

Mt Keith Nickel Project: Tailings storage upgrade

Western Mining Corporation Limited

**Report and recommendations
of the Environmental Protection Authority**

**Environmental Protection Authority
Perth, Western Australia
Bulletin 812
April 1996**

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.

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

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 contents of the assessment report or 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
12th Floor, Dumas House
2 Havelock Street
WEST PERTH WA 6005

CLOSING DATE

Your appeal (with the \$10 fee) must reach the Minister's office no later than 5.00 pm on 26 April, 1996.

Environmental Impact Assessment Process Timelines

Date	Timeline commences from receipt of full details of proposal from proponent for public review	Time (weeks)
31/1/96	Proponent document released for public comment	3
21/2/96	Public comment period closed	
23/2/96	Issues raised during public comment period forwarded to the Proponent	1
26/2/96	Proponent response to the issues raised received	
12/4/96	EPA reported to the Minister for the Environment	7

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Contents

	Page
Summary and recommendations	i
1. Introduction and background	1
1.1 Purpose of this report	1
1.2 Background	1
1.3 Structure of the report	1
2. Summary description of proposal	4
3. Identification of issues	4
3.1 Method of assessment	4
3.2 Public and agency submissions	5
3.3 Review of topics	6
3.3.1 Identification of topics	6
3.3.2 Identification of issues requiring EPA evaluation	6
3.3.3 Summary	12
4. Evaluation of key environmental issues	12
4.1 Loss of remnant vegetation	12
4.2 Impacts on land systems	13
4.3 Protection of the Wanjarri Nature Reserve	15
4.4 Maintenance of surface drainage systems	16
4.5 Protection of fauna with high conservation significance	18
4.6 Contamination of groundwater resources	19
4.7 Decommissioning and rehabilitation of the tailings storage facility	22
5. Conclusions and recommendations	27
6. Recommended environmental conditions	28
7. References	31

Figures

1. Location plan of the Mt Keith project	2
2. Environmental attributes adjacent to the TSF	3

Tables

1. Identification of issues requiring Environmental Protection Authority evaluation	10
2. Direct impacts of the proposal on land systems	14
3. Summary of Environmental Protection Authority recommendations	25

Appendices

1. Project description	
2. Environmental impact assessment flowchart	
3. Summary of submissions	
4. Proponent's response to issues raised in submissions	
4. List of submitters	
5. Proponent's list of environmental management commitments	

Summary and recommendations

This report and recommendations provides the Environmental Protection Authority's advice to the Minister for the Environment on the environmental acceptability of the proposal by Western Mining Corporation Limited (the proponent) to develop an upgraded tailings storage facility at its Mt Keith nickel operations.

The Mt Keith nickel mine is situated in the north eastern goldfields region of Western Australia, approximately 100 kilometres north of Leinster. Mining operations commenced at the site in 1994.

The proposed storage facility is a centralised discharge system consisting of a containment embankment approximately 4.6 kilometres in diameter. The embankment would carry a ring main distribution pipe which would feed nine vertical risers located within the storage facility. Tailings slurry would be discharged through the risers and would flow out to form a series of low overlapping cones having a slope of approximately 3%.

A number of environmental topics generated by the proposal were considered by the Environmental Protection Authority. From these, the Environmental Protection Authority has identified the major environmental issues requiring detailed evaluation as:

- impacts of the development of the tailings storage facility on surface water systems and regional groundwater quality;
- potential for impact on the nearby Wanjarri Nature Reserve; and
- the probable rehabilitation and decommissioning scenarios for an operation, when the likely success of rehabilitation is unknown at the time of commencing the operation.

The Environmental Protection Authority considers that the major environmental issues identified during the assessment could be adequately managed through the proposal design and the proponent's environmental management commitments.

Although the proponent has committed to the preparation of a rehabilitation plan for the project area, the Environmental Protection Authority considers it important that the rehabilitation and decommissioning strategy be identified as early in the project life as possible, so that rehabilitation can be best integrated with the operational development of the storage facility.

Following evaluation of the major issues, the Environmental Protection Authority has concluded that the proposal is environmentally acceptable subject to the proponent's commitments and the recommendations in this assessment report.

Recommendation No.	Summary of recommendations
1	That the proposal is environmentally acceptable subject to the successful implementation of the proponent's commitments and the EPA's recommendations.
2	That the proponent should prepare and implement a plan which describes the process for decommissioning and rehabilitation of the tailings storage facility including development of a 'walk away' rehabilitation solution.
3	That after five years the proponent should report on the development of the proposal to the Environmental Protection Authority.

1. Introduction and background

1.1 Purpose of this report

This report and recommendations provides the Environmental Protection Authority's (EPA's) advice to the Minister for the Environment on the environmental acceptability of the proposed construction of an alternative tailings storage facility at Western Mining Corporation's Mt Keith nickel mine.

1.2 Background

Western Mining Corporation Limited (WMC) proposes to develop an upgraded Tailings Storage Facility (TSF) at the Mt Keith nickel mine. The Mt Keith mine is located approximately 100 kilometres north of Leinster in the north-eastern Goldfields region of Western Australia (see Figure 1).

Mining and processing of nickel ore commenced at Mt Keith in 1994. To date, two conventional paddock storage type tailings cells have been used to store tailings, and the proponent has approval to construct an additional two cells.

In 1990, a feasibility study into centralised thickened discharge disposal was initiated at Mt Keith, with subsequent engineering and environmental investigations for a "best practice" storage facility. Test work continued during 1992, and a tailings disposal options study was commissioned in 1993.

As a result of these studies, in 1994 the proponent decided to continue investigations into advanced tailings management, and the development of techniques such as centralised discharge disposal.

The need to upgrade the tailings storage capacity has become more immediate due to a number of technical factors and revised projections for nickel concentrate production. The primary factors include:

- The initial design life of the current storage cells was based on a tailings output of 6.5 million tonnes per annum (Mtpa), however output has increased to 8.5 Mtpa.
- Further increases in nickel production and subsequent tailings output are anticipated. The initial four-cell paddock storage system was designed to cater for 130 Mt of tailings, however, projected mining and production operations now indicate that a total tailings storage capacity of about 240 Mt is required.

1.3 Structure of the report

This document has been divided into 7 sections.

Section 1 describes the historical background to the proposal and its assessment, and describes the structure of this report. Section 2 briefly describes the proposal; more detail is provided in the proponent's Consultative Environmental Review (WMC, 1996). Section 3 explains the method of assessment and provides an analysis of submissions received on the proposal.

Section 4 includes the evaluation of the key environmental issues associated with the proposal. In each subsection, the objectives of the assessment and the policy and technical framework relating to that issue are defined. The likely effect of the proposal, the advice to the Environmental Protection Authority from submissions, and the proponent's response to submissions are discussed.

