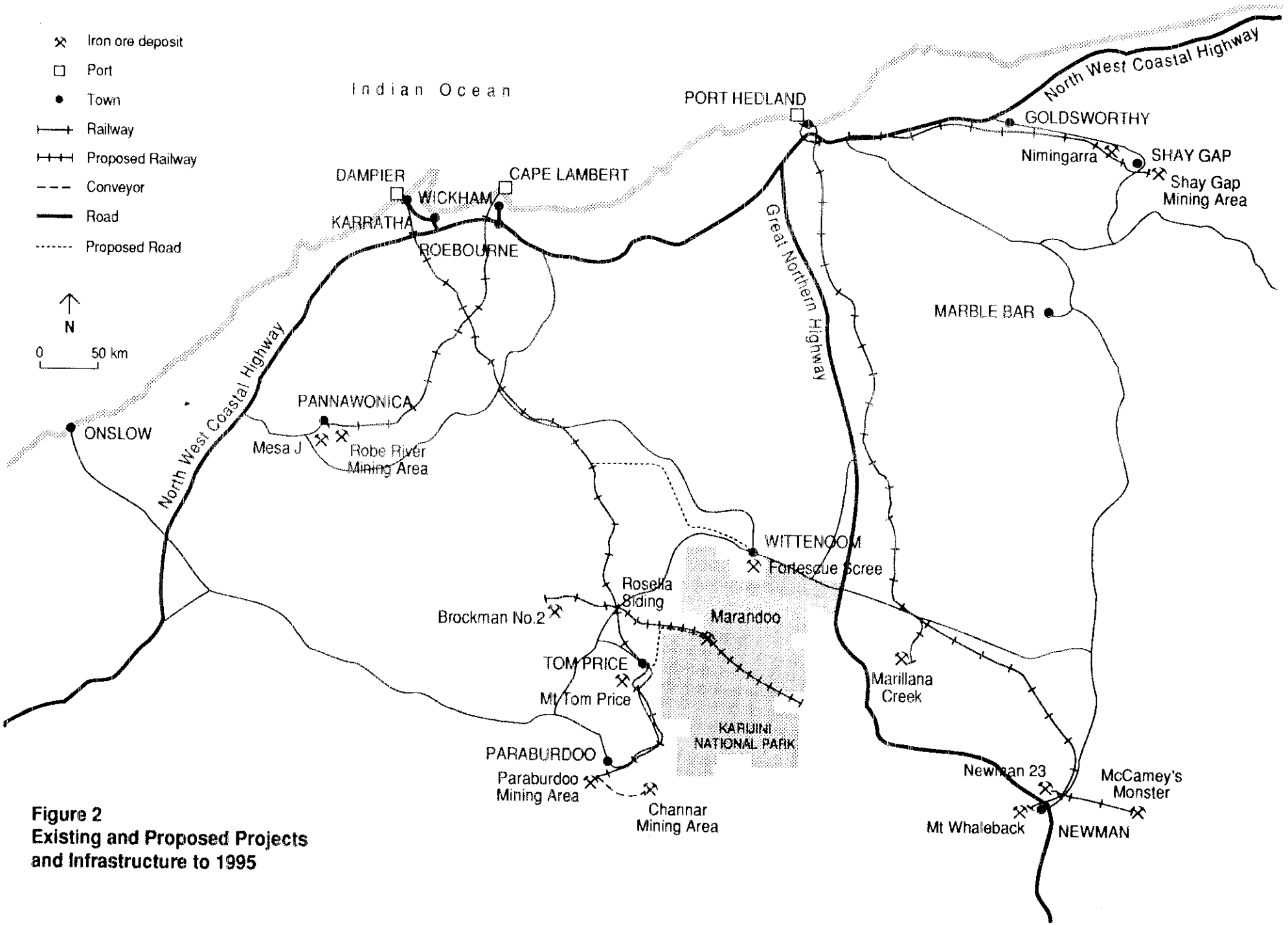
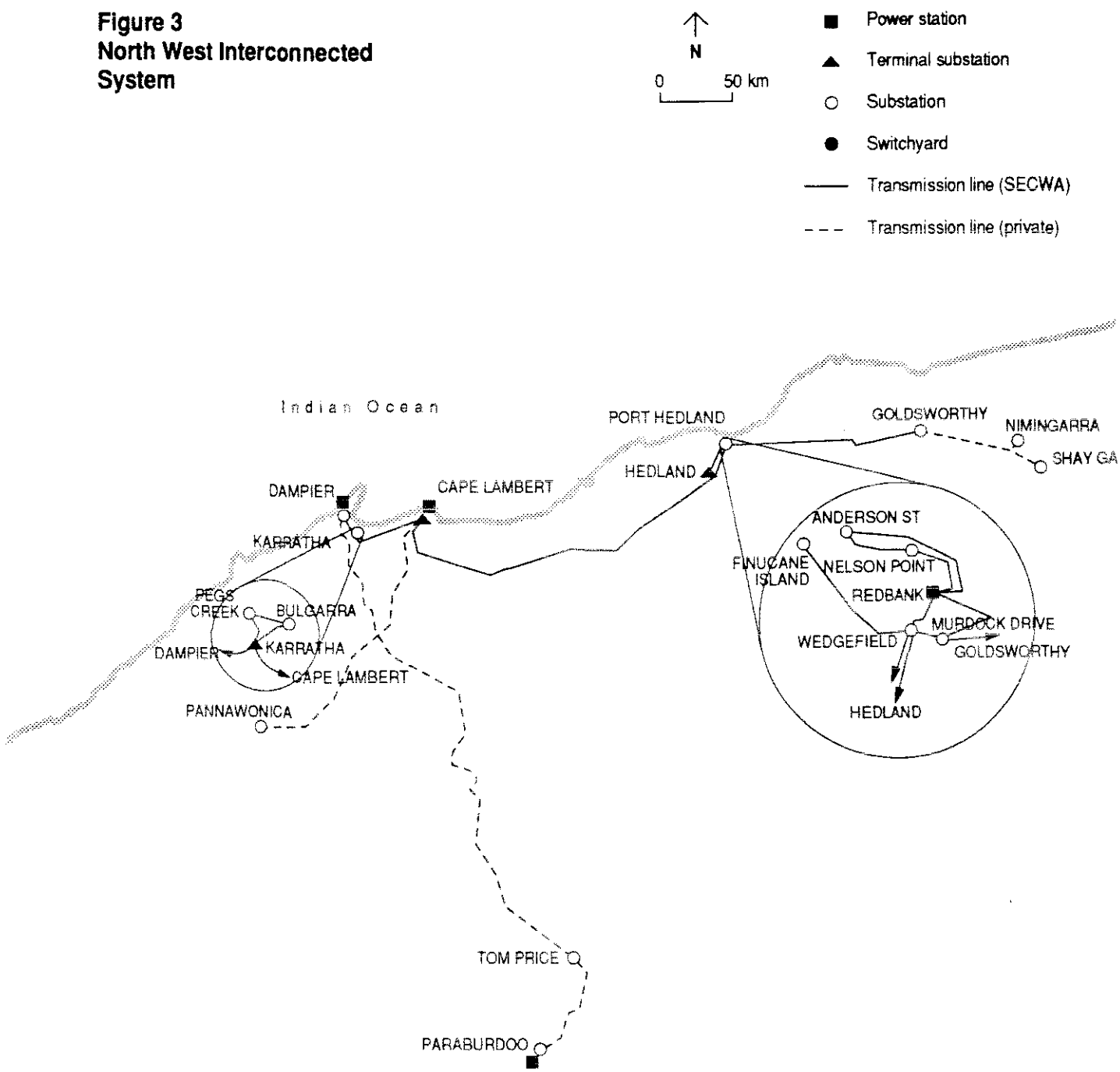


Figure 2
Existing and Proposed Projects and Infrastructure to 1995

Figure 3
North West Interconnected System



Generating Plant within the North West Interconnected System

Power Station	Owned by	Capacity (MW)	Fuel		
			Gas	Oil	Distillate
1970 Cape Lambert	Robe River Iron Associates	105	✔		
1971 Dampier	Hamersley Iron	120	✔		
1973 Redbank A	SECWA	22.4		✔	
1978 Redbank B	SECWA	48.8		✔	
1980 Dampier	SECWA	19			✔
1985 Paraburdoo	Hamersley Iron	20			✔

TOTAL INSTALLED CAPACITY = 335MW

3.2 Project Identification

Figures 4 to 10 show the possible orebody development patterns, by the four iron ore producers, to meet expected demands under the two scenarios. It must be stressed that the start dates in these Figures are based on the above projections. Actual start dates and sequencing of developments beyond 1995 will be modified by company strategies, future ore discoveries, and varying political, social and market conditions.

