

**ENEABBA WEST MINERAL SANDS PROJECT**

**AMC MINERAL SANDS LIMITED**

Report and Recommendations  
of the  
Environmental Protection Authority

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## SUMMARY AND RECOMMENDATIONS

AMC Mineral Sands Limited has submitted a proposal to extend their existing heavy mineral sand mining operation. The proposed extension is 5 km west of the existing operation at Eneabba, which lies 250 km north of Perth. Expansion of the mining operation will necessitate an expansion of the existing dry processing plant at Narngulu near Geraldton.

It is proposed to mine 200 million tonnes of ore over a 14 year period, resulting in a 40% increase in production at the Eneabba operations.

Mining of the deposit would be carried out using a bucketwheel dredge connected to a floating process plant. This plant produces a wet concentrate which is dried on-site prior to being railed to the Narngulu dry processing plant.

At Narngulu, the concentrate would be subjected to a complex series of electrostatic, magnetic and gravity separation processes to separate the various heavy mineral component products.

These products will be transported to the Geraldton wharf for export. Waste materials produced from the separation process will be buried in earth bunkers at the site. It is intended to retreat the material in the future.

The proposed minesite at Eneabba West is located upon private land much of which has been cleared for agricultural purposes. The remnant native vegetation has been grazed to varying degrees.

Native vegetation of the proposed minesite area can be divided into three types; Banksia heath, mixed low heath and wetland heath.

The dry processing plant is located approximately 10 km south-east of Geraldton within the Narngulu Industrial Estate. Soils beneath the site are principally clay with some sand and limestone. The main aquifers in the area contain brackish water, potable groundwater occurs in isolated pockets near the surface.

In considering the Company's initial proposal the Environmental Protection Authority determined that the potential for environmental impact was such that the proposal would require assessment under Part IV of the Environmental Protection Act, 1986, and that the level of assessment would be a Public Environmental Report (PER) with an eight week public review period.

The major environmental issues considered during the assessment of the proposal were generally related to:

- impacts of the proposal on adjacent conservation reserves;
- hydrological impacts in the area of the minesite as a result of mining;
- potential for increased salinisation of the mined area as a result of mining; and
- dieback occurrences caused by Phytophthora species.

In its assessment of the proposal the Authority carefully considered these potential impacts with respect to long and short term effects and final stability at the proposed minesite.

This report addresses the various environmental issues raised during the assessment of the proposal as well as a number of other recommendations that have been made to ensure that adequate environmental management programmes are adopted for the project.

Upon consideration of the Public Environmental Report that was submitted for the project, the Environmental Protection Authority has concluded that the proposal would be environmentally acceptable subject to the following recommendations:

## **RECOMMENDATION 1**

The Environmental Protection Authority concludes that the proposal described in the Public Environmental Report is environmentally acceptable and recommends that it could proceed subject to the Environmental Protection Authority's recommendations in this Assessment Report and the commitments made by the proponent for environmental management including:

- establishment of long-term monitoring studies to assess revegetation;
- implementation of rehabilitation and monitoring programmes based on results obtained from pre-mining research;
- monitoring of groundwater levels and groundwater quality in the vicinity of the minesite; and
- strict adherence to all Western Australian regulations and the Commonwealth Code of Practice relating to radiation.

## **RECOMMENDATION 2**

The Environmental Protection Authority recommends that the mining and processing operation be carried out in accordance with the provisions for the protection and management of the environment contained in the Mineral Sands (Eneabba) Agreement Act (1975-1988). These provisions ensure that the proponent carries out a programme of investigation and research, to ascertain the effectiveness of its measures to protect the environment. Under the agreement a Mineral Sands Agreement Rehabilitation Co-ordinating Committee has been established, which monitors the rehabilitation situation at Eneabba and advises the Minister for Resources Development.

## **RECOMMENDATION 3**

The Environmental Protection Authority recommends that, prior to the commencement of productive mining, the proponent prepares and implements a dieback hygiene programme for locations identified by the Department of Conservation and Land Management to the satisfaction of the Environmental Protection Authority. The approved programme should be available for public information.

## **RECOMMENDATION 4**

The Environmental Protection Authority recommends that the proponent ensures that there be no unacceptable detrimental effects from the mining operation on vegetation, groundwater levels or groundwater quality within the adjacent Reserves for the Conservation of Flora and Fauna. Accordingly, prior to commencement of mining, the proponent should prepare and implement a programme to monitor vegetation, groundwater levels and groundwater salinity in the Reserves, in consultation with the Department of Conservation and Land Management to the satisfaction of the Environmental Protection Authority.

Should this programme identify any adverse effects, the proponent should report these immediately to the Environmental Protection Authority together with a plan of remedial action.

## **RECOMMENDATION 5**

The Environmental Protection Authority recommends that the productive agricultural land that is to be mined should be rehabilitated to an environmentally stable condition. Accordingly, the proponent is to develop a rehabilitation prescription in consultation with the Department of Agriculture, to the satisfaction of the Environmental Protection Authority.

## **RECOMMENDATION 6**

**The Environmental Protection Authority recommends that any proposal to modify the dry separation process requiring the addition of chemical reagents or altering the chemical composition of the product compounds should be referred to the Environmental Protection Authority for assessment prior to that process being adopted.**

## **1. BACKGROUND**

AMC Mineral Sands Ltd has submitted a proposal to expand their existing heavy mineral sand mining and processing operation. The proposed minesite is located 5 km to the west of the existing Eneabba operation and is termed the Eneabba West deposit. Initial processing at the minesite would produce a heavy mineral concentrate which would be railed to the existing dry processing plant at Narngulu near Geraldton. In order to cater for the increased load an additional processing circuit would be constructed at the Narngulu plant.