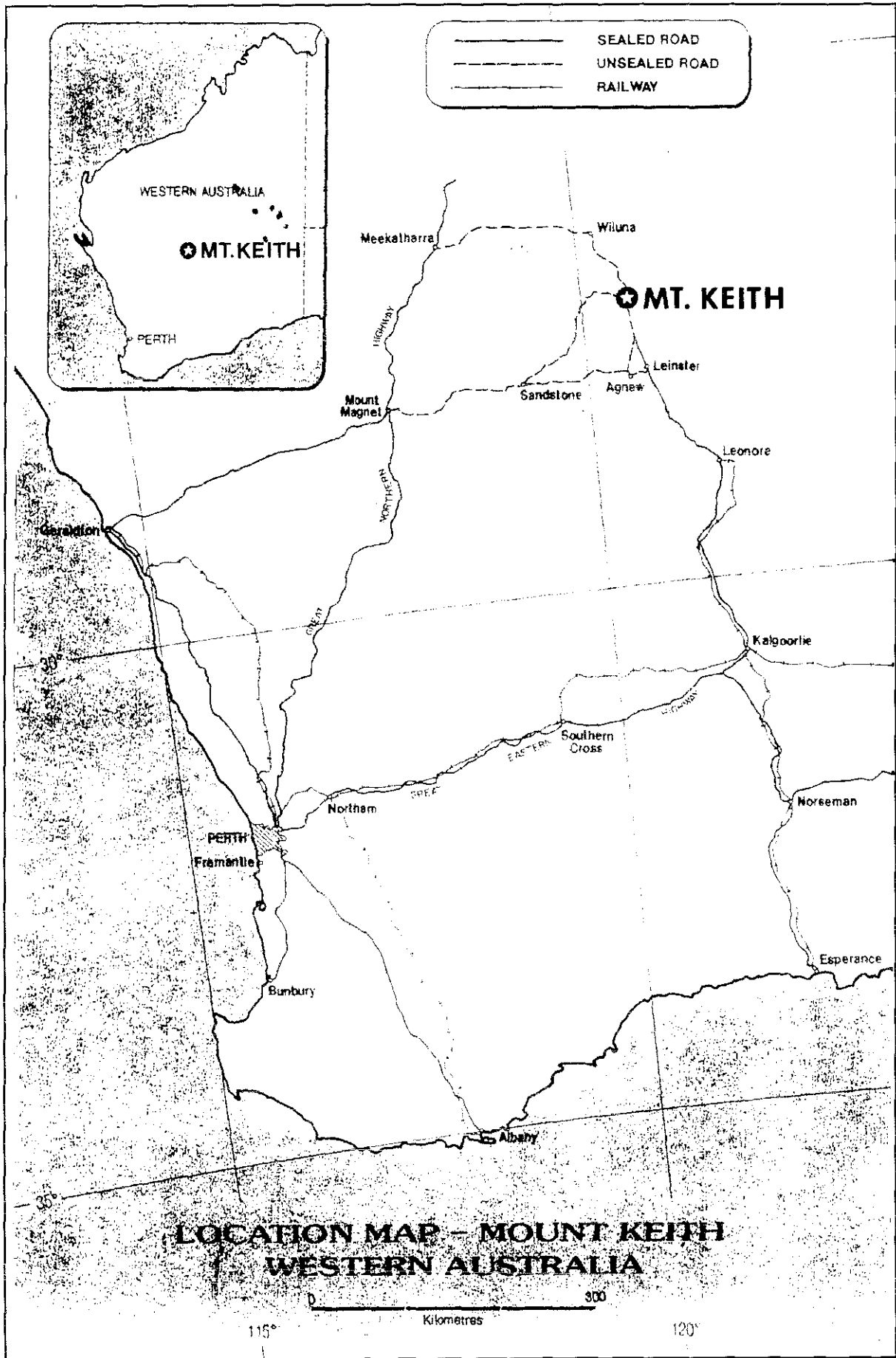
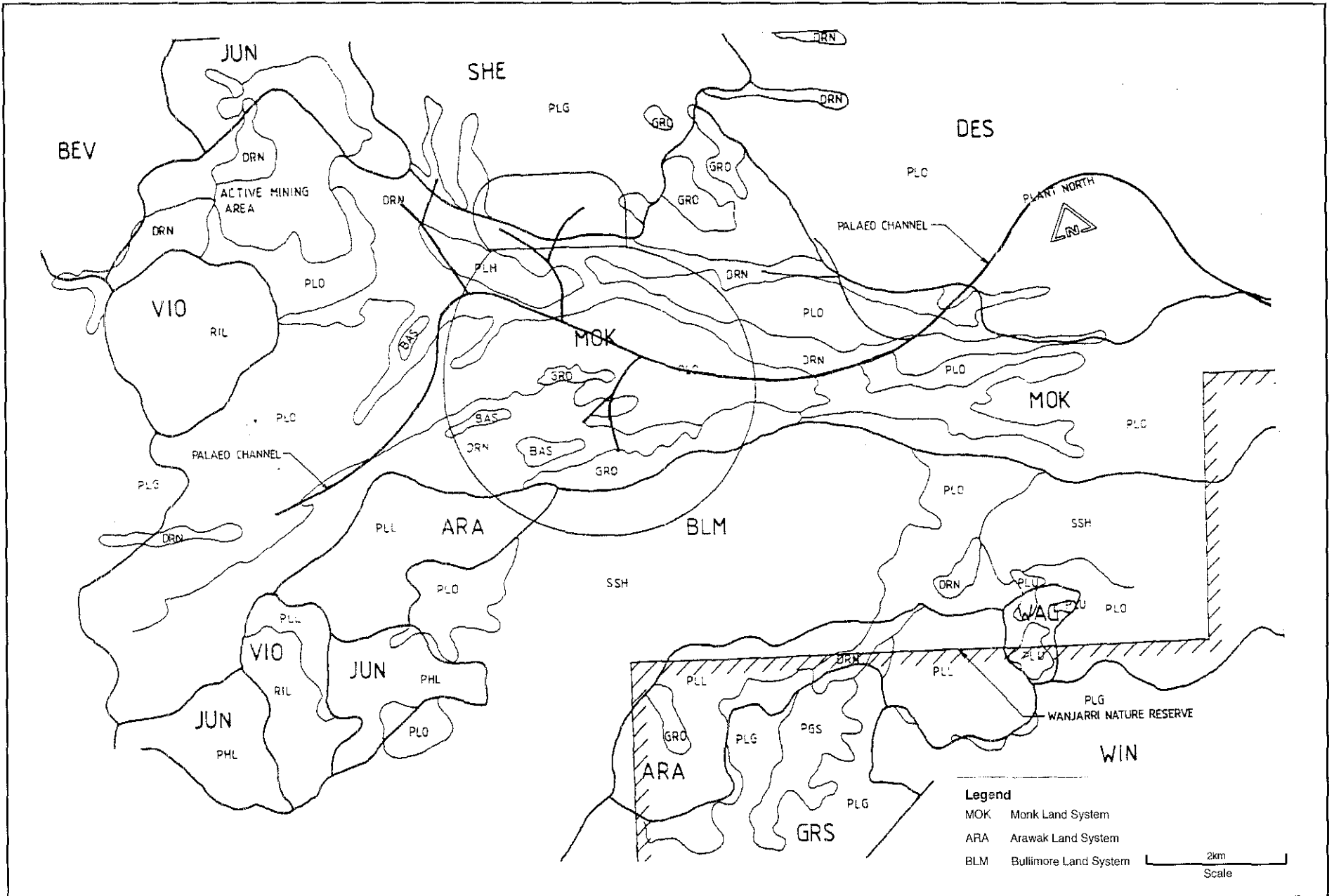


Figure 1. Location plan of the Mt Keith nickel mine (Source: WMC, 1996).

Figure 2. Environmental attributes adjacent to the TSF. (Source: WMC, 1996)



The adequacy of the proponent's response is considered in terms of project modifications and environmental management commitments in achieving an acceptable outcome. The Environmental Protection Authority's analysis and recommendations with respect to the identified issues are contained in this section. Where inadequacies are identified, recommendations are made to achieve the environmental assessment objectives.

Section 5 summarises the conclusions and recommendations. Section 6 describes the recommended environmental conditions. References cited in this report are provided in Section 7.

2. Summary description of proposal

The proposed storage facility will be a centralised discharge type, consisting of a containment embankment 4, 600 metres in diameter and 3 to 5 metres in height. The embankment would carry a ring main distribution pipe which would feed nine vertical risers located within the storage facility.

Tailings slurry would be discharged through the risers and would flow out to form a series of low, overlapping cones with a slope of approximately 3%. The rate and distribution of tailings placement will be actively managed and optimised to achieve rapid drying, maximum solids density, rapid sealing of the underlying ground surface and minimal ponding of water within the facility.

Tailings water and stormwater runoff would be recovered and recycled to the mine plant as process water. When completed, the tailings storage facility would form a series of low conical mounds 1,700 hectares in area, 45 metres high in the centre and with an average slope of 3%.

The centralised discharge tailings storage principle has not been used in Western Australia but has been used successfully in a number of other locations including Gove in the Northern Territory.

A full project description (extracted from the proponent's CER) is included in Appendix 1 of this report.

3. Identification of environmental issues

3.1 Method of assessment

The purpose of the environmental impact assessment process is to determine whether a proposal is environmentally acceptable, or under what conditions it could be environmentally acceptable.

The environmental impact assessment process for this proposal followed the administrative procedures shown in Appendix 2.

The first step in the assessment method was the identification of the potential environmental issues requiring consideration. A list of topics (or possible issues) was identified by the Department of Environmental Protection, on behalf of the Environmental Protection Authority, through the preparation of guidelines.

The proponent then considered these topics during the preparation of the CER through the identification of potential impacts and devising environmental management strategies.

The CER was then reviewed to ensure that topics had been discussed in sufficient detail prior to its release for public and government agency comment. The proponent's CER was available for public review for three weeks between 31 January 1996 and 21 February 1996, during which seven written submissions were received.

Following completion of the public review period, the responses received were forwarded by the Department of Environmental Protection to the proponent.

Western Mining Corporation was invited to respond to matters raised in the submissions. Appendix 3 contains a summary of the submissions and the proponent's response to those submissions. The list of submitters is included in Appendix 4.

By this stage in the assessment 10 topics had been identified, of varying environmental significance. The Environmental Protection Authority considered all the topics and identified those that did not require further evaluation. Often these topics can be addressed by other agencies or can be resolved through project design. The remaining topics were considered to be issues of environmental significance that required further evaluation by the Environmental Protection Authority.