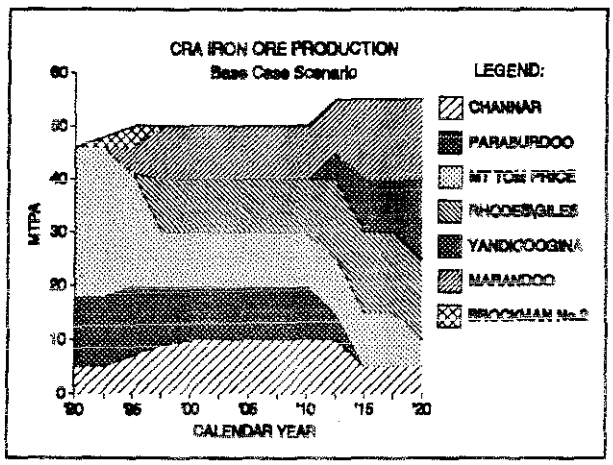


Figure 4

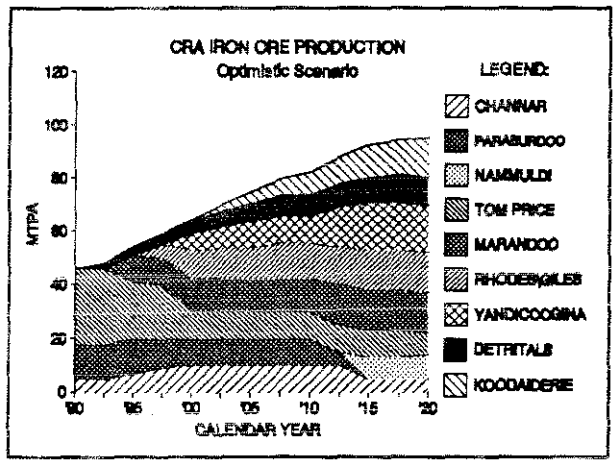


Figure 5

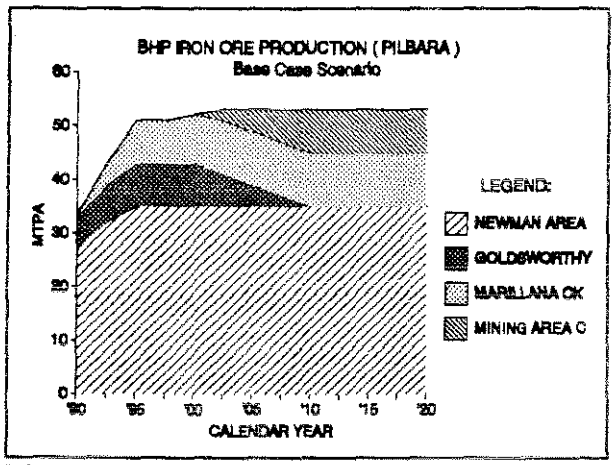


Figure 6

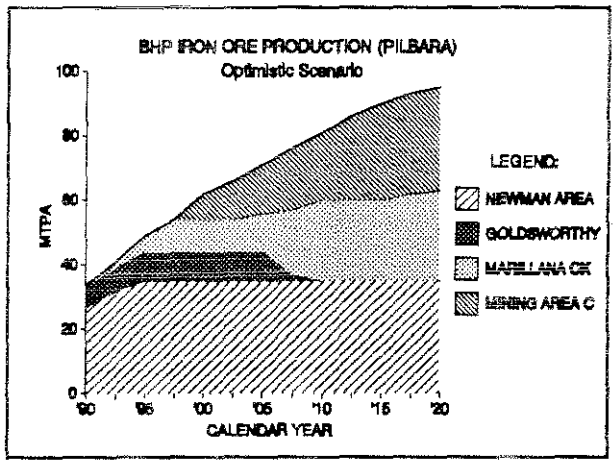


Figure 7

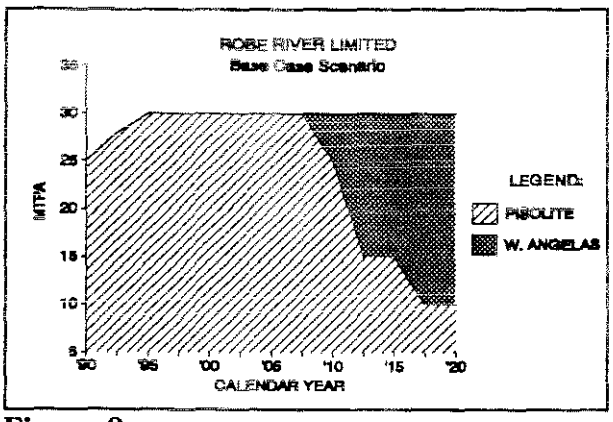


Figure 8

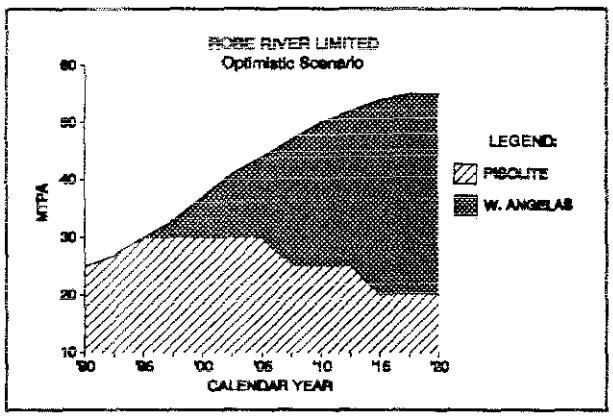


Figure 9

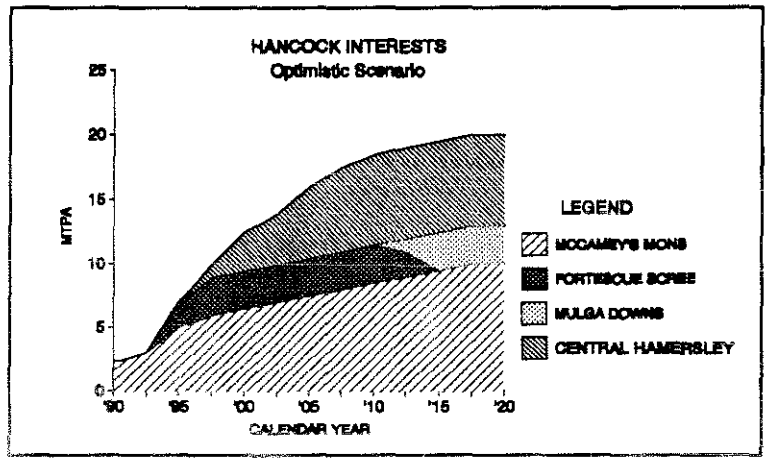


Figure 10

For Hamersley Iron, and Robe River, the information shown is taken from Pilbara 21. However, the Hancock interests development pattern is different. When the Pilbara 21 document was prepared, the development of a mine based on resources on TR 5616 near Wittenoom was not included. This mine, now termed the Fortescue Scree project, is expected to be in production before the Central Hamersley Range deposits held by Hancock interests and is now included in the revised scenario. The McCamey's Monster project was recently purchased by BHP. This will mean a transfer of tonnage to BHP, rather than a change to the expected production. Since the details of the ownership change are not finalised at this time, McCamey's Monster is still shown as a Hancock interest project.