In considering the initial proposal the Environmental Protection Authority determined that the project would require assessment under Part IV of the Environmental Protection Act, 1986, and that the level of assessment would be a Public Environmental Report

## **2. PROJECT DESCRIPTION**

The Eneabba West proposed minesite is located approximately 5 km west of the existing Eneabba mineral sands mining operation (Figure 1).

The Eneabba West deposit is estimated to contain 200 million tonnes of ore at an average grade of 3% heavy mineral, which will be mined over a period of approximately 14 years. Mining of the deposit would be carried out using a bucketwheel dredge which will float on a pond averaging 15 m in depth. The mining dredge would pump the ore directly to a wet concentrator plant which would float behind the dredge in the same pond.

The function of the wet concentrator plant is to separate waste tailings and slime in the ore from the heavy minerals and to produce a concentrate of the heavy minerals. The process utilises gravity to separate the waste material from the valuable heavy minerals. Waste material in the ore have lower specific gravities than the heavy minerals and the two streams separate as they pass through a series of spiral and cone concentrators. There are no chemical additives used in the process. The waste material is then used to backfill the dredge pond, while the wet concentrate would be stockpiled for a short period prior to being transported by road to the Eneabba South concentrator for attritioning and drying. The dried concentrate will then be railed to the Narngulu Processing Plant for separation into the heavy mineral products.

It is noted that the proponent has made a minor amendment to the method of operation outlined in the Public Environmental Report. The starting position of the dredge has been altered to allow an easier commissioning phase. As a consequence, the water supply dam will also be relocated. The environmental effects of these relocations are considered minimal.

Mining and rehabilitation at Eneabba West is proposed to be integrated and carried out in a progressive manner. As mining proceeds, tailings from the wet concentrator would be used to fill the rear of the dredge pond.

Existing rehabilitation methods will be applied to areas rehabilitated to native revegetation at the site. The initial step will involve re-establishment of the landform by the placement of tailings on the mine path, and contouring the surface. Topsoil which has been salvaged ahead of mining will be re-spread over the re-placed waste material.

The soil surface will be stabilised by planting a low density cover crop and by spreading vegetative mulch harvested prior to mining. A seed mix composed of locally collected species will be sown to augment seed contained in the topsoil and mulch. Selected species may be planted out as nursery stock in the second year to supplement other establishment procedures.

Rehabilitation for agricultural use will also involve re-establishment of the landform and replacement of topsoil. The land would then be planted to the selected agricultural crops using conventional techniques.