For each environmental issue, the environmental impacts of the proposal, and the proponent's environmental management commitments, were evaluated in the context of the Environmental Protection Authority's assessment objective and relevant policy and technical information. The complete list of the proponent's environmental management commitments is included in Appendix 5 of this report. If the commitments achieve the assessment objectives, there is no need for the Environmental Protection Authority to make recommendations to the Minister for the Environment on that issue. Where the proposal has unacceptable environmental impacts, the Environmental Protection Authority can either advise the Minister for the Environment against the proposal proceeding, or make recommendations to improve the environmental acceptability of the proposal.

Limitation

This evaluation has been undertaken using information currently available. The information has been provided by the proponent in the CER and supplementary documentation, by DEP officers utilising their own expertise and reference material, by utilising expertise and information from other State government agencies, information provided by members of the public and contributions from Environmental Protection Authority members.

The Environmental Protection Authority recognises that further studies and research may affect the conclusions. Accordingly, the Environmental Protection Authority considers that if the proposal has not 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 Environmental Protection Authority.

3.2 Public and agency submissions

Comments were sought on the proposal from the public, interest groups and local and State government agencies. During the public review period seven (7) written submissions were received. Issues raised in the submissions were forwarded to the proponent for their response (Appendix 3).

The principal topics of concern raised in the submissions were:

Biophysical Impacts

- loss of remnant vegetation and sections of regional land systems;
- potential effects on the Wanjarri Nature Reserve;
- maintenance of surface drainage flows;

Pollution Potential

- potential impacts on groundwater resources;

Other

- decommissioning and rehabilitation.

The Environmental Protection Authority has considered the submissions received and the proponent's response as part of the proposal.

3.3 Review of topics

3.3.1 Identification of topics

Ten topics were raised during the environmental impact assessment process including those topics identified in the guidelines for the CER, subsequent consultations, and the submissions described above. The topics are as follows:

Biophysical Impacts

- loss of remnant vegetation;
- impacts on land systems;
- protection of the Wanjarri Nature Reserve;
- maintenance of surface drainage systems;
- protection of fauna with high conservation significance;

Pollution Potential

- contamination of groundwater resources;
- noise;
- dust;

Other

- consideration of alternative sites;
- structural integrity of the facility;
- alternative systems of tailings storage; and
- decommissioning and rehabilitation of the tailings storage facility;

The Environmental Protection Authority has evaluated the above topics and considers that a number of them can be managed by the proponent in accordance with their environmental management commitments and in compliance with the requirements of other agencies, in particular the Department of Minerals and Energy (see Table 1). Each topic is discussed below in order to identify those issues warranting further evaluation by the Environmental Protection Authority.

3.3.2 Identification of issues requiring EPA evaluation

Biophysical Impacts

Loss of remnant vegetation

Construction of the tailings storage facility involves direct disturbance to 1800 hectares of land and subsequent removal of remnant vegetation. The change to the landform also has the potential to affect downstream areas of vegetation through the requirement to redirect surface water flows around the structure.

Advice from the Department of Conservation and Land Management indicates that it is satisfied with the design of the project and the proponent's commitments for the management of this issue. These commitments include minimising clearing and progressive rehabilitation of disturbed areas, and an assessment of the site for Declared Rare Flora and priority listed species.

It is not expected that Declared Rare Flora would be affected by this proposal. The distribution of vegetation associations outside the project area and within the Wanjarri Nature Reserve requires evaluation.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Impacts on land systems

The proposal would directly affect three land systems represented within the region, and offsite impacts could potentially impact on other land systems. These systems are shown in Figure 2.

The proponent has evaluated the conservation significance of the affected land systems on the basis of: known association with declared rare and endangered flora; distribution within the north eastern goldfields; resource condition; and reservation within the Wanjarri Nature Reserve.

Advice from the Department of Conservation and Land Management indicates that it is satisfied with the design of the project and the proponent's commitments for the management of this issue.

The distribution of affected land systems outside the project area and within the Wanjarri Nature Reserve requires evaluation.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Protection of the Wanjarri Nature Reserve

The Wanjarri Nature Reserve is an 'A' class nature reserve situated 1.8 kilometres south of the proposed tailings storage facility. Although the proposal would not have a direct impact on the reserve, Wanjarri could potentially be affected by impacts on surface and groundwater systems as a result of the proposal.

The proponent has committed to manage surface drainage and ground water quality to minimise impact on Wanjarri Nature Reserve. Western Mining has also committed to contribute to the management of Wanjarri Nature Reserve in accordance with the existing Memorandum of Understanding for cooperative management in the Mt Keith/Wanjarri Nature Reserve as agreed between WMC and CALM.

The potential for the proposal to affect the conservation values of the Wanjarri Nature Reserve has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Maintenance of surface drainage systems

The construction of a structure approximately 4.6 kilometres in diameter would intercept existing surface drainage lines and intercept overland surface water flow. These changes could have adverse impacts on vegetation situated downstream of the tailings storage facility.

Advice from the Department of Conservation and Land Management and the Water and Rivers Commission indicates that those agencies are satisfied that the stormwater diversion and extreme rainfall event management measures proposed by Western Mining are adequate.

The proponent has committed to design the stormwater diversion drains to replicate as closely as possible the natural drainage pattern downstream of the facility. WMC also proposes to implement soil erosion and vegetation monitoring programmes. If these programmes identify adverse impacts as a consequence of the Tailings Storage Facility, remediation programmes would be implemented.

This topic has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Protection of fauna with high conservation significance

The proposal involves the removal of 1800 hectares of habitat. Of the land systems within the project area, the Bullimore land system is known to support a gazetted rare fauna species, the mulgara.

The submission from the Department of Conservation and Land Management indicates that it is satisfied with the management measures proposed and the proponent's commitments in relation to rare fauna issues.

The commitments made by Western Mining and the general management measures proposed to minimise impacts on fauna and fauna habitat, have been identified as an issue requiring evaluation by the Environmental Protection Authority.

Pollution Potential

Contamination of groundwater resources

The tailings storage facility overlies superficial and palaeochannel aquifer systems. Most tailings water and stormwater in the TSF would be collected by underdrains and directed to sumps from where it will be piped to the process plant as required. Some water could seep through the base of the tailings and may reach the water table.

The modelling undertaken by the proponent to predict potential saline seepage suggests that the salinity levels of groundwater would not be increased by more than 30%. The total dissolved salts (TDS) of groundwater sampled from the palaeochannel is in the range between 700 and 1500 mg/L.

Existing groundwater quality is in the range of potable to subpotable, although future use of the groundwater resource is most likely limited to the watering of stock.

The submission from the Water and Rivers Commission expressed a number of specific requirements regarding the monitoring programme to be implemented by the proponent.

The adequacy of the proponent's management measures to safeguard future uses of the groundwater resource has been identified as an issue requiring evaluation by the Environmental Protection Authority.

Noise

Adverse noise impacts arising from the proposal, would be associated with the construction phase only. The TSF is located adjacent to the existing mine and processing facilities at Mt Keith, and the nearest residential centre is Wiluna, approximately 70 kilometres from the mine.

Compliance with the Noise Abatement (Neighbourhood Annoyance) Regulations is a requirement of this operation.

Further evaluation of this topic by the Environmental Protection Authority is not required.

Dust

The construction, operation and decommissioning of the TSF could result in fugitive dust emissions. Wiluna is the nearest residential centre to the site, and is approximately 70 kilometres away.

Dust management has been addressed by the proponent in Section 6.6.2 of the Consultative Environmental Review. Dust associated with the construction and operations of the TSF would be addressed within the Department of Environmental Protection's works approval and licensing provisions under the *Environmental Protection Act* (1986). Satisfactory rehabilitation and decommissioning of the site (discussed in Section 4.7) would reduce the dust generation potential of the TSF area.

Further evaluation of this topic by the Environmental Protection Authority is not required.

Other

Consideration of alternative sites

The proponent has evaluated five different sites in determining the preferred area for the tailings storage facility. That evaluation is detailed in Section 2.4 of the CER (WMC, 1996), and has included environmental considerations in addition to engineering factors.

The advice received from the Department of Conservation and Land Management has supported the selection of the final site.

Further evaluation of this topic by the Environmental Protection Authority is not required.

Structural integrity of the facility

The proposed storage facility is unique in Western Australia because of its size and proposed tailings disposal methodology.

The risk associated with the proposed storage is considered to be lower than most other types of tailings storage systems due to a number of factors including:

- separation of the outer embankment wall from the toe of the tailings by approximately 400 metres;
- the use of safety alarms and automatic riser flushing systems;
- flexibility to use several risers at once to control deposition;
- an underdrainage system to facilitate the consolidation of tailings;
- a seepage control and detection system; and
- minimisation of contained water.

The proponent has committed that the design of the facility will comply with the Department of Minerals and Energy's most stringent guidelines (Category 1 Tailings Storage).