A minor change has also been made to the BHP base case, with a differentiation being made between Marillana Creek and Area C production, whereas for Pilbara 21 these were combined.

The deposits most likely to be developed between 1995 and 2005, based on the two scenarios and the above considerations, have been listed in Table 3, together with their likely infrastructure provisions. Locations are given in Figure 11.

Hamersley Iron has indicated in the Marandoo ERMP that it would develop a mine in the Central Hamersley area, either at Giles Mini, Rhodes Ridge or Yandicoogina about 1997. The deposits that are not developed then are expected to be developed later in the period.

The listed deposits are all low in phosphorous, as this impurity is presently the major constraint on the saleability of export iron ore (phosphorous increases the brittleness of steel). Iron ore is sold either as lump, which is suitable as direct feed to a blast furnace and receives a price premium, or as fines, which is generally agglomerated by either sintering or pelletising, as a preparatory step. The ores of the listed deposits vary greatly in their level of impurities, other than phosphorous, and in their proportion of lump. These variations, which are a function of ore type, affect the marketability of a particular ore and must be taken into account by companies in their scheduling of new developments, such that the final blended product for export meets the market requirements for quality and consistency.

For this reason, it is not always possible for a company to develop deposits that may appear, from their location, to be the next logical step. Whilst location to existing infrastructure is a major factor in the sequencing of development, a deposits physical and chemical properties, and its size, are equally as important. This need to produce blended products also means that multiple export points cannot be used and there is a strong need to retain a single port focus for multiple operations that together produce the final blended product.

In the allocation of resource areas the State has attempted to maintain a logical grouping of Company deposits. However, this is always constrained by the need to allow companies to make

TABLE 3 - FUTURE PROJECTS 1995 - 2005

PROJECT	PROPONENT	RESOURCE Mt (See Appendix 2)	ORE TYPE (See Appendix 3)	INFRASTRUCTURE		
				ORE TRANSPORTATION	WORKFORCE ACCOMMODATION	POSSIBLE POWER OPTION
Hope Downs (Sugar Fault) (Luncheon Tree)	Hancock Resources	300 indicated	Marra Mamba	New railway or link to existing.	Minesite village or central Hamersley Township	On site generation or grid
Giles Mini	CRA/Hanwright	180 demonstrated	Brockman	Railway extension from Juna Downs	Minesite Village or central Hamersley Township	Transmission line from Marandoo
Mulga Downs	Hancock Resources	50 indicated	Marra Mamba	Link to existing railway	Minesite village	On site generation or grid
Rhodes Ridge (Bakers South)	CRA/Hanwright	346 probable	Marra Mamba	Railway extension from Juna Downs	Minesite Village or Central Hamersley Township	Transmission line from Marandoo
Bungaroo Creek	Robe River Iron Associates	390 indicated 1000 inferred	Marra Mamba	Railway extension from Mesa J	Commute from Panawonica	Transmission line extension from Mesa J
Area C	BHP Iron Ore	200 probable 2000 inferred	Marra Mamba	Railway extension from Marillana Creek	Minesite Village or Central Hamersley Township	On site generation or grid
Newman satellite orebodies	BHP Iron Ore	<100	Detrital	Railway extension or road transport to existing railway	Newman (existing workforce)	On site generation
Tom Price scree orebodies	Hamersley Iron	<100	Detrital	Railway extension or road transport to existing railway	Tom Price (existing workforce)	On site generation
W. Angelas	Robe River Iron Associates	300 indicated	Marra Mamba	New railway or link to existing	Minesite Village or Central Hamersley Township	On site generation or grid
CRA Yandicoogina	Hamersley Iron	1700 inferred	Pisolite	Railway extension from Juna Downs	Minesite Village or Central Hamersley Township	On site generation or grid

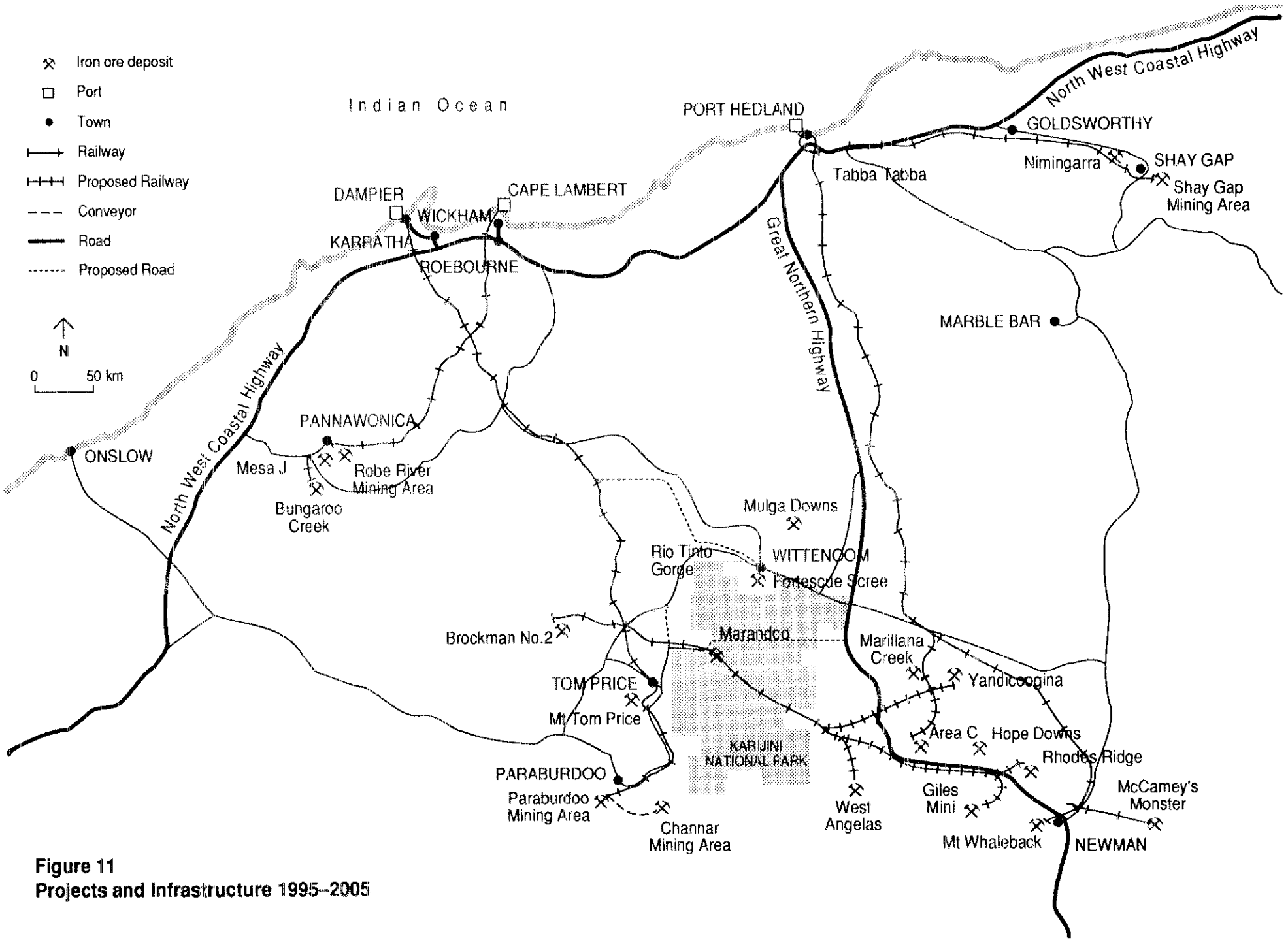


Figure 11
Projects and Infrastructure 1995–2005

their best commercial judgements concerning the resource areas that they wish to hold and the overall development sequence for those areas.