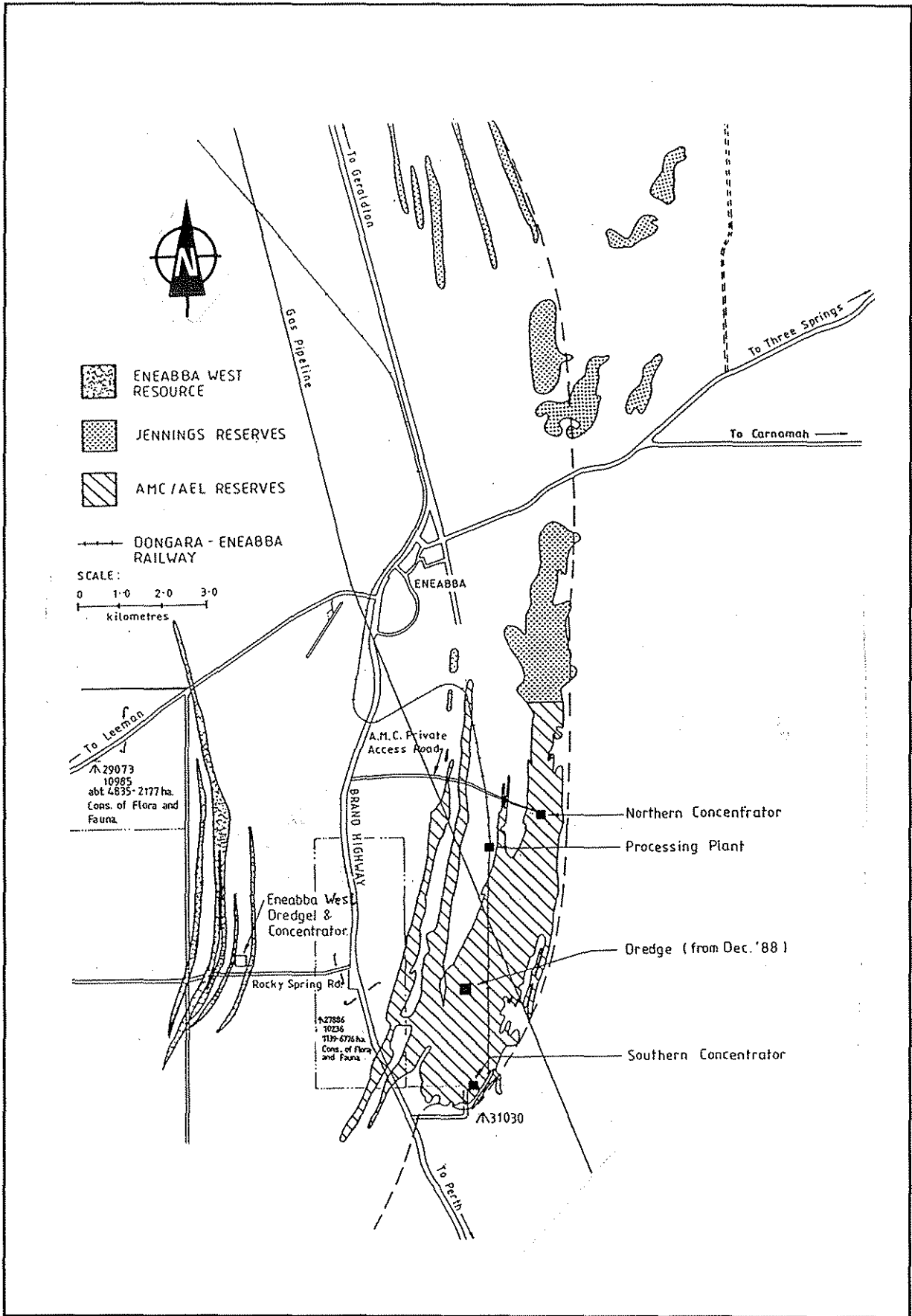


Figure 1: Eneabba West Locality Plan



As the dredge pond proceeds along the mine path, this sequence of tailing placement, re-contouring and re-vegetation would be carried out progressively in the wake of the dredging operation

Following mining and initial on-site concentration, the produced heavy mineral concentrate would be railed to the dry processing plant at Narngulu near Geraldton (Figure 2). At Narngulu, the concentrate would be passed through a complex series of electrostatic, magnetic and gravity separation equipment. The various heavy mineral components of the concentrate have a unique combination of electrical and magnetic properties and specific gravities on which the separation process relies. Ilmenite and rutile are electrical conductors while zircon and monazite are non-conductors. Therefore, as the concentrate passes through an electrical field, the conductors and non-conductors separate and can be collected. As ilmenite is magnetic, it can be separated from the rutile, which is non-magnetic, by passing this stream through a magnetic field. A similar process can be used to separate monazite from zircon. Gravity separation is used to further refine some of the final product streams.

Waste material from the dry processing plant, consisting of silica, non-commercial minerals and small quantities of heavy minerals, will be buried in earth bunkers on-site. Disposal will be carried out in such a way so as to allow re-treatment of the heavy mineral fraction in the future, if deemed viable. Final products will be transported to the Geraldton wharf for export, with the exception of monazite which would be railed to Fremantle for shipping.

### **3. EXISTING ENVIRONMENT**

The proposed minesite area at Eneabba West consists predominantly of low dune ridges with inter-dunal swales subject to seasonal waterlogging. The general features are typical of the Bassendean Sand formation which covers most of the Swan Coastal Plain.

The site is underlain by a shallow aquifer which features relatively slow flow rates. The deeper aquifer of the Cockleshell Gully Formation provides more consistent flow rates, although the water from this deeper aquifer has a higher level of salinity. The proposed mining area is all on private land, a significant portion of which has been cleared for agricultural purposes. These areas are planted with pasture species for stock grazing. The remnant native vegetation at the site consists primarily of native heath with areas of Banksia heath, mixed low heath and wetland heath. The vegetation survey concentrated on identifying vegetation types, species significantly different from those on the existing mining area, and rare species. The rare plant search for species known to occur in the locality failed to record any individuals in the proposed mining area.

The climate at Eneabba is dry mediterranean with predominantly winter rainfall, high evaporation rates, with high and occasionally extreme temperatures in summer. Strong easterly winds occur in the mornings during the summer, usually reverting to the south west in the afternoon.

Existing land use at the proposed minesite is for agricultural purposes, primarily sheep grazing. Grazing into native vegetation occurs where it is accessible. Reserves for the conservation of flora and fauna exist to the east and west of the mining area.

The Narngulu Processing Plant is located within the Narngulu Industrial Estate at Geraldton.