The geotechnical work undertaken by the proponent has suggested that the storage structure would be stable for all conditions of static and dynamic earthquake loading. Advice from the Department of Minerals and Energy has indicated that it is satisfied with the proposed design.

The structural integrity of the tailings storage facility is most appropriately managed through the licence requirements of the Department of Minerals and Energy.

Further evaluation of this topic by the Environmental Protection Authority is not required.

Alternative systems of tailings storage

The study programme initiated by WMC to review available tailings storage and disposal methods determined that there were three different methods of tailings storage possible on the basis of practicality, safety, robustness, environmental acceptability and cost effectiveness. These were co-disposal (disposal of tailings and mining overburden together), a ring dyke structure (such as the existing two cell paddock-type storage), and a thickened and centralised discharge. The conclusion of that study was that the proposed centralised method has significant cost and environmental advantages (WMC, 1996).

Although the extension of the approved existing ring dyke structure would require only 1300 hectares of land (in comparison with the proposed TSF which requires 1800 hectares), the Environmental Protection Authority recognises that the TSF has a number of distinct advantages over conventional tailings storage systems. These are particularly evident in relation to long term rehabilitation and structural stability. The benefits in terms of rehabilitation are discussed further in Section 4.7.

TOPICS	PROPOSAL CHARACTERISTICS	GOVERNMENT AGENCY'S COMMENTS	PUBLIC COMMENTS	IDENTIFICATION OF ISSUES
<i>Biophysical Impacts</i>				
Loss of remnant vegetation	1800 hectares will be cleared.	CALM: Satisfied with CER and commitments.		EPA EVALUATION REQUIRED refer Table 2 (Issue 1)
Impacts on land systems	Three land systems within the footprint of the TSF.	CALM: Satisfied with CER and commitments.		EPA EVALUATION REQUIRED refer Table 2 (Issue 2)
Protection of the Wanjarri Nature Reserve	Wanjarri is an "A" Class Nature Reserve located downstream of the TSF.	CALM: CALM and WMC have developed a Memorandum of Understanding for cooperative management in the Mt Keith/Wanjarri Nature Reserve area.		EPA EVALUATION REQUIRED refer Table 2 (Issue 3)
Maintenance of surface drainage systems	TSF structure will intercept existing drainage lines.	CALM: satisfied with CER and commitments. WRC: Stormwater diversion and extreme rainfall issues adequately covered.	Base-line data on vegetation downstream should be collected before construction.	EPA EVALUATION REQUIRED refer Table 2 (Issue 4)
Protection of fauna with high conservation significance	The mulgara is associated with the habitat type within the TSF.	CALM: Satisfied with CER and commitments.		EPA EVALUATION REQUIRED refer Table 2 (Issue 5)
<i>Pollution Potential</i>				
Contamination of groundwater resources	Worst case modelling indicates that salinity of the superficial aquifer could double. A more "realistic" model predicts < 30% quality change.	CALM: Satisfied with CER and commitments. WRC: Consider <30% quality change tolerable.		EPA EVALUATION REQUIRED refer Table 2 (Issue 6)
Noise	Associated with construction phase only. Existing mine and processing operations adjacent to the site. Nearest residence 70 - 80 km from site.			Noise limits established through Noise Abatement (Neighbourhood Annoyance) Regulations. NO FURTHER EVALUATION REQUIRED BY EPA

Table 1. Identification of issues requiring Environmental Protection Authority evaluation

TOPICS	PROPOSAL CHARACTERISTICS	GOVERNMENT AGENCY'S COMMENTS	PUBLIC COMMENTS	IDENTIFICATION OF ISSUES
Dust	Dust generated by unstable surfaces during construction, operations and decommissioning			Dust covered by DEP's works approval and licensing. NO FURTHER EVALUATION REQUIRED BY EPA
<i>Other</i>				
Consideration of alternative sites	Five sites considered. Site selection process included consideration of environmental aspects.	CALM: Believes site selection was rigorous.		Site selection process complete. NO FURTHER EVALUATION REQUIRED BY EPA
Structural integrity of facility	Storm events and earthquakes considered in the design. Design will comply with DME's guidelines (Category 1 Tailings Storage).	DME: Satisfied with proposal design.		Appropriately managed by DME licence requirements. NO FURTHER EVALUATION REQUIRED BY EPA
Alternative systems of tailings storage	Three methods of storage evaluated. Proposed method had significant cost and environmental advantages.		Extension of the existing ring dyke structure would require only 1300 ha.	There has been adequate consideration of alternative tailings storage systems. NO FURTHER EVALUATION REQUIRED BY EPA
Decommissioning and rehabilitation of the tailings storage facility	Tailings surface will be saline and therefore difficult to rehabilitate. Free draining nature of structure may reduce potential for creation of an internal water table.		There is no evidence to suggest that 2m high topsoil stockpiles will retain biological activity into the future. It would be better to use topsoil elsewhere in the leases rather than stockpile it all.	EPA EVALUATION REQUIRED refer Table 2 (Issue 7)

Table 1. Identification of issues requiring Environmental Protection Authority evaluation (cont'd)

The Environmental Protection Authority concludes that there has been adequate consideration by the proponent of alternative tailings storage systems.

Further evaluation of this topic by the Environmental Protection Authority is not required.

Decommissioning and rehabilitation of the tailings storage facility

The Environmental Protection Authority has in past assessments recognised that rehabilitation management should not impose unreasonable short or long term costs on the community of Western Australia. This is particularly important when the probable success of rehabilitation cannot be evaluated in the short to medium term.

Given the design and proposed operation of the storage facility, progressive rehabilitation of the tailings surface is not possible. The proponent would have to wait for the completion of tailings discharge and decommissioning of the TSF before rehabilitation could commence, which is potentially twenty years away.

This topic has been identified as an issue requiring Environmental Protection Authority evaluation.

3.3.3 Summary

Table 1 summarises the process used by the Environmental Protection Authority to evaluate the topics raised during the environmental impact assessment process. The table identifies the topics, the relevant proposal characteristics, and comments received from specialist government agencies and the public. If a topic is considered environmentally significant it becomes an issue and is further evaluated by the Environmental Protection Authority (as summarised in Table 3). Section 4 of this report provides the detail of this evaluation.

The issues identified in Table 1 as requiring further evaluation by the EPA are:

- loss of remnant vegetation;
- impacts on land systems;
- protection of the Wanjarri Nature Reserve;
- maintenance of surface drainage systems;
- protection of fauna with high conservation significance;
- contamination of groundwater resources; and
- decommissioning and rehabilitation of the tailings storage facility.

4. Evaluation of key environmental issues

4.1 Loss of remnant vegetation

Objective

Rare flora, priority flora, and regionally significant vegetation associations should be protected. The loss of locally significant vegetation associations should be minimised.

Policy information

The legislative framework for the protection of rare and poorly known flora is established through the *Wildlife Conservation Act (1950)*, and administered by the Department of Conservation and Land Management (CALM).

Technical information

The construction of the tailings storage facility would result in the loss of plant communities within the area to be directly disturbed.

The majority of the vegetation within this area consists of open mulga woodland/shrubland with a hummock grass understorey, on gentle loamy plains. Much of the mulga overstorey in the area is dead with poor regeneration and accelerated soil erosion, possibly as a result of overgrazing (WMC, 1996).

Within the drainage lines, the mulga overstorey is more dense and in good condition. Understorey is sparse.

The vegetation units present within the project area are represented in the region, and within Wanjarri Nature Reserve.

The proponent has initiated a number of surveys over the project area (WMC, 1996), and has not found any Declared Rare Flora species within the TSF area.

The only possible priority listed or Declared Rare Flora species are likely to be associated with the sand plain spinifex hummock grasslands within the sand sheet land unit of the Bullimore land system. The proponent does not expect the proposal to result in the loss of any Declared Rare Flora or priority species (WMC, 1996).

Comments from key agencies / interest groups

The Department of Conservation and Land Management has indicated that it is satisfied with the management measures and commitments proposed by the proponent in relation to vegetation and declared rare flora issues.

Response from the proponent

The proponent has committed that only the minimum area required for construction and operation of the project will be cleared. Once construction is completed, all disturbed areas no longer required for the operation of the facility will be rehabilitated in line with the tenement conditions.

WMC has also committed to undertake a site assessment in conjunction with CALM over the project area specifically for Declared Rare Flora and priority species prior to construction. If required, conservation plans will be prepared.

Environmental Protection Authority Evaluation

The Environmental Protection Authority recognises that the species of remnant vegetation present in the area are likely to be represented elsewhere in the region, including within the Wanjarri Nature Reserve. The Environmental Protection Authority concludes that the design of the project, and the commitments made by the proponent are adequate to achieve the EPA's assessment objective for this issue.