3.3 Future Infrastructure

As outlined above, over the next decade a steadily increasing percentage of Pilbara iron ore will come from the Central Hamersley Range area which is located east of the Karijini National Park. For the HI and RRIA operations, access from this area to the coast at Dampier and Cape Lambert would be through the infrastructure corridor across the Park. For the BHP operations, the focus would be Port Hedland.

The Hancock operations would be unlikely to be able to support separate infrastructure facilities in this period and would be expected to link into existing rail and port facilities. The Fortescue Scree project plans road trucking of ore to the HI railway. The Hope Downs/Mulga Downs development could conceivably link to either the HI or BHP railways, but as tonnages increased over the period there could be a separate port established on the coast, probably at Ronsard Island, with a dedicated rail link.

For Pilbara mine developments, the Government supports a policy of workforce accommodation in the region. A preference is for the establishment of new open towns, but where this is not practical or economic, commuting from established regional centres is encouraged. The preferred regional centres are Port Hedland, Karratha, Tom Price/Paraburdoo and Newman. Long distance commuting is the least favoured option from a regional development perspective.

The projects proposed to 1995 do not justify the construction of a town. However, as the forecast projects to 2005 are progressively developed, there will be increasing interest in the prospects for a town, or towns, in the Central Hamersley Range area.

These forecast projects to 2005 could, in total, support a town of about 5000 people, which is the equivalent size of another Tom Price. However, it is considered unlikely that a single townsite could be located such that all operations are within an acceptable daily commute distance, which is usually regarded as 50kms or 40 minutes travelling time.

The most probable locations of new towns would be near the Great Northern Highway, within acceptable commute distances from the projects. The section of the Highway from Newman to Port Hedland was completed in 1989. The route through the Central Hamersley Range area was selected in the early 1980's with road access to future mine projects and towns in mind.

The State has maintained both a monitoring and planning role in this regard. In 1982 and 1988 studies were undertaken by the State to evaluate potential townsites in the region in response to possible mine developments. The first was undertaken when Goldsworthy Mining Limited was investigating Area C and Cliffs Robe River Iron Associates (now RRIA) the West Angelas project. The second study was triggered by planning for the recent Marallina Creek development by BHP. This present evaluation suggests that a detailed strategic study of the future development patterns in the Central Hamersley Range area would be timely and could include consideration of the preferred future locations for towns in the area and possible timing for development.

Electricity for these projects could be supplied on an individual project basis by each developer or from a Pilbara power grid system. The total additional load from the forecast projects and a township is estimated at 35MW. The grid option is considered more practical and secure for the long term and could result in a small central power station being established in the area in the future. It would necessitate an upgrading of the generating capacity of the coastal power plants and the construction of a transmission system linking with the Northwest Interconnected System. A grid system would have little environmental impact as transmission lines could be located on established rail routes. The implications of timing for the grid system could also be considered in the strategic study mentioned above.

The Main Roads Department plans to complete construction of the Tom Price to Rio Tinto Gorge road, construct a road on an east/west alignment across the Karijini National Park and to continue upgrading the Tabba Tabba to Marble Bar road during the period covered by this review. The mining companies will construct access roads to mine sites from the existing road system and railway maintenance roads adjacent to railway alignments. Possible railway extensions and road alignments are shown in Figure 11. The main road system established by 1995 is expected to be able to cater for the developments expected to 2005.

There are large quantities of good quality groundwater available in the area. Any environmental impact from the development of borefields to support future projects is expected to be minor and localised.

The increase in tonnage and diversity of iron ore products from these new mine developments will require a commensurate increase in infrastructure at the various ports. These developments will include additional stockpile areas and loading facilities within existing port areas, rather than new port developments.

Appendix 1

The Iron Ore Industry
(Extract from Pilbara 21 Overview)

DESCRIPTION OF CURRENT AND PROPOSED OPERATIONS

Hamersley Iron Pty Ltd

During calendar year 1990, Hamersley Iron shipped 39.7 million tonnes of iron ore. Shipments by Hamersley Iron since commencement of the project in 1966 are shown in Figure 2.

Hamersley Iron presently employs 3,168 persons at the Tom Price, Paraburdoo, Dampier and Channar operations.

- Mt Tom Price and Paraburdoo Mines

Hamersley Iron operates two wholly owned open cut iron ore mines, one at Mt Tom Price and the other at Paraburdoo. The nominal capacity of these mining operations, including the output from the concentrator at Mt Tom Price, is 46 Mt/a.

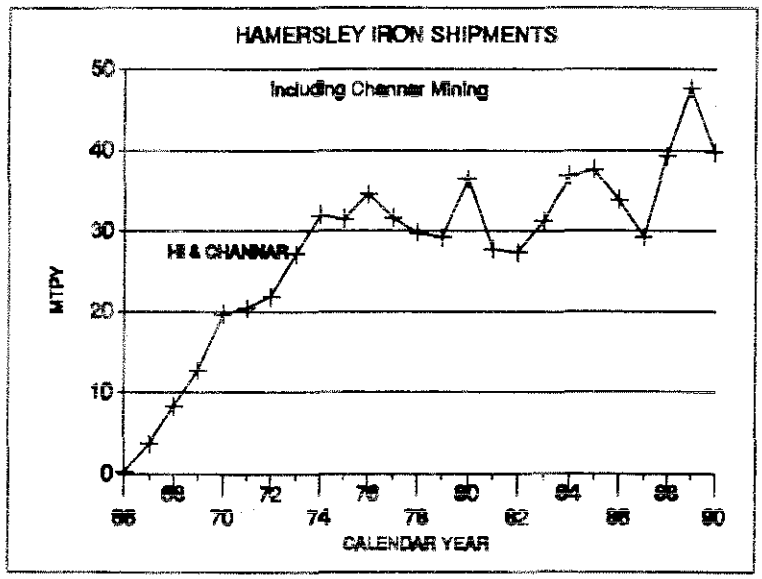


Figure 2

Tom Price ore is a high lump low phosphorus "Brockman" type. Paraburdoo ore while still of the Brockman type, has lower lump and higher phosphorus. Remaining proven reserves at the two mines are approximately 350 million tonnes. There are also additional resources of bedded and detrital ore along the Paraburdoo Range and the Turner Syncline.

At Mt Tom Price there are two crushing and screening plants, and a low grade ore concentrator. The Paraburdoo mining operation has one primary crusher.

Hamersley Iron operates a 386km standard gauge railway from Paraburdoo through Tom Price to Dampier (see Locality Map: Figure 5). The Company has two loading berths at Dampier -one at Parker Point and one at East Intercourse Island (EII). The EII wharf can accommodate vessels of up to 250,000 dwt and Parker Point, vessels of up to 140,000 dwt.

Power for the HI operation is mainly generated at Dampier by the Company. A 220 kV line was constructed in 1978 from Dampier to the mining towns of Tom Price and Paraburdoo. Dampier, Karratha and Wickham were then interconnected by SECWA using a 132 kV line in 1983.

Expansion Plans

Hamersley Iron has announced plans to extend its operations beyond the present mines, to maintain its ore quality and production rate into the next century.

The first new mine will be developed at Marandoo, followed by deposits to the east of the Hamersley Range National Park (HRNP), which will be linked to the main railway by a spur line within an infrastructure corridor across the National Park.

Hamersley's long term planning strategy is currently based around an annual output of 50 Mt/a. This compares with an average annual production of about 35 Mt/a over the last decade.

- Brockman No. 2 Detritals Project

  This A$50 million development is designed to mine 4 Mt/a of detrital iron ore over a five year period from an area 60km north-west of Tom Price.

  The project will provide employment for 150 persons during the construction phase, and a contractors' workforce estimated at 70 during operations. This workforce will be accommodated at the minesite.

  The construction and mining contract was let in the first week of August 1991. Construction has commenced and commissioning is expected in mid-1992.