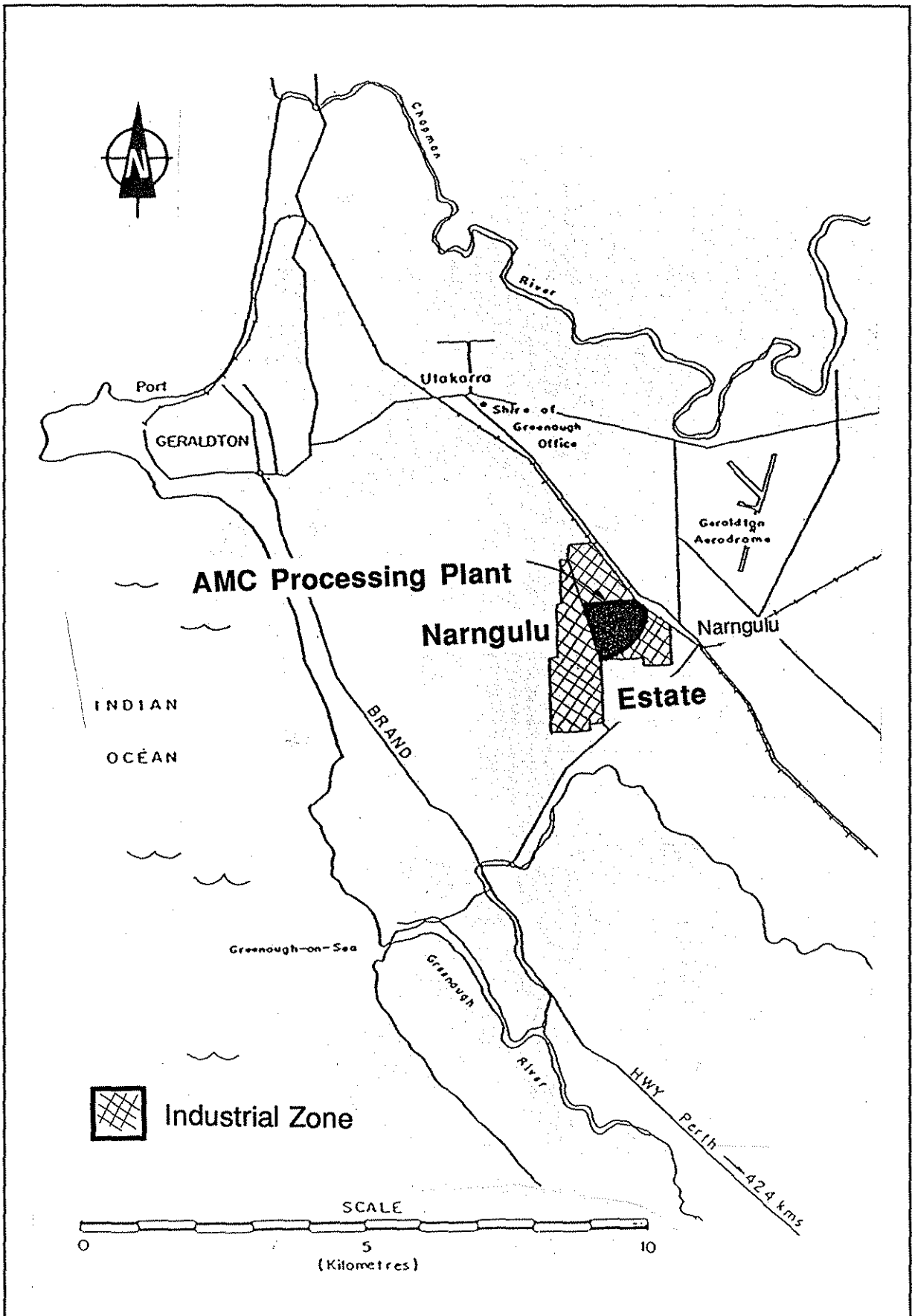


Figure 2: Location of Narngulu Processing Plant

#### 4. PUBLIC AND GOVERNMENT SUBMISSIONS

One public and eight State Government agency submissions were received during the public review period.

A summary of the issues raised is provided in Table 1.

The predominant concerns raised in the submissions were mainly with regard to rehabilitation of the minesite, flora and fauna surveys and, hydrological impacts of the mining operation both on and off the site. The specific issues together with the proponents responses are set out in Appendix 1 of this report.

After reviewing submissions received, the Environmental Protection Authority considered that the environmental issues raised could be adequately managed. Accordingly, where considered necessary those issues of concern have been covered by the recommendations in this Assessment Report.

Table 1. Summary of Submissions

---ISSUE	No of Submissions
Minesite Rehabilitation	4
Botanical Survey	3
Faunal Assessment	3
Hydrological Impacts of Mining Operation	3
Dieback	2
Radiation Hazards	2
Impact of Mining Operation on Soil Salinity	2
Aboriginal Site Survey	1

#### 5. ENVIRONMENTAL ISSUES

In considering the proponent's initial proposal, the Environmental Protection Authority determined that the potential for environmental impact was such that the proposal would require assessment under Part IV of the Environmental Protection Act, 1986, and that the level of assessment would be Public Environmental Report (PER)

The Public Environmental Report was submitted for the proposal and has undergone an eight week public review period, which finished on 25 July 1989.

Following a review of the environmental aspects of the proposal and taking into account submissions from the public and government agencies', the Environmental Protection Authority concludes that the proposal would be environmentally acceptable, subject to a number of conditions as discussed in the following sections of this report.

##### RECOMMENDATION 1

The Environmental Protection Authority concludes that the proposal described in the Public Environmental Report is environmentally acceptable and recommends that it could proceed subject to the Environmental Protection Authority's recommendations in this Assessment Report and the commitments made by the proponent for environmental management including:

- establishment of long-term monitoring studies to assess revegetation;
- implementation of rehabilitation and monitoring programmes based on results obtained from pre-mining research;
- monitoring of groundwater levels and groundwater quality in the vicinity of the minesite; and

- **strict adherence to all Western Australian regulations and the Commonwealth Code of Practice relating to radiation.**

The proponents commitments to environmental management are set out in Appendix 2 of this report.

#### 5.1 ENVIRONMENTAL CONTROL OF THE MINING OPERATIONS

The proponents mining and processing operations at Eneabba and Narngulu are carried out under the provisions of the Mineral Sands (Eneabba) Agreement Act (1975-1988). A number of the provisions of the Agreement Act relate to environmental management including; an obligation by the proponent to carry out a continuous programme of environmental investigations and research and, a comprehensive reporting mechanism outlining existing and proposed environmental management programmes. Supervision of the company's activities is carried out by an inter-departmental committee, the Mineral Sands Agreement Rehabilitation Co-ordinating Committee. This committee is comprised of representatives from the Departments of Resources Development, Mines, Conservation and Land Management, and Agriculture, as well as the Environmental Protection Authority. The Environmental Protection Authority considers that the provisions of the Agreement Act are a suitable mechanism for the environmental control of the Eneabba Mineral Sand mining operations.