4.2 Impacts on land systems

Objective

Protect the ecological values of land systems and associated vegetation, habitats and fauna.

Technical information

Construction of the tailings storage facility would result in direct disturbance to the Monk, Bullimore and Ararak land systems, as shown in Figure 2. Other land systems are located within a few kilometres of the TSF and could potentially be indirectly affected by its construction.

Table 2 below indicates the area of each system likely to be affected, and includes an analysis of the significance of that impact in terms of the conservation value of the unit, its known association with declared rare and endangered flora, resource condition, how well the unit is represented within the region (defined as the north eastern goldfields), and the extent to which it is represented in the nearby Wanjarri Nature Reserve. Additional discussion of the rationale for the determination of the significance of the impact is included in Section 5.2.1 of the CER (WMC, 1996 pp 33 - 34).

Table 2. Direct Impacts of the Proposal on Land Systems

Land System	Total Area in Region (ha)	Area in Wanjarri Nature Reserve		Conservation Priority (van Vreeswyk, 1995)	Area Disturbed by TSF Footprint		Significance of Impact	
		(ha)	% of area in region		(ha)	% of area in region	Regional	Local
Monk	816, 219	4, 305	0.5	Very low	1440	0.18	Very low	Low
Bullimore	2, 401, 326	29, 919	1.2	Moderate	270	0.01	Negligible	Very low
Ararak	202, 141	1, 901	0.94	Very low	90	0.04	Negligible	Negligible

From: WMC (1996), Mt Keith Nickel Project Tailings Storage Upgrade, Consultative Environmental Review (p. 34)

The land systems to be directly affected by the TSF are all widely distributed, of low to medium conservation value and well represented in the Wanjarri Nature Reserve. The impact of this proposal on the distribution and total area of these land systems is expected to be minor at both the local and regional scale (WMC, 1996).

Comments from key agencies / interest groups

The Department of Conservation and Land Management has indicated that it is satisfied with the management measures proposed by the proponent in the CER and the commitments of the proponent in relation to potential impacts on landforms and land systems.

Environmental Protection Authority Evaluation

The Environmental Protection Authority concludes that the land systems likely to be adversely affected by the proposal are well represented both within the region of the north eastern goldfields, and within the Wanjarri Nature Reserve. The Environmental Protection Authority considers that the selection of the project area has achieved the EPA's assessment objective for this issue.

4.3 Protection of the Wanjarri Nature Reserve

Objective

Protect the ecological values of the Wanjarri Nature Reserve from direct and indirect disturbance as a result of the projects operation.

Technical information

The Wanjarri Nature Reserve is situated approximately 1.8 kilometres south east of the site of the tailings storage facility. Construction of the TSF is unlikely to have a direct impact on the nature reserve.

The reserve is however located downstream of the TSF in relation to both surface water flows and groundwater flow. Consequently, there is some potential for the proposal to indirectly impact on the nature reserve.

Surface water

A small proportion of the natural surface drainage from the site to the TSF flows across the northern end of the Wanjarri Nature Reserve. The area also receives runoff from within Wanjarri itself (WMC, 1996).

Drainage diverted around the tailings embankment would be released immediately downstream of the facility. Within a short distance, and before reaching Wanjarri, the proponent expects that surface water flows would have substantially reverted to their natural pattern. It is not expected therefore that there would be run-off shadowing effects from the TSF on the Wanjarri Nature Reserve. While the TSF is located 1.8 kilometres from the reserve at its closest point, the distance between Wanjarri and the nature reserve along the drainage lines potentially affected is 7 kilometres (WMC, 1996).

Groundwater

Hydrogeological investigations carried out for the project indicate that groundwater in the superficial aquifer moves very slowly from the TSF site towards the Wanjarri Nature Reserve. In the palaeochannel aquifer a hydraulic discontinuity exists between the TSF and Wanjarri. A saline plume in the superficial aquifer could therefore travel through the nature reserve if not properly managed (WMC, 1996).

The superficial and palaeochannel aquifers have no known ecological significance for the vegetation or fauna of Wanjarri Nature Reserve. The vegetation of the reserve is all xerophytic, and is not therefore groundwater dependent. There are no large eucalypts or similar trees which could rely on groundwater. The absence of permanent surface water (such as soaks) means that animals do not have access to the groundwater and therefore would be unaffected by changes in groundwater quality (WMC, 1996).

Comments from key agencies / interest groups

CALM has advised the EPA that it believes that areas of concern such as declared rare flora and fauna, water shadow effects and potential for leakage have been addressed in the CER, and that appropriate commitments have been made by WMC.

CALM has also advised that CALM and WMC have recently signed a Memorandum of Understanding for cooperative management in the Mt Keith / Wanjarri Nature Reserve area.

Response from the proponent

WMC proposes to implement an appropriate management strategy to protect the ecological values of the Wanjarri Nature Reserve from direct and indirect disturbance associated with the project.

The environmental values to be protected include:

- land systems and land units within the Reserve;
- superficial and palaeochannel groundwater resources;
- vegetation, flora and fauna, particularly rare or threatened species; and
- the public amenity of the Reserve.

The analysis included in the proponent's CER (WMC, 1996) indicates that the construction and operation of the TSF would have no significant direct or indirect impacts on the Wanjarri Nature Reserve. This is due to:

- the selection of the site for the TSF that incorporates a reasonable buffer to the Nature Reserve;
- the low potential for off-site impacts from the proposal; and
- management measures to be put in place to mitigate surface drainage, groundwater quality and other impacts should they occur.

The proponent has also committed to contribute to the management of Wanjarri Nature Reserve, in accordance with the existing Memorandum of Understanding between Western Mining Corporation and CALM.

Environmental Protection Authority Evaluation

The Environmental Protection Authority considers that the proponent's commitments and management details contained in the CER are adequate to meet the objectives in relation to the direct and indirect impacts of the proposal on the ecological values of the Wanjarri Nature Reserve.

4.4 Maintenance of surface drainage systems

Objective

To maintain as far as possible the pre-existing surface water flow patterns, and to protect downstream vegetation from the effects of saline runoff.

Technical information

Surface Drainage Interruption

The TSF will permanently obstruct surface water flows in existing drainage channels within its footprint. The proponent intends to construct diversion drains to divert water around the TSF and release it as diffuse sheet flow on the downslope side. The total area of the catchment that contributes flow to these drainage lines is approximately 18,000 hectares. The patterns of surface flow in the area of the TSF are generally west to east. Some concentration of flow is inevitable in this process (WMC, 1996).

The identified impacts arising from the diversion of surface water flows would include:

- the potential for water starvation of downstream vegetation caused by run-off 'shadowing'; and
- potentially accelerated soil erosion downstream due to concentration of run-off.

Drainage Shadow Effects

Vegetation in the drainage lines downstream of the TSF relies on occasional inundation for growth and flowering. Interference with this pattern of periodic inundation could result in vegetation stress and plant deaths.

Structures such as the TSF may potentially 'shadow' downslope areas by obstructing the natural flow of water in shallow drainage lines and sheet wash areas, thereby causing the death of vegetation or changing vegetation distribution. This impact may be reduced by correct dam design and management of the stormwater (WMC, 1996).

The proponent has developed a surface water management strategy to re-establish natural flow downstream and avoid such impacts. The distribution of this modified flow is likely to be different from the original flow regime, so some areas of land may potentially become better watered while others receive less water.

Two broad, shallow, braided drainage lines pass through the proposed location of the TSF. The more northern of these drainage lines is more substantial, and currently receives flow which has already been diverted around the existing mine infrastructure upstream, by a series of flood protection and diversion drains.

The southern, less substantial, drainage line receives run on flow from the west and southwest of the proposed TSF site. Some of this flow has been previously interrupted upstream by the Wiluna-Leinster Road.

The proposed diversion drains will divert flow around the northern and southern sides of the TSF. The drains will release this diverted flow within the same braided drainage lines downstream of the site.

The potential for run on shadowing is considered minimal because the drains will re-instate flow in those drainage lines.

The vegetation type most likely to be affected is mulga woodland near the release points, which may be subject to more regular or more substantial inundation (WMC, 1996).

The only areas which will receive less flow are those contained within the TSF, which will have been cleared during construction.

Erosion

Concentration of run-off will cause increased flow velocities in some drainage channels and may cause localised erosion. Where flow is diverted around the TSF this may also cause erosion of the adjacent soils.

The diversion drains will be designed to achieve a diffuse release of water and so minimise the potential for erosion. The low slopes downstream of the TSF and occasional nature of run-off events will further reduce this potential. This impact is expected to be minor and localised (WMC, 1996).

Stormwater Run-off from the TSF

Preliminary calculations have indicated that stormwater shed from the surface of the TSF may, through dissolution of salts from the tailings, be too saline to be released to the environment. All run-off from storms up to a 1 in 100 year storm event will be retained within the TSF perimeter wall and reclaimed for use in the process plant (WMC, 1996).