- Marandoo Iron Ore Project

  Hamersley Iron intends to develop the Marandoo iron ore deposit located 50km south of Wittenoom. The mine is principally being developed to extend the life of the Tom Price and Paraburdoo iron ore bodies to ensure the continued long term supply of high quality iron ore for export. The ore is of the Marra Mamba type.

  The A$500 million project is planned to be operational in 1994 at an initial 5 Mt/a production rate rising to a planned production rate of 10 Mt/a. During the construction phase, the project will employ 1,200 persons. Employment during the operations phase is expected to be 300 persons and they will commute to the mine on a daily basis from Tom Price.

  Hamersley Iron is presently finalising its development plans and environmental studies.

- Channar Iron Ore Project

  Hamersley Iron Pty Ltd and the China Metallurgical Import and Export Corporation (CMIEC) signed a memorandum of understanding in Beijing, China, on 30 June 1987 for the joint development of the Channar Iron Ore Project.

Channar Mining Pty Ltd, a subsidiary of Hamersley Iron, holds 60% of the project with CMIEC holding 40%.

The Iron Ore (Channar Joint Venture) Agreement Act was ratified by State Parliament on 13 November 1987, with detailed proposals receiving Ministerial approval in February 1988.

During calendar year 1990, 3.3 million tonnes of iron ore was shipped to the Peoples Republic of China (PRC). The major share of the iron ore is utilised by the Baoshan Iron and Steel Complex in Shanghai (China).

The Channar project involves the mining and recovery of iron ore at an initial mining rate of 3 Mt/a, increasing to 10 Mt/a by 1998. The mined ore is crushed at Channar and then transported to Paraburdoo on an overland conveyor where is it blended with the crushed ore from the Paraburdoo mine. The ore is then further blended into the Hamersley Iron system. The ore is of variable quality Brockman types. The Channar project has a remaining proven and probable reserve of 200 million tonnes of high grade ore.

In addition to a primary crusher and conveyor system, a heavy vehicle workshop, service and fuel facilities are provided. An administration office, control room and other facilities are incorporated into the single Mine Operations Centre building. Electrical power is mainly generated at Hamersley Iron's Dampier power station and is transmitted to Channar via a branch line from the main 220 kV Dampier-Paraburdoo transmission line.

The initial permanent workforce of 150 is expected to grow to some 250 as the project develops to a maximum production rate of 10 Mt/a. The workforce is housed at Paraburdoo and commutes on a daily basis to the minesite.

BHP Iron Ore Ltd

During calendar year 1990, 27 million tonnes of iron ore was shipped from the Mt Newman mining operations. During 1991 the Goldsworthy mining operations shipped 6.5 million tonnes of iron ore. Shipments since commencement of operations in 1969 are shown in Figure 3.

Mt Newman employs 1,800 persons at Newman and 1,300 at Port Hedland. The Goldsworthy operation presently employs 906 persons at its three minesites and on Finucane Island.

- Mt Newman Iron Ore Project

The principal producing mine for the Mt Newman operations is Mt Whaleback. The current production rate is estimated at 22 Mt/a. The ore is of the high lump, low phosphorus Brockman type. The ore body has a remaining proven and probable reserve of 900 Mt. Mining should continue for about 35 years at a production rate of 25 Mt/a.

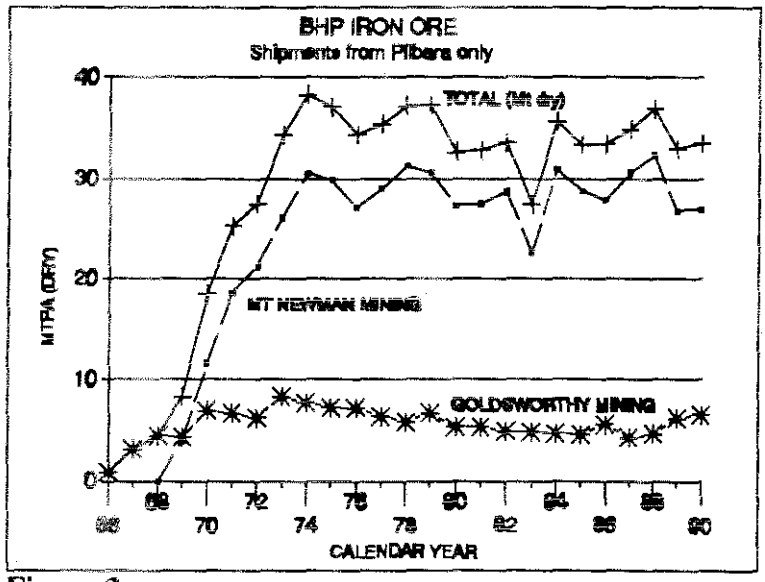


Figure 3

Orebodies 29 and 25 both of which are close to Newman, produce about 3 Mt/a of Marra Mamba ore and 2.25 Mt/a of scree ore respectively.

The Company is planning to move its scree mining operations from Orebody 25 to Orebody 23. The proposal will involve the mining of 150,000t of scree ore for a period of 2 - 3 months. The Orebody is located 4 Km from the existing scree operations at Orebody 25.

A 426km railroad links the mining operations near Newman to Port Hedland. Each train carries a payload of about 25,000 tonnes. Only primary crushing is done at the minesite with secondary and tertiary crushing carried out at Port Hedland.

The Port Hedland port facilities are capable of handling iron ore carriers of over 220,000 dead weight (dwt) and two 160,000 dwt carriers can be loaded simultaneously.

In 1985, a 200km 200 kV transmission line was built by SECWA between Wickham sub-station and Port Hedland to interconnect the main population centres of Karratha, Wickham and Port Hedland. The Company owns and operates the power generation and transmission system at Newman - the only major iron ore town not connected to the Pilbara grid. The power station has an installed capacity of 50 MW.

In July 1991, BHP Iron Ore announced a rationalisation program for its Pilbara projects. The principal aims of the program are to maximise the use of its iron ore resource, and to increase the flexibility and reliability of supply.

BHP Iron Ore has also announced that a new reclaimer will be installed at Nelson Point and additional mobile equipment will be purchased for Mt Whaleback.

- Goldsworthy Iron Ore Project

Current mining operations are located at Shay Gap, Nimingarra and Sunrise Hill, approximately 180km east of Port Hedland. Iron ore reserves are adequate to sustain mining operations for about 15 years.

These operations are serviced by a standard gauge heavy duty railway system between Port Hedland and Nimingarra, a distance of about 180km. Three trains are used, delivering a total of 20,000 tonnes per day of iron ore to Port Hedland.

When the Nimingarra and Shay Gap deposits were opened, the ship loading berth at Port Hedland was expanded and upgraded. The current maximum ship loading rate is 5,500 tonnes per hour and the average rate is 3,000 tonnes per hour. Vessels of 18,000 to 180,000 dwt can be accommodated.

The town of Goldsworthy was closed in June 1991 as part of the rationalisation of operations following BHP Iron Ore's acquisition of the project.

SECWA commissioned a 66 kV power transmission line from Port Hedland to Goldsworthy in 1989. This line was connected to a company owned 66 kV transmission line to Shay Gap.

Expansion Plans

Earlier this year, BHP Iron Ore announced that it would spend an estimated A$100 million in the next five years to increase output from the Goldsworthy project. This capital investment program is primarily designed to lift Goldsworthy's iron ore production from 6 to 8 Mt/a, reduce operating costs, and improve the Company's shipping capacity at Port Hedland.

The Company is also planning a large prospecting program for new iron ore reserves in close proximity to the existing infrastructure.

- Marillana Creek Iron Ore Project

Production of pisolitic limonite from the Marillana Creek project is expected to come on stream in early 1992. Production will start at 5.5 Mt/a, with the intention of progressively expanding to 10 Mt/a as markets develop, to match the capacity of the installed plant.

Mining operations will be located 90km north north-west of Newman and indicated resources total 1,800 million tonnes. Mining and primary crushing operations will initially be carried out by contractors.