In addition to the Agreement Act, the mining operation is subject to the various controls under the provisions of the Environmental Protection Act 1986.

#### **RECOMMENDATION 2**

**The Environmental Protection Authority recommends that the mining and processing operation be carried out in accordance with the provisions for the protection and management of the environment contained in the Mineral Sands (Eneabba) Agreement Act (1975-1988). These provisions ensure that the proponent carries out a programme of investigation and research, to ascertain the effectiveness of its measures to protect the environment. Under the agreement a Mineral Sands Agreement Rehabilitation Co-ordinating Committee has been established, which monitors the rehabilitation situation at Eneabba and advises the Minister for Resources Development.**

#### 5.2 DIEBACK

One of the major environmental issues that is concerned with the mining operation is the potential to spread infections of dieback disease, that are known to occur in the area.

Dieback disease occurs as a fungal pathogen known as Phytophthora, which when present in soils attacks the root systems of selective plant species eventually killing the less tolerant of these species. Dieback is known to occur widely throughout the south-west of Western Australia where special management programmes have been adopted to control the spread of the disease. At present only one outbreak of the fungus has been identified in the vicinity of the proposed Eneabba West minesite. Factors that increase the risk of infection are generally, number of susceptible hosts, presence of free water, soil type and activities which disturb the soil.

Many susceptible species are known to occur in the native heath vegetation common to the existing and proposed minesites and adjacent nature reserves. Parts of the minesite are prone to inundation particularly those areas where the water table is close to ground surface. The dredge pond itself will introduce a new source of free water.

Although the issue of dieback was not addressed in the Public Environmental Report for this project the proponent has stated in its response to submissions that it will be reviewing its dieback prevention policy in the light of a recent outbreak near the proposed minesite.

### RECOMMENDATION 3

The Environmental Protection Authority recommends that, prior to the commencement of productive mining, the proponent prepares and implements a dieback hygiene programme for locations identified by the Department of Conservation and Land Management to the satisfaction of the Environmental Protection Authority. The approved programme should be available for public information.

#### 5.3 IMPACTS OF MINING OPERATIONS ON ADJACENT NATURE RESERVES

Reserves for the conservation of flora and fauna, are located adjacent to the proposed minesite at Eneabba West. Reserve 27886 (vested in the Western Australian Wildlife Authority) abuts the south eastern boundary of the site whilst Reserve 29073 (unvested) adjoins the north western boundary (Figure 1).

There is some concern as to the effect of the mining method on groundwater quality and quantity and the impact this will have on vegetation within the nearby nature reserves. The dredge pond will be excavated some 5 metres below groundwater level into the superficial aquifer. Although make-up water to maintain the water level in the pond will be sourced from a deeper aquifer, there will be groundwater inflow to the pond from the shallow superficial aquifer to compensate for losses due to evaporation.

It is expected that this temporary drawdown of the superficial aquifer, caused by water inflow into the dredge pond, would be up to 1 m at 1 km from the dredge pond. This level of drawdown is not expected to affect the native vegetation in the reserves. However, it is intended to monitor the effects of drawdown from the beginning of the operation, which will allow a number of years research before the dredge path comes close to the reserves.

A related environmental issue is the contribution of salts to the superficial aquifer from the water sourced from the deeper aquifer within the Cockleshell Gully Formation.

The water pumped from the deeper aquifer and used for dredge pond make-up water at a rate of 1500 cubic m per day, has a higher average salinity level than the water in the superficial aquifer. The proponent believes that from the data available the increase in the salinity level of the shallow aquifer from the contribution of water from the deeper aquifer would be marginal.

The proponent recognises the limited information available on groundwater levels, salinity and aquifer properties in the Eneabba West area, and has made a commitment to carry out monitoring to provide more detailed information.

### RECOMMENDATION 4

The Environmental Protection Authority recommends that the proponent ensures that there be no unacceptable detrimental effects from the mining operation on vegetation, groundwater levels or groundwater quality within the adjacent Reserves for the Conservation of Flora and Fauna. Accordingly, prior to commencement of mining, the proponent should prepare and implement a programme to monitor vegetation, groundwater levels and groundwater salinity in the Reserves, in consultation with the Department of Conservation and Land Management to the satisfaction of the Environmental Protection Authority.

Should this programme identify any adverse effects, the proponent report these immediately to the Environmental Protection Authority together with a plan of remedial action.

#### 5.4 PROTECTION OF EXISTING LAND-USE

The Eneabba West deposit is located on private agricultural land used primarily for sheep grazing purposes. Approximately half of the land has been cleared and sown to pasture, with the remnant native vegetation being grazed where it is accessible to stock.

Rehabilitation will aim to return the agricultural areas to agricultural production and, outside of these areas, native vegetation will be planted as much as possible.

Alternative agricultural crops and tree belts will be investigated to improve production and reduce the rate of groundwater recharge on farmland. In order to reduce the groundwater level and hence the potential for salinisation of surface soils, the use of artificial lakes will be investigated. The intent is to increase water loss through evaporation thereby reducing the level of the water table.

In the context of the whole site, given that much of the land will be cleared for the proposed mining activities, it is important to put in place mechanisms for long-term environmental management of the site. Therefore, rehabilitation of the area should have the objective of ensuring the land can support sustainable agricultural production in the long-term.

The opportunity exists to develop farm plans for the site to meet this objective taking into account; land contours, drainage, water logging, erosion control, soil type, and vegetation planting.