Run-off from a greater than 1 in 100 year storm will overflow via properly constructed overflow structures. This run-off will be of relatively low salinity due to dilution, and will be released into an environment which will already be substantially flooded, resulting in further dilution.

Comments from key agencies / interest groups

One submission commented on the proponent's statement that vegetation and invertebrates would be monitored to assess the effects of changes in drainage patterns as a result of the use of diversion drains to redirect surface flow from above TSF to below it in a diffuse pattern. The submitter suggested that the aims of such a study and the collection of base-line data should be determined prior to construction.

One submission also stated that although stormwater management requirements are included in the CER, it is not clear how the water will be redistributed across slopes that are deprived.

Response from the proponent

The proponent has indicated that some base line studies of vegetation and invertebrates have been already been undertaken over the Mt Keith mine site. Vegetation and invertebrate monitoring points will be located both downstream and upstream (control) of the proposed TSF. These will be sited within comparative land units and habitat types.

The aim of this monitoring programme will be to detect any changes in vegetation - habitat health, which may be attributable to the proposed TSF.

In addition to the vegetation monitoring programme, the proponent has committed to implement a soil erosion monitoring programme. Should accelerated soil erosion as a result of the TSF be detected, a remediation programme will be implemented.

In response to the query regarding the surface water management strategy, the proponent has referred to Section 6.3 of the CER. It is not expected that any slopes downstream of the structure will be deprived of surface water, because the proposed TSF is situated in a gentle valley, and not at the headwaters of a catchment. The diffuse release of surface water will be via level sill drains constructed on the contour, which are designed to prevent channelled flow. These types of structures are widely utilised to achieve this throughout arid areas of Western Australia.

Environmental Protection Authority Evaluation

The Environmental Protection Authority concludes that the design of the project and the commitments made by the proponent are adequate to achieve the Environmental Protection Authority's assessment objective for this issue.

4.5 Protection of fauna with high conservation significance

Objective

To protect fauna of significant conservation value.

Technical information

Construction of the TSF would result in the removal of 1800 hectares of fauna habitat and may truncate or cause boundary effects on adjoining habitats.

The Bullimore land system is associated with the mulgara *Dasymercus cristicaudata*, a Gazetted Rare fauna species. The preferred habitat of the mulgara in Western Australia is sandy flats between low sand dunes, a landform which does not occur in or near the footprint of the TSF. Mulgara have however been sighted in Wanjarri Nature Reserve, in association with the Bullimore sand sheet unit (WMC, 1996).

A CALM officer inspected the TSF site in January 1996 and found no indication that the mulgara was present. The likelihood of direct impact on the mulgara is therefore considered to be low (WMC, 1996).

Other fauna present in the project area are widespread and common. The impact on them will therefore be limited to the removal of 1,800 hectares of habitat.

Following decommissioning and rehabilitation, an equivalent area of different habitat will be created. In the long term, temporary ponding of stormwater and rainwater within the decommissioned TSF may increase the usefulness of the area for fauna, particularly birds.

Edge and Barrier Effects

Edge effects occur where undisturbed habitat is bordered by a disturbance such as mining, clearing or traffic. Edge effects increase the effective area of disturbance by providing an avenue into the undisturbed area for weeds, predators, vehicles and humans, by fragmenting habitats and blocking fauna movements.

In this case, edge effects will be limited as the TSF will be an inactive, rather than active, boundary. Active disturbance at the boundary will only occur during the construction of the TSF, at which time boundary effects will be managed.

Comments from key agencies / interest groups

CALM has advised the EPA that it believes that the potential impacts of the proposal on fauna have been adequately addressed in the CER, and that appropriate commitments have been made by WMC.

Response from the proponent

The proponent has committed to conduct a trapping programme over the TSF to the requirements of the Department of Conservation and Land Management, prior to any construction commencing. If any mulgara are trapped, an appropriate relocation programme would be implemented.

WMC also has an ongoing commitment to fund and conduct long term research into the distribution and ecology of the mulgara within the north eastern goldfields.

Environmental Protection Authority Evaluation

The Environmental Protection Authority notes that the mulgara is likely to be the only fauna species of high conservation significance to occur within the project area. The Environmental Protection Authority considers that the design of the project, and the commitments made by the proponent are adequate to protect fauna of significant conservation value from adverse impacts resulting from the project.

4.6 Contamination of groundwater resources

Objective

To safeguard future uses of the groundwater resource.

Technical information

Impacts on Groundwater

Most tailings water and stormwater in the TSF will be collected by underdrains and directed to sumps from where it will be piped to the process plant as required. Some water will, however,

seep through the base of the tailings and may reach the water table. The aquifers affected will depend on the rate of seepage and the permeability distribution within the aquifers. The rate of seepage will depend on:

- the possible occurrence of a water table within the tailings (however this is not expected);
- the duration of stormwater ponding;
- the permeability of the tailings and the substrate, including preferential flow pathways;
- the sealing effect of the tailings; and
- the distribution and rate of application of the tailings.

Rate of Seepage

The proponent has undertaken groundwater modelling to predict a worst case scenario for seepage from the TSF.

The maximum seepage rate predicted by the worst case model was 450 kilolitres per day (kL/d) for the first ten months, which reduced to 5.5 kL/d after one year and 1.6 kL/d after five years. The total predicted seepage in this worst case over the 20 year operating life of the facility is 69,000 kL, which equates to less than 1% of the estimated underlying groundwater resource. The fall in seepage over time is due to the sealing effect of the tailings on the ground surface.

Due to the use of worst case assumptions, this is likely to be a substantial over-estimate. The actual seepage should be considerably less, given that:

- a water table is not expected to form within the tailings;
- measures would be implemented to limit the duration and extent of water ponding;
- much of the potential seepage water will be intercepted by the system of collector drains and trenches; and
- air drying and desiccation of the tailings, which will be promoted by the scheduling of tailings deposition, will significantly reduce the permeability of the base of the TSF (WMC, 1996).

Seepage Composition

The seepage water will contain salts at a concentration of 50,000 to 80,000 mg/L. Seepage originating from ponded stormwater may be substantially less saline than this.

In addition to salt, the seepage water will contain elevated concentrations of magnesium, calcium, sulphate and boron. The full chemistry of the tailings water is shown in Appendix A of the proponent's CER.

Groundwater Resources

The water quality of the superficial and palaeochannel aquifers underlying the TSF is in the range of potable to subpotable, with salinities of 700 - 1500 mg/L. Based on hydrogeological studies, the TSF footprint directly overlies a groundwater resource of approximately 8 million kL within the superficial aquifer. The seepage water would form a 'plume' of saline water within the superficial aquifer. The degree of mixing with the aquifer water would depend on the time interval and the presence of horizontal layers of varying permeability within the aquifer.

Using the modelled seepage as described above, and allowing for partial depletion of the resource by twenty years of groundwater pumping, it has been calculated that the average salinity of the underlying superficial aquifer could rise by approximately 1,070 mg/L over the 20 year operational life of the TSF.

If a saline plume develops, it is likely to have higher peak salinity than the estimated average value, if it develops along a preferred pathway. It is very difficult to accurately and reliably predict the seepage rate and salinity of a plume along a preferred pathway. Such plumes are readily identifiable using electromagnetic imaging and bore monitoring methods, where there is

a measurable difference between background and plume salinity (conductance) values. A groundwater management strategy is proposed to manage the impacts on groundwater resources of saline plumes with average salinity values in excess of 4000 mg/L, with the aim of maintaining the groundwater resource within subpotable limits.

The actual average rise is likely to be significantly less than 1070 mg/L because of:

- the use of worst case assumptions in the seepage modelling;
- dilution of the groundwater by natural recharge; and
- lower salinity of seepage due to dilution by stormwater

A 1,070 mg/L rise in the salinity of the superficial aquifer would have no significant impact on the current value of the groundwater resource for human use or natural ecosystems. This is because:

- although the quality of the groundwater is in the range of potable to subpotable, there is insufficient demand to require its development as a domestic supply;
- cattle and sheep can drink water with up to 5000 mg/L and 6000 mg/L respectively, so future pastoral use would be unimpaired; and
- the depth of the superficial groundwater (approximately 16 to 18 m below ground) is too great for trees, other plants or animals to access it. The vegetation in and near the project area is all xerophytic (ie adapted to dry conditions) and is therefore not groundwater dependent (WMC, 1996).

Following the modelled influx of tailings water, the groundwater would continue to meet the Australian and New Zealand Environment and Conservation Council (ANZECC) water quality guidelines for livestock watering. The groundwater parameters in these guidelines include Boron and Magnesium.