Existing Mt Newman Mining infrastructure and equipment will be used to minimise capital expenditure. A 32km rail spur is being built to the Mt Newman-Port Hedland railroad. The ore will be crushed, screened, stockpiled and loaded at the Nelson Point facility. Power for the operation is from site diesel generation plants.

The project will employ 300 persons during the construction phase. Employment during the operations phase is estimated at 71 persons.

Robe River Iron Ore Project

During calendar year 1990, the Robe river project shipped 24.5 million tonnes of iron ore. Shipments since commencement of the project in 1972 are shown in Figure 4.

Currently Robe River employs 470 persons at Cape Lambert, and 330 persons at Pannawonica.

- Robe River Area

Currently mining is being carried out at Eastern Deepdale deposits L, M, N and at Deepdale deposit K. Ore is of the pisolitic limonite type. Remaining reserves in these deposits will only support mining for another 2 years, after which the operation will transfer to Mesa J.

Robe River operates a 190km standard gauge railroad between the mine at Pannawonica and Cape Lambert (Port Walcott). Over the past few years, the railroad has been substantially upgraded with the completion date scheduled for June 1992. The Company operates a power station at Cape Lambert and a 132 kV line between Cape Lambert and Pannawonica. The Company generates excess power which is sold to SECWA for distribution in the Pilbara. (See Figure 6).

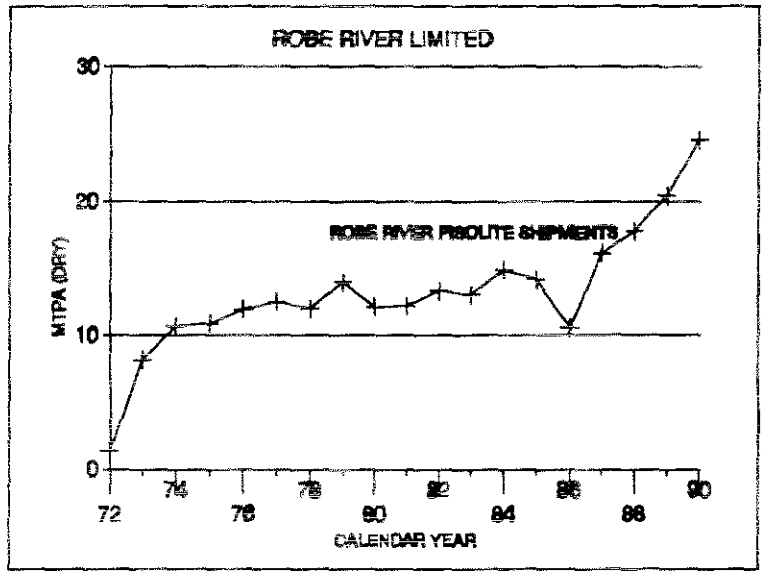


Figure 4

Expansion Plans

The Company plans an increase in capacity from 24 Mt/a to 32 Mt/a. The expansion is being undertaken to enable the Company to take advantage of increases in the international iron ore market for its particular product (pisolitic limonite sinter fines).

The expansion involves upgrading the crushing and screening plant at Cape Lambert, which currently constrains production capacity. The proposal also includes an additional feed stockpile and revetment work in the product stockpile area at the port, and the purchase of additional orecars.

The capital cost of the proposed expansion is approximately $24 million, and construction will take approximately 18 months. An additional 35 persons are expected to be employed as a result of the expansion.

- Mesa J

  Robe River will extend its mining operations to the Mesa J deposit, south of the current mining operations, in the next 18 months.

  The mining of Mesa J is to be undertaken to replace depleted reserves from other mining areas, and will provide 20 to 30 years of iron ore at the current extraction rate.

  The development will involve a 13km extension of the Cape Lambert to Pannawonica railway, rail bridges across the Robe River, iron ore load-out facilities, workshops, offices and extensions to the power line.

  The construction workforce is expected to peak at an estimated 100 persons.

Hancock Mining Limited

The joint venture known as "McCamey's Iron Associates" was formed in June 1971 to investigate the deposits of McCamey's Monster. In 1986, the McCamey's Monster Agreement was varied, making Hancock Mining Limited the sole participant. Portman Mining Ltd, who is the manager of the project, has an option to purchase 50% of the shares in Hancock Mining Ltd (via Minvest Pty Ltd).

During calendar year 1990, the McCamey's project produced 2.3 million tonnes of iron ore. Currently the project employs an estimated 50 persons.

- McCamey's Monster Iron Ore Project

  The McCamey's Monster iron ore deposits are located 40km east of Newman. An indicated resource of 39.8 million tonnes of low phosphorus iron ore has been established for the deposit.

  The project has developed in stages:

  Stage I: Involved a low cost scree mining operation which commenced in March 1989. This operation ceased in May 1991. A rail spur from the Mt Newman railway was constructed and iron ore was sold to BHP Iron Ore at the railhead.

  Stage II: Commenced in June 1991, and involves the mining of a bedrock deposit near the scree operations. The contract is for the supply of 3 million tonnes of primary crushed ore to BHP Iron Ore over approximately one year.