#### **RECOMMENDATION 5**

**The Environmental Protection Authority recommends that the productive agricultural land that is to be mined should be rehabilitated to an environmentally stable condition. Accordingly, the proponent is to develop a rehabilitation prescription in consultation with the Department of Agriculture, to the satisfaction of the Environmental Protection Authority.**

#### 5.5 RADIATION HAZARDS

Radiation hazards associated with the proposal were considered with regard to both occupational and public health aspects.

Areas where there is transport or storage of radio-active substances (or irradiating apparatus) come under the Radiation Safety Act. Accordingly, the provisions of this Act must be complied with in respect to the following aspects of the proposal:

- Monazite transport to Fremantle;
- Monazite storage at Narngulu;
- on-site gauges using radioactive sources; and
- on-site X-ray analysis equipment.

The proponent would also be required to comply with relevant Codes of Practice. (eg Mineral Sands, Mining, Transport, Gauges, X-ray apparatus).

Other responsibilities would include:

- Education of the workforce about radiation safety (including dust); and
- ensuring that, at the eventual cessation of mining and processing, all radiation levels are reduced to levels which existed prior to mining.

The Authority noted that the Company has made a commitment to strictly adhere to all Western Australian Regulations and Commonwealth Codes of Practice relating to radiation protection including:

- a comprehensive radiation level monitoring programme at both the minesite and the dry process plant;
- isolation of the monazite process circuit into a separate section; and
- comprehensive dust suppression measures.

## 5.6 MODIFICATION OF PROPOSED FACILITIES AT NARNGULU

An additional circuit utilising existing treatment methods will be built within the Narngulu Processing Plant to treat the new material. After reviewing the expansion of the processing method the Authority considers that there are no significant environmental impacts that cannot be adequately managed. The expansion of the Narngulu plant is subject to the provisions of Part V of the Environmental Protection Act, 1986 which require Works Approval and Licensing.

The proponent has mentioned in the Public Environmental Report a possible modification to the dry separation process should pyrite become a contaminant of the rutile product. This would entail the installation of a floatation circuit with reagents to remove the pyrite.

### **RECOMMENDATION 6**

**The Environmental Protection Authority recommends that any proposal to modify the dry separation process requiring the addition of chemical reagents or altering the chemical composition of the product compounds should be referred to the Environmental Protection Authority for assessment prior to that process being adopted.**

Under Part V of the Environmental Protection Act, 1986, the mine requires licencing, and a Works Approval is required for additions to the dry processing plant.

### **6. CONCLUSION**

Upon assessment of the AMC Mineral Sands Ltd proposal, the Environmental Protection Authority has concluded that the proposed Eneabba West Project would be environmentally acceptable subject to the operation being carried out in accordance with the commitments in the Public Environmental Report (Appendix 2) and the Environmental Protection Authority's Recommendations.

## REVIEW OF SUBMISSIONS AND PROPONENTS RESPONSE

**1. MINESITE REHABILITATION****(a) Submission**

A number of submissions commented that rehabilitation at both the existing Eneabba operation and the Company's Capel operation was disappointing. Further information is required and should address the following points:

- proportion of land being returned to native vegetation as opposed to pasture;
- native species that will be used for rehabilitation; and
- method of implementation of the rehabilitation.

**(b) Proponents Response**

It was suggested in some submissions that further details of the Company's proposed rehabilitation are required, and that rehabilitation in the past has been disappointing. On the other hand, other submissions acknowledged the Company's experience in high standards of rehabilitation.

A number of rehabilitation strategies were proposed in the Public Environmental Report to reduce groundwater recharge, lower groundwater levels, reduced salinization and improve production. These strategies require further research and investigation. Specific rehabilitation plans will be developed progressively in consultation with the landowners and the Department of Agriculture, and submitted for approval by the Minister responsible for the Agreement Act under which the project will be carried out. In considering these proposals, the Minister will be advised by the Mineral Sands Agreement Rehabilitation Co-ordinating Committee. Membership of this committee is drawn from the EPA, Department of Conservation and Land Management, Department of Agriculture, Department of Resources Development and Department of Mines. Through these provisions, the Government will have ongoing control over the rehabilitation programme (and all other environmental matters) based on the most up-to-date information.

A private submission expressed concern at inadequate rehabilitation at the Company's Capel operations, quoting the Report on Conservation and Rehabilitation in the Mineral Sands Mining Industry. It was suggested that the Company submit a definitive programme to rehabilitate the Capel operations prior to receiving EPA approval for Eneabba West. The Company has been conducting a comprehensive programme of rehabilitation on the site referred to for some years. Part of this programme involves establishing wetlands ecosystems for the conservation of water birds and includes an integrated multi-disciplinary research programme. Further research and investigations are being carried out on the dryland areas. These programmes form part of a detailed Environmental Management Programme for the whole Capel site approved by the Department of Mines, and is subject to annual review by the Department of Mines and Department of Conservation and Land Management. With these programmes, the request of the private submission has already been met.

**2. BOTANICAL SURVEY****(a) Submission**

Several submissions considered the botanical survey inadequate for the following reasons:

- species diversity was not addressed;
- vegetation communities were not discussed;
- distribution of vegetation communities was not discussed; and



- lack of overall assessment in botanical survey.

(b) Proponents Response

Two submissions considered the botanical survey inadequate as it did not address species diversity, the vegetation communities or their distribution.