WMC has undertaken some revised estimates of potential groundwater contamination using a more realistic scenario rather than a worst case estimate. This additional modelling indicated that TDS levels in the groundwater should not increase by more than 30%.

Comments from key agencies / interest groups

The Water and Rivers Commission (WRC) considered that the re-run of the model with the consultant's "realistic" seepage predictions suggesting a long term impact of less than 30% quality change in the superficial aquifer close to the dam, could be considered tolerable at the project site. The WRC noted that little impact on the palaeochannel quality could be anticipated as the limited seepage is expected to be held up in the voids in the low permeability hardpan beneath the dam.

The WRC also had a number of specific requirements regarding the monitoring programme to be implemented by the proponent. The WRC considered that, subject to a satisfactory response to the comments made in its submission, the water resource protection issues associated with this project had been adequately addressed by the proponent.

Response from the proponent

WMC has met with WRC to discuss the issues raised in its submission. It has been clarified that the bores within 2.5 kilometres radius of the external wall of the TSF were specifically Howards Well and Two Tank Well. Both bores are believed to be operational and consequently, WMC will include them in the monitoring programme for the TSF. WMC agrees with the monitoring programme proposed by the WRC which is specifically as follows:

- quarterly checks of pH and EC for all monitoring bores;
- annual check of chemical analysis of monitoring bore samples; and
- electro magnetic survey every two to three years.

WMC undertakes to install monitoring bores within the perimeter of the TSF for early monitoring in the first five years of operation of the TSF. The purpose of these monitoring bores is to provide an early indication to any potential seepage problems so that a seepage management programme can be implemented well in advance of any seepage plume migrating outside of the storage area.

Measures will be adopted to minimise the formation of a saline plume. These include monitoring to identify such a plume and the use of production bores to recover saline water and return it to the process plant (WMC, 1996).

It should be stressed that the occurrence of significant saline seepage into the superficial aquifer, if it occurs at all, will be a very short-term phenomenon, and will essentially have ceased after five years. By the time the TSF is decommissioned after approximately 17 years of operation, the rate of seepage will be so low that the quantity of saline water entering the aquifer will be negligible and will have no measurable effect on the salinity of the groundwater (WMC, 1996).

Seepage modelling and investigations indicate that seepage potential from this type of storage is lower than traditional paddock storages.

Environmental Protection Authority Evaluation

The Environmental Protection Authority considers that the management measures proposed by the proponent, and the proponent's environmental management commitments are adequate to safeguard future uses of the groundwater resource.

4.7 Decommissioning and rehabilitation of the Tailings Storage Facility

Objective

To ensure successful and self-sustaining rehabilitation of the TSF at and beyond the end of the project.

Policy information

Assessments by the Environmental Protection Authority of other mining proposals provide a policy framework for consideration of the rehabilitation and decommissioning scenario proposed, and the expectations of the Environmental Protection Authority.

The Environmental Protection Authority has recognised that for rehabilitation to be most effective it must be integrated into the operating plans early on in a project's development, and not left to the conclusion of the operation (EPA, 1991 Bulletin 547).

It is of paramount importance to the State that rehabilitation management does not impose short or long term costs on the community of Western Australia. This is particularly relevant when the success of rehabilitation cannot be evaluated in the short to medium term (EPA, 1994, Bulletin 766).

Technical information

Given the design and proposed operation of the storage facility, progressive rehabilitation of the tailings surface would not be possible. The proponent would have to wait for the completion of tailings discharge and decommissioning of the TSF before rehabilitation could commence. This is potentially 20 years away.

WMC aims to provide self-sustaining vegetation cover and stable landforms through progressive rehabilitation of disturbed land and final long-term rehabilitation as a part of decommissioning of the TSF.

The main environmental objectives of rehabilitation are to:

- ensure structural stability and safety to the public;
- minimise off-site impacts by controlling infiltration, sedimentation and related degradation of existing drainages;
- return the storage facility and surrounds to a condition that will support land uses consistent with the Mt Keith Environmental Management Programme and tenement conditions, potentially including fauna habitat, pastoral use, mineral exploration and aesthetic values; and
- employ rehabilitation methods that do not require ongoing maintenance to ensure long-term performance (WMC, 1996).

The proponent recognises that the best way of achieving these objectives in the long-term is to establish stable land forms with self-sustaining vegetation cover consistent with the multiple land use objectives. The proponent has stated that the main difficulty facing the establishment of such vegetative cover at Mt Keith will be the salinity of the tailings surface (WMC, 1996).

The tailings storage system proposed by WMC has several advantages for rehabilitation over conventional tailings storage systems. It is expected that, after drying and consolidation of the tailings, there will be no perched water table, as could be expected in a conventional system. Both entrained water and stormwater run-off will be shed to the water storage area in the eastern side of the storage and, depending on the final salinity levels, will be contained and allowed to evaporate (WMC, 1996).

Due to the absence of a perched water table in the tailings, capillary rise of saline water and the concentration of salts at the surface will be minimised and the salinity of the surface layers will gradually decrease due to leaching by rainwater. Water shedding will also reduce salts from most of the storage area as the salts will be dissolved from the surface crust by stormwater and will collect in the water storage area. This reduction in surface and near-surface salinity will enhance the conditions for vegetation (WMC, 1996).

Rehabilitation Strategy

The rehabilitation strategy proposed by WMC involves the pre-stripping and stockpiling of topsoil prior to construction. This stockpile and the perimeter wall will be revegetated immediately after construction with indigenous lower and middle storey species to maintain biological viability of the topsoil. Revegetation of the perimeter wall will involve the placement of topsoil and seeding or hydromulching of the outer walls, bunds and diversion drains where appropriate. Erosion and dust generation may be controlled by planting a local grass species (WMC, 1996).

The proponent has stated that at the current time, a rehabilitation strategy for the tailings surface would be inappropriate as rehabilitation will not be undertaken for 16 years or more, when tailings deposition ceases. During this time, the state of knowledge about rehabilitation and the revegetation of tailings in the Goldfields area is expected to increase, in part due to studies and trials which will be undertaken in association with this project. The rehabilitation concept described below is considered likely to be both an effective and a cost-effective method. This method has been successfully trialled at WMC's Kambalda mining operations (WMC, 1996).

At the current time the probable scenario for rehabilitation would involve the placing of closely spaced mounds of waste rock and stored top soil on top of the final tailings surface. These mounds will typically be 1.5 m high, 6 m in diameter and with a volume of 12 - 14 m³. Saline water rising by capillary action is not expected to rise further than the low points between the mounds due to the capillary break provided by the coarse material in the mounds.

The sides and tops of the mounds will then be suitable for the growth of vegetation, while the low points will become 'salinas' (saline gullies) where vegetation will not initially grow. The mounds will be positioned so as to impede water and wind flow, to minimise erosion of the salinas. It is anticipated that there will be no perched water table in the tailings, so capillary rise of saline water will cease shortly after deposition of tailings is finished. These low points will therefore gradually become less saline and eventually be able to support vegetation which will arise from the seeding of mound vegetation.

The mounds will be fertilised and seeded. The initial species may be selected for their ability to survive adverse conditions such as high salinity. However the revegetation strategy will aim to eventually re-establish local indigenous species.

Rehabilitation Trials

In order to establish the most effective rehabilitation strategy, the surfaces of tailings Cells 1 and 2 will be domed by centralised discharge following their decommissioning, and used as trial areas in order to test rehabilitation concepts over an extended period prior to rehabilitation of the TSF. The method described above will be trialled as will other possible revegetation methods such as amendment of the tailings surface. Trials will include assessment of erosion, salt crusting, the salinity of surface run-off, dust erosion, the best configuration of topsoil mounds, and the most appropriate vegetation species (WMC, 1996).

Decommissioning

Following closure, approximately 75% of the surface of the storage will be rehabilitated. The water storage area and the low area between the tailings mounds will not be rehabilitated as they may be inundated regularly with saline water and would, therefore, be unsuitable for revegetation.

The rehabilitation programme will continue and its success will be monitored after decommissioning until the vegetation has reached a stage where it is self-sustaining and compatible with the surrounding natural vegetation and future beneficial uses. The monitoring and completion criteria for rehabilitation will be developed in consultation with the DME, DEP and CALM (WMC, 1996).

Comments from key agencies / interest groups

Submissions raised queries regarding the specific logistics of the rehabilitation operation including the possible option of retaining patches of trees and bushes which might provide a foci for stability, for recolonisation, and for organic matter within the otherwise barren tailings area. This pattern has been used at some goldmines in the Yilgarn with beneficial results on mine abandonment.

Whereas the topsoil dump storage proposals are considered in a submission to be exemplary, a problem exists with extant vegetation. Mulching and burning versus leaving vegetation in situ to decompose has not been dealt with by the proponent.