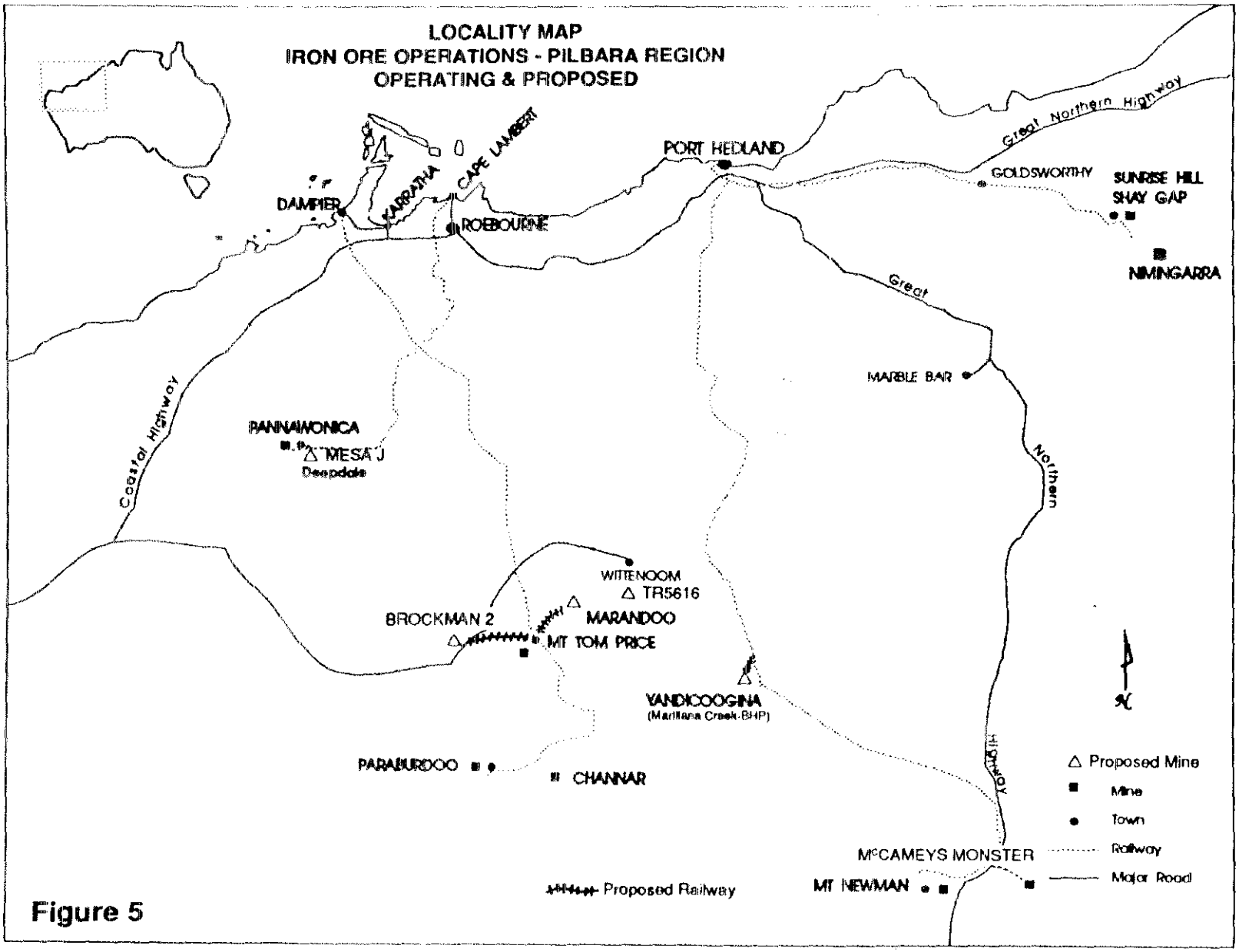
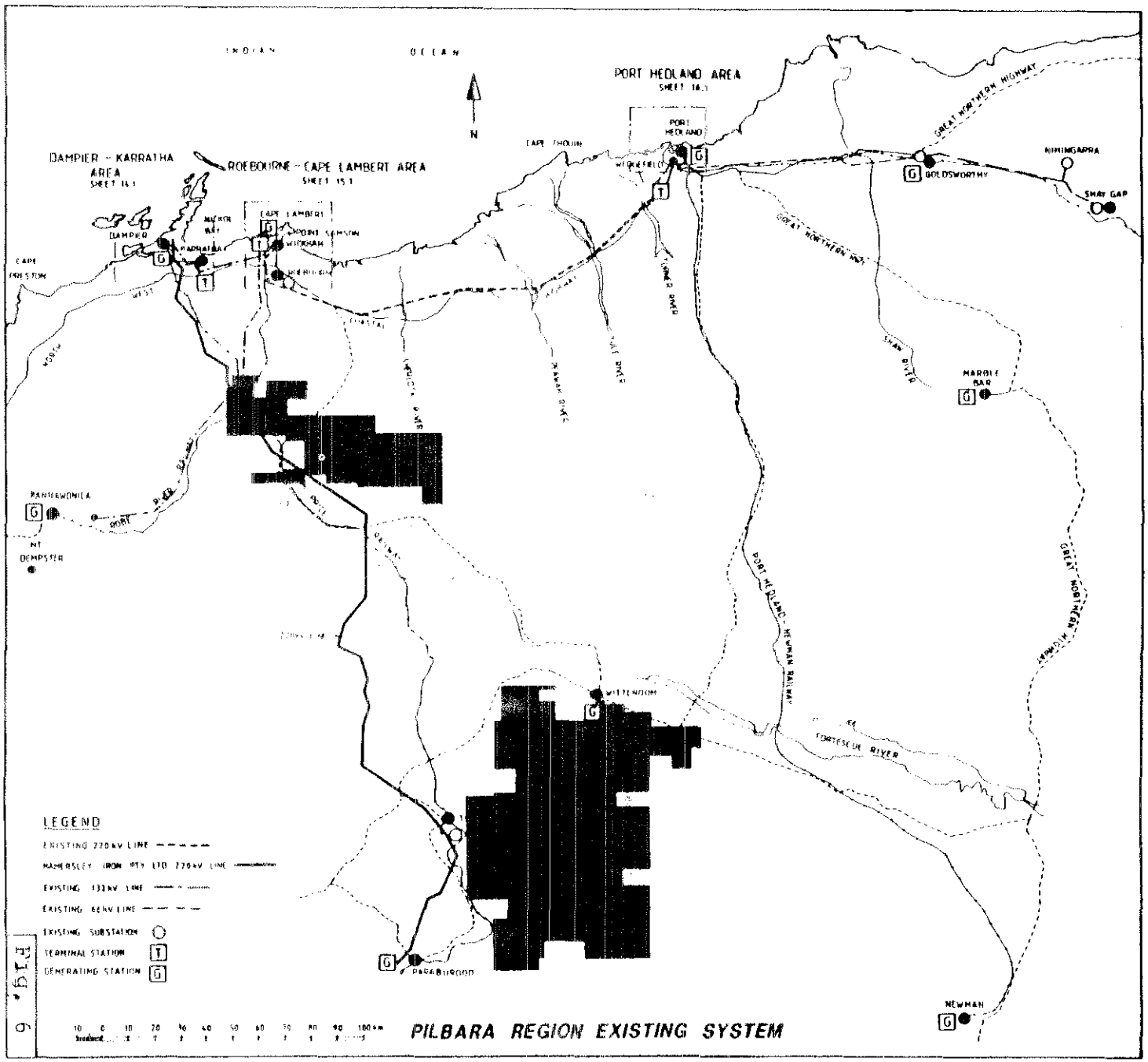

LOCALITY MAP
IRON ORE OPERATIONS - PILBARA REGION
OPERATING & PROPOSED
PORT HEDLAND
Great Northern Highway
GOLDSWORTHY
SUNRISE HILL
SHAY GAP
NIMINGARRA
DAMPIER
KARRATHA
CAPE LAMBERT
ROEBOURNE
Great
MARBLE BAR
Coastal Highway
PANNAWONICA
MESA J
Deepdale
Northern
WITTENOOM
TR5616
MARANDOO
BROCKMAN 2
MT TOM PRICE
YANDICOOGINA
(Mariliana Creek-BHP)
PARABURDOO
CHANNAR
McCAMEYS MONSTER
MT NEWMAN
Proposed Mine
Mine
Town
Railway
Major Road
Proposed Railway

Figure 5


INDIAN OCEAN
N
PORT HEDLAND AREA
SHEET 16.1
DAMPIER - KARRATHA AREA
SHEET 16.1
ROEBOURNE - CAPE LAMBERT AREA
SHEET 15.1
PORT HEDLAND
GREAT NORTHERN HIGHWAY
NINGAGARRA
SHAY GAP
GOLDSWORTHY
DAMPIER
KARRATHA
CAPE LAMBERT
MOUNT SAMSON
WICKHAM
ROEBOURNE
CAPE PRESTON
MARBLE BAR
PARABURDOO
MT DEMPSTER
WITTENOOM
FORTESCUE RIVER
NEWMAN
LEGEND
EXISTING 220kV LINE
EXISTING SUBSTATION
TERMINAL STATION
GENERATING STATION
PILBARA REGION EXISTING SYSTEM

Appendix 2

An Explanation of Resource Types

A **resource** is an identified mineral occurrence in the ground quantified on the basis of geological data and geological cut-off grade only.

A **reserve** is that part of a resource that is viable to be mined after all factors are taken into account, including dilution, the constraints of mining techniques, economic, political, social, marketing, etc.

An **inferred** resource is where data is insufficient to have confidence in the continuity of mineralisation.

An **indicated** resource is the equivalent of a probable reserve, but before economic parameters are applied.

A **measured** resource is the equivalent of a proven reserve, but before economic parameters are applied.

A **demonstrated** resource is the combined total of measured and indicated resources of a particular deposit.

A **probable** reserve has a lower level of confidence in the tonnage and grade than a proven reserve, but is such that an economic assessment can be made.

A **proven** reserve has a high degree of confidence that the tonnes and grade produced will not vary greatly from those stated.

APPENDIX 3

An Explanation of Iron Ore Types of the Pilbara Region

Iron Ore Types

Iron ores of the region are of three fundamental types; bedded ore, pisolite ore and detrital ore. Some banded iron-formations (BIF's), especially those that are magnetic such as at Fortesque, may also have potential to become "ores" by beneficiation (BIF is a rock unit containing bands of iron minerals and is host rock to the bedded ore of the region).