The Eneabba West orebody occurs on private land generally used as pasture land of low productivity. Isolated pockets of natural vegetation remain unfenced within the pastures. The size of the pockets of vegetation and the species diversity varies according to the amount of grazing that has taken place.

In the northern end of the site there was only one small area considered to have the species diversity of the vegetation of the northern sandplains. All other areas were degraded through grazing, and included regrowth following previous clearing.

At the southern end, the vegetation consists of wetland Banksia heath. These areas continue to be grazed and are noted to be vermin havens for rabbits that have caused a significant reduction in species diversity, particularly in the herbs, grasses and sedges on which they feed..

Due to the general downgraded nature and isolation of natural pockets of vegetation, the botanical survey concentrated on identifying vegetation types, species significantly different from those on the existing minesite, and rare species. The vegetation communities were described in this context, and their distribution shown on Figure 6 in the Public Environmental Report. The rare plant search for species known to occur in the locality failed to record any individuals in the proposed mining area.

Quantitative data and species lists have been collected by the Company from many sites and vegetation types around the existing operation including Reserve 27886 adjacent to Eneabba West project. This botanical information provides community and species lists from a range of habitats and is used to plan the rehabilitation of the complex vegetation at the Eneabba operations.

### 3. FAUNAL SURVEY

(a) Submission

One submission regarded the lack of a fauna survey as being an important omission from the Public Environmental Report, as the fauna are an important component of the environment of the area.

(b) Proponents Response

The submission considered that a faunal assessment should have been done and that the wetland depressions could contain important faunal assemblages.

The botanical survey described the degraded nature of the vegetation. In particular, the wetlands sites were found to be havens for such vermin as rabbits and foxes. In early discussions with the EPA, it was considered that, under the circumstances, a faunal survey was not warranted, particularly as the habitats were better represented in adjacent reserves.

However, faunal quantitative data and species lists are being developed from extensive surveys being undertaken by the Company at the existing operations 5 km to the east. These studies include a vertebrate survey due for completion in 1989 that has sample sites in Reserve 27886 adjacent to the Eneabba West project, and examined a range of habitats including dryland and wetland heath and rehabilitated sites. Invertebrate studies have occurred over many years, and there are current research projects examining ground and shrub dwelling species in natural vegetation and rehabilitated land around the site. These ongoing studies are providing comprehensive lists of faunal species in the heathland vegetation at Eneabba.

#### 4. HYDROLOGICAL IMPACTS OF THE MINING OPERATION

##### (a) Submission

Several submissions raised the following issues in relation to groundwater abstraction:

- the information on hydrogeology contained in the Public Environmental Report is based upon preliminary investigation and should not be relied upon too heavily;
- effects of mining on the salinity and level of the shallow aquifer; and
- potential for increase in soil salinity.

##### (b) Proponents Response

One submission noted that the hydrological interpretation and predictions are based on preliminary investigations, and therefore results are unguaranteed. A related matter is raised by another submission which seeks more precise information on the likely change of groundwater levels and quality within the nature reserves.

More detailed investigations should always allow marginally more accurate predictions. However, any investigation necessarily stresses an aquifer less than the full-scale project, so that a degree of uncertainty is normal and has to be accepted.

It is proposed to follow the usual course in these circumstances. Actual impacts will be monitored and compared with the predictions. Where necessary, the model will be adjusted and new predictions will be made. If revised predictions indicate possibly unacceptable impacts, then appropriate actions will be taken to reduce the impacts. The management option is to control groundwater levels by pumping from bores or recharging groundwater through ditches.

Other submissions express concerns about the effect of mining on the salinity of the shallow aquifer. They suggest that a maximum amount of make up water should be taken from the shallow aquifer. This option was examined. It would be beneficial to lower the water table beneath saline farmland, but detrimental to do so to any significant extent beneath wetland vegetation. Conservation of the wetland vegetation has been given priority.

Further concern was expressed about a possible threat to vegetation communities growing along Erindoon Creek and in and around Erindoon Lake. The Rockwater Report indicates that it is unlikely there will be any effects on these communities.

The increase of salinity in the tailings due to the use of make up water from the Cattamarra Coal Measures is discussed in Rockwater's Report. Initially, these salts will be confined to the strand of tailings. The salinity of groundwater draining from the tailings would be about 3,000 mg/l (the average salinity of the dredge pond) in winter and in summer there will be negligible drainage. The salinity of groundwater beneath the ponds will be suitable for stock use. This strand of groundwater which is slightly more saline than that beneath surrounding land, will slowly disperse due to natural processes after the mining operation.

One submission is also concerned about higher salinity in the strand of back-filled tailings. They note that groundwater levels will be temporarily higher in the tails area behind the dredge. For this reason, groundwater will move away from the area (principally towards the dredge pond) reducing the tendency for salts to accumulate at the ground surface.

On average, the tailings will not be sufficiently saline to prevent plant growth, but areas of slightly higher salinity will occur where the final layer of tailings is applied in summer. As noted in Rockwater's Report, some salts will accumulate at the surface of the slimes in summer, but these will be buried by topsoil prior to revegetation, and

subsequently the salts will be leached downwards by rain, so long as the water table is maintained at a depth of one or two metres below ground level.

## **5. DIEBACK**

### **(a) Submission**

A number of submissions pointed out the presence of dieback in an area just to the north of the proposed minesite. This has highlighted the need for a dieback prevention and containment programme for the Eneabba West project.

### **(b) Proponents Response**

Some submissions raised the need for measures to prevent the introduction or spread of dieback in view of the recent outbreak on a site north of King Road. The Company has already had close consultation with the Department of Conservation and Land Management in relation to that outbreak.

For some years AMC has had a policy to restrict entry to mining and rehabilitation areas to prevent entry of weeds and diseases. Following this recent outbreak, this policy is being reviewed and upgraded specifically in relation to dieback control. Various sources of information, including Department of Conservation and Land Management, are being consulted for this review. Details of the reviewed policy will be outlined in the Company's Triennial Report due for submission under the Agreement Act at the end of 1989. In considering his approval of that Report, the Minister will consult with the Mineral Sands Agreement Rehabilitation Co-ordinating Committee, on which the Department of Conservation and Land Management is represented.

## **6. RADIATION**

### **(a) Submission**

The issue of the safety of personnel associated with the loading and transport of product from the Narngulu Processing Plant was raised.

### **(b) Proponents Response**

A submission raised the issue of continued guaranteed safety of its personnel relating to radiation levels in and around the Narngulu Plant and sought access to any relevant monitoring data.

AMC has committed in the Public Environmental Report to a radiation safety programme to ensure compliance with all statutory requirements, including the As Low as Reasonably Achievable principle. This principle states that all radiation doses will be kept as low as reasonably achievable, economic and social factors being taken into account. The Company is also committed to extending its radiation safety programme to all new operations. These commitments ensure that all personnel, both AMC and others, are not exposed to radiation levels higher than necessary.

The doses of employees involved in the handling of products have been calculated from monitoring in the past and found to be indistinguishable from the natural background level. It is expected that this situation will continue.

## **7. ABORIGINAL SITE SURVEY**

### **(a) Submission**

One submission pointed out that there had been no consideration of aboriginal sites in the assessment of the Eneabba West Project. Further, it would be beneficial if a study was carried out to determine the existence of any sites so as not to breach the Aboriginal Heritage Act 1972-80.

(b) Proponents Response

A submission raised the question of Aboriginal sites on the project area and drew attention to the Aboriginal Heritage Act 1972-80.

The orebody occurs entirely on private land which has all been disturbed to various degrees. A large part of the land has been cleared and cultivated by the landholders. The remaining areas have been disturbed by grazing.

An archaeological survey of nearby areas was conducted some years ago by the Museum for Allied Eneabba Ltd, a subsidiary of AMC Mineral Sands Ltd. That survey did not locate any Aboriginal sites.

Under the circumstances, a further survey was not considered warranted for this proposal. However, the Company acknowledges the provisions of the Aboriginal Heritage Act 1972-80, and will consult with the Museum if any site is located during its operations.

## APPENDIX 2

### ENVIRONMENTAL MANAGEMENT COMMITMENTS BY AMC MINERAL SANDS LTD FOR ENEABBA WEST PROJECT

In addition to the Environmental Protection Act (1986), the Company has obligations under the Mineral Sands (Eneabba) Agreement Act (1975-1988) for environmental management, including:

- submission of detailed proposals for approval by the Minister,
- conduct of a continuous programme of investigations and research including monitoring, and
- submission of Triennial Reports for approval by the Minister, together with interim reports of progress.

Through these processes, the Company will be submitting specific plans for mining and environmental management for Ministerial approval on an ongoing basis.

The Company is committed to achieving a high standard of environmental management and rehabilitation. Towards this end, the Company is committed to the following:

1. construction of access to and from the Brand Highway to MRD and Shire standards with special regards to road safety.
2. application of a comprehensive occupational health and safety policy and systems to achieve more stringent standards than those set by legislation.
3. pre-operational monitoring of radiation on the minesite and reporting of results to the Department of Mines as required under the Code of Practice on Radiation Protection in the Mining and Milling of Radioactive ores (1987).
4. extension of OHS monitoring, where relevant, to new mining and processing facilities constructed under this proposal including:
  - 4.1 personal and environmental air sampling in accordance with requirements of Regulations under the Mines Regulation Act;
  - 4.2 monitoring for noise under the yet-to-be proclaimed amendments to the Mines Regulation Act and Regulations;
  - 4.3 monitoring for radiation in compliance with the Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores (1987);
  - 4.4 monitoring and reporting of lost time accidents under the Department of Mines "Axtat" system.
5. monitoring the hydrology of the Erindoon Creek catchment including:
  - 5.1 groundwater levels and electrical conductivity in suitable farm bores within a five kilometre radius of the minesite, as well as in the dredge pond, production bores and two lines of piezometers;
  - 5.2 analysis of major ions in water samples from Lake Erindoon on a quarterly basis;
  - 5.3 monitoring of surface soil salinity along two transects through saline land, on a quarterly basis.
6. investigation of the use of deep rooted species such as native species, lupins, lucerne, tagasaste and tree belts to lower groundwater levels by increasing evapotranspiration.
7. development of suitable rehabilitation strategies in consultation with the landowners and the Department of Agriculture following the appropriate investigations, and submission of these strategies for approval under the Agreement Act.
8. monitoring the effect of water table drawdown on standing native vegetation along three drill lines to determine the need to develop strategies to minimise drawdown effects.

9. monitoring the establishment and development of rehabilitated native vegetation using the existing electronic botanical data management system.
10. minimising the area open to operations and reporting details of areas disturbed, areas rehabilitated and area open through the reporting procedures of the Agreement Act.
11. Review and upgrading of dieback prevention policy for the Eneabba operations.