Bedded Ore

This is the major ore type of the province. Deposits of this type occur as discrete bodies within the two major BIF units of the region, the Brockman Iron Formation and the Marra Mamba Iron Formation, and also within the older Cleaverville Formation in the Goldsworthy area. The iron content of bedded ore bodies is greater than 60%, compared to 35% for the host BIF's.

Bedded deposits in the Brockman Iron Formation or **Brockman** type ores, constitute approximately 53% of the iron resource of the region. They are of variable quality and range from the high iron (> 63%), low phosphorus (0.05% to 0.08%), high lump (45% to 55%) Whaleback or Tom Price type to the lower iron (60% to 63%), high phosphorus (> 0.1%), low lump (35% to 45%) regional Brockman type. Giles Mini, in the central Pilbara area, is the only known significant deposit of the higher quality Whaleback type that remains undeveloped. Production of this quality ore will decrease through the early 21st century as reserves at Tom Price, Paraburdoo, Channar and Whaleback are depleted.

Bedded deposits in the Marra Mamba Iron Formation constitute 24% of the iron resource of the region. **Marra Mamba** ores have similar iron grade as the regional Brockman type deposits but have lower and inferior lump (25% to 40%) while containing less phosphorus (0.05% to 0.07%). Production of this ore type will increase substantially as new developments, such as Marandoo, Mining Area C, Rhodes Ridge and West Angelas come on-stream.

Bedded deposits in the Cleaverville Formation are restricted to the northern part of the Pilbara. They have similar iron grades as Brockman Ore (>63%) but less phosphorus (0.05%).

Detrital Ore

Detrital, or **scree** ores, are poorly consolidated scree deposits occurring on plains and in valleys adjacent to outcropping ridges of bedded ore or BIF. They consist of angular fragments of haematite within a matrix of iron rich clay. Detrital deposits can usually be upgraded by dry screening to produce a high grade lump product. Phosphorus is usually low. **Canga** is a form of high grade detrital which has been cemented to a hard conglomerate. Detrital deposits are known throughout the region and are being mined as adjunct to existing operations at Whaleback (Orebody 23) and Tom Price (Southern Plains). Larger deposits, such as the Brockman detritals, will be developed where they are close to existing rail facilities.

Pisolite Ore

Pisolite ores of the Robe River and Yandicoogina type consist of gravelly limonite occupying the channelways of ancient river systems. Iron grades are in the 52% to 59% range with contained water of crystallisation averaging about 10%. Grades increase to greater than 60% iron when this water is driven off by heating (calcining). Phosphorus content is usually less than 0.07%. This ore type produces fines only and requires sintering before it is suitable for blast furnace feed. About 25% of Western Australia's iron ore shipments are presently of this type. Production of this ore type will increase when Marillana Creek, and later Yandicoogina, come on-stream.

Appendix 4

Example of Conditions Placed on Mining Operations under Part V of the Environmental Protection Act

AIR POLLUTION CONTROL CONDITIONS

A1 DUST CONTROL EQUIPMENT

All dust control and dust collection equipment installed on the premises including:

- coverings on conveyors, transfer points and discharge points;
- skirtings;
- water sprays; and
- dust filters,

shall be operated and maintained in accordance with the manufacturer's instructions, so as to achieve a consistent and acceptable level of dust emissions control.

A2 HAUL ROADS, ACCESS ROADS, WORK AREAS - DUST SUPPRESSION

Water carts shall be used to suppress dust from haul roads, stockpile access roads and work areas.

A3 PRIMARY CRUSHER - DUST CONTROL

The licensee shall operate when necessary the water sprays on the coarse ore feed point to the primary crusher to prevent or minimise the generation of dust.

A4 GENERAL PLANT - DUST GENERATION CONTROL

Routine maintenance and housekeeping practices shall be employed to ensure that there is no accumulation of waste materials in or around the premises which may lead to the generation of airborne dust.

A5 DARK SMOKE EMISSIONS - BURNING

(a) Burning of waste material shall not be undertaken at any time, without prior approval from the Director, Pollution Control Division.

(b) No rubber, rubber products, plastic or plastic products may be burned at any time.

(c) No waste oil may be burned at any time.

WATER POLLUTION CONTROL CONDITIONS

B1 IMPERVIOUS HOLDING FACILITIES

All matter containing potentially polluting substances, eg metals, hydrocarbons, shall be retained within impervious holding facilities, such that there is no impairment of surface or underground waters.

B2 HYDROCARBON STORAGE

All aboveground hydrocarbon storage facilities shall be bunded with impervious bunds having a minimum capacity of 110 per cent of the hydrocarbon store capacity.

B3 STORMWATER DISCHARGE

Stormwater shall only be discharged from the bunded area after it has been established that it is not contaminated with hydrocarbons.

B4 DISCHARGES OF CONTAMINATED WATER

Contaminated stormwater shall either be treated before discharge to remove the hydrocarbon content or disposed of off-site in an approved facility.

B5 DRAINAGE FROM ANCILLARY FACILITIES

All wastewater discharges from ancillary facilities such as maintenance workshops and laboratories (other than that used for dust suppression purposes), shall be treated to remove contaminants prior to discharge to drainage or soakage, or otherwise, disposed of by solar evaporation in impervious holding areas.

B6 LIQUID WASTE COLLECTION AND DISPOSAL

Waste oils, lubricants and coolants from vehicle servicing and power generation facilities shall be collected in impervious holding tanks for recycling or export offsite to an approved disposal facility.

B7 SILT CONTROL

The licensee shall install and maintain silt controls downstream of disturbed areas and ore stockpiles via diversion bunds and silt traps to prevent siltation of surface streams.

SOLID WASTE POLLUTION CONTROL CONDITIONS

S1 RE-USE OF WASTE

The licensee shall, if practicable, re-use waste wholly or in part or make waste available for re-use by another person.

S2 SOLID WASTE DISPOSAL

All solid wastes, excluding toxic and hazardous substances, shall be disposed of by landfill. Such landfills shall be located away from areas subject to flooding or erosion. Toxic and hazardous solids shall be exported offsite for disposal as approved by the Health Department of Western Australia.

Appendix 5

Indicative Guidelines for the Central Pilbara Railway Environmental Management Programme

Draft Guidelines for the Preparation of the Central Pilbara Railway Environmental Management Programme

Objective

These guidelines are issued as a checklist of matters which the Environmental Protection Authority considers should be addressed in the environmental management programme (EMP) for the Central Pilbara Railway. The potential environmental impacts of the railway and associated infrastructure need to be identified, with the proposed management of each impact clearly described. The following information needs to be presented in sufficient detail to allow the Authority to assess how these impacts are proposed to be managed.

Description of Proposed Development

A brief description of the proposed railway and associated infrastructure to place it in context for this report.

Description of Existing Environment

Present a brief appraisal of the environment that would be potentially effected by the proposal including:

- landform and geomorphology of the corridor east of Marandoo;
- drainage and catchment information of basins discharging across or along the railway alignment;
- analysis of vegetation and identification of vegetation communities that are sensitive to construction/operational impacts;
- survey of alignment for populations of important flora (rare priority listed, or geographically restricted) and fauna (gazetted under Wildlife Conservation Act).

Description of Environmental Impacts

An assessment and identification of potential environmental impacts of the proposal including:

- criteria used to select preferred route and location of alignment of railway and access road;
- criteria used, and location of, all areas to be disturbed such as laydown areas, construction camps, ballast and borrow sites.

Environmental Management

- methods for control of clearing, particularly around sensitive sites;
- criteria used and design of railway to minimise environmental impact;
- description of construction methods and staging for rail and road to minimise environmental impact;
- design criteria for drainage features and methods to minimise erosion and impacts on vegetation;
- methods for fire and weed quarantine and control;

- management of the barrier effect of the railway embankment on movement of fauna.
- management of impacts of the crossing of Turee Creek.
- detailed description of rehabilitation methods for all disturbed areas; and
- methods of monitoring to detect impacts including contingency plans, and reporting of monitoring results. Environmental attributes to be monitored should include vegetation, erosion, fauna, and rehabilitation;