One submission also requested clarification of the vegetation types that would be re-established. Topsoil storage should utilise fast growing, native, leguminous species. A number occur naturally in the area, although little is known at present of their cultivation requirements and symbiotic efficiencies. There is no evidence that 2 metre high stockpiles will retain biological activity in the future. As much of the available material as can be used elsewhere within the leases should be so used rather than stockpiled. The bund function of topsoil is not well argued. It is likely that spillages and surface leaching may contaminate these reserves. The total area to be managed would seem to be some 135 hectares.

ISSUES	OBJECTIVE	EVALUATION FRAMEWORK	PROPONENT'S COMMITMENTS	EPA RECOMMENDATION
1 Loss of remnant vegetation	Protect significant remnant vegetation.	Vegetation survey conducted Vegetation represented outside the TSF and in the Wanjarri Nature Reserve. No declared rare flora identified in preliminary survey.	Minimise clearing of vegetation and rehabilitate areas no longer required for operations. Assess TSF site for Declared Rare Flora and priority listed species.	The proponent's commitments are considered adequate.
2 Impacts on land systems	Prevent the loss of significant land systems.	The conservation significance of each land system affected by the TSF.		All land systems well represented in the Wanjarri Nature Reserve. No recommendation required.
3 Protection of the Wanjarri Nature Reserve	Protect conservation values of the Wanjarri Nature Reserve.	No direct effect. Potential indirect effect due to changes in surface drainage.	Manage surface drainage and ground water quality. Contribute to the management of Wanjarri Nature Reserve.	The proponent's commitments are considered adequate.
4 Maintenance of surface drainage systems	To ensure downstream areas are not starved of water due to changes in surface water flow.	Minimise change to surface water flow outside of the TSF.	Design stormwater diversion drains. Implement a soil erosion monitoring and remediation programme. Implement a vegetation monitoring and remediation programme.	The proponent's commitments are considered adequate.
5 Protection of fauna with high conservation significance	Protect fauna of significant conservation value.	Reserve listed fauna species that potentially may occur in the area is the mulgara. Habitats are represented elsewhere, including Wanjarri Nature Reserve.	Conduct mulgara trapping and relocation over TSF. Fund and conduct research into distribution and ecology of mulgara.	The proponent's commitments are considered adequate.

Table 3. Summary of Environmental Protection Authority recommendations

ISSUES	OBJECTIVE	EVALUATION FRAMEWORK	PROPONENT'S COMMITMENTS	EPA RECOMMENDATION
6 Contamination of groundwater resources	To safeguard any future use of the groundwater resource.	<p>Future use limited to the watering of livestock.</p> <p>Modelling indicates that groundwater will remain within ANZECC guidelines for livestock watering.</p>	<p>Manage TSF to minimise the risk of seepage.</p> <p>Implement monitoring and response programme to detect and monitor saline seepage from TSF.</p>	The proponent's commitments are considered adequate.
7 Decommissioning and rehabilitation of the tailings storage facility	To ensure successful and self-sustaining rehabilitation of the TSF at and beyond the end of the project.	<p>Determine appropriate final land use.</p> <p>Determine rehabilitation scenarios early in projects development.</p>	Within two years of operations, a draft Rehabilitation Plan will be prepared.	<p>Prepare a comprehensive Rehabilitation Programme for the TSF within five years to define and subsequently implement 'walk away' solution.</p> <p>Report to EPA on project after five years of operations.</p>

Table 3. Summary of Environmental Protection Authority recommendations (cont'd)

Response from the proponent

The proponent has clarified that cleared vegetation will be stockpiled on top of topsoil stockpiles. Clearing is needed to install the designed underdrainage system. Patches of trees and bushes left in place would interrupt water recovery and cone formation. They would also soon die on contact with saline process water.

Stockpiled vegetation (unmulched) will assist in providing fauna habitat. Vegetation left in situ would be sterilised by saline process water.

Revegetation will utilise locally occurring species including *Acacia aneura* (mulga) and several other species from the shrub, middle and upper storeys.

The topsoil is not required to function as a bund, as it is only stockpiled against an engineered stormwater diversion bund. Furthermore, sufficient clearance will be maintained between the toe of the topsoil stockpile and the sedimentation trench to ensure that there will not be contamination of the topsoil pile.

Environmental Protection Authority Evaluation

While the proponent has committed to the preparation, and revision of a rehabilitation programme, the importance of a 'walk away' rehabilitation solution with no ongoing liability to the State must also be considered.

The Environmental Protection Authority recommends that the proponent should prepare and implement a plan which describes the process for decommissioning and rehabilitating of the project area, provides for the long term management of ground and surface water systems affected by the tailings disposal facility and provides for the development of a 'walk away' solution (Recommendation 2, Section 5).

As this proposal represents an innovative alternative to traditional methods of tailings management in Western Australia, the Environmental Protection Authority considers that the proponent should provide an updated report on the progress of the facility's development after five years of operation. At such time, the Environmental Protection Authority could determine appropriate follow-up reporting requirements (Recommendation 3, Section 5).

5. Conclusions and recommendations

Following review of the proponent's Consultative Environmental Review, the issues raised in the public submissions, advice received from government departments, relevant literature and the proponent's consolidated environmental management commitments, the Environmental Protection Authority concludes that the proposal by Western Mining Corporation Limited for the development of the Upgraded Tailings Storage Facility at the Mt Keith nickel mine is environmentally acceptable, subject to the successful implementation of the proponent's commitments and the EPA's recommendations.

The Environmental Protection Authority also recognises that the system developed by WMC represents an alternative with considerable advantages to the conventional tailings storage systems developed in Western Australia. As such, the EPA considers that routine reporting on the project to the EPA would provide a mechanism for updating knowledge regarding the development of alternative tailings management systems.

The Environmental Protection Authority is satisfied that, using information currently available, the following recommendations may be made to the Minister for the Environment.

Recommendation 1

The proposal is environmentally acceptable subject to the proponent's revised environmental management commitments and the EPA's recommendations in this report.

Recommendation 2

Within five years of commissioning the Tailings Storage Facility, or at such later time considered appropriate by the Minister for the Environment, the proponent should prepare and subsequently implement a plan which:

- describes the process for the decommissioning and rehabilitation of the project area;**
- provides for the long term management of ground and surface water systems affected by the tailings disposal area; and**
- provides for the development of a 'walk away' solution for the decommissioned tailings storage facility,**

to the requirements of the Environmental Protection Authority, on the advice of the Department of Minerals and Energy and the Water and Rivers Commission.

Note: A 'walk away' solution means that the site shall either no longer require management at the time the proponent ceases discharge operations, or if further management is deemed necessary, the proponent shall make adequate provision so that the required management is undertaken with no liability to the State.

Recommendation 3

The proponent should provide a report to the Environmental Protection Authority after five years of operations which describes the development and details of the operation, issues arising from and variations required to the operation, and reports on monitoring results. A decision should be made by the Environmental Protection Authority at that time on the need for subsequent five yearly reports.

6. Recommended environmental conditions

Based on its assessment of this proposal and the recommendations in this report, the Environmental Protection Authority considers that the following Recommended Environmental Conditions are appropriate.

PROPOSAL: MT KEITH NICKEL PROJECT: TAILINGS STORAGE UPGRADE, 400 KM NORTH OF KALGOORLIE (995)

CURRENT PROPONENT: WESTERN MINING CORPORATION LIMITED

This proposal may be implemented subject to the following conditions:

1 Proponent Commitments

The proponent has made a number of environmental management commitments in order to protect the environment.

- 1-1 In implementing the proposal, the proponent shall fulfil the commitments made in the Consultative Environmental Review and in response to issues raised following public

submissions; provided that the commitments are not inconsistent with the conditions or procedures contained in this statement.

The environmental management commitments (January 1996) were published in Environmental Protection Authority Bulletin 812 (Appendix 6) and a copy is attached.

2 Implementation

Changes to the proposal which are not substantial may be carried out with the approval of the Minister for the Environment.

- 2-1 Subject to these conditions, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal.
- 2-2 Where, in the course of the detailed implementation referred to in condition 2-1, the proponent seeks to change the designs, specifications, plans or other technical material submitted to the Environmental Protection Authority in any manner which the Minister for the Environment determines, on the advice of the Environmental Protection Authority, to be not substantial, those changes may be effected.

3 Proponent

These conditions legally apply to the nominated proponent.

- 3-1 No transfer of ownership, control or management of the project which would give rise to a need for the replacement of the proponent shall take place until the Minister for the Environment has advised the proponent that approval has been given for the nomination of a replacement proponent. Any request for the exercise of that approval by the Minister shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the project in accordance with the conditions and procedures set out in the statement.

4 Decommissioning

The satisfactory decommissioning of the project, removal of the plant and installations and rehabilitation of the site and its environs to a sustainable condition in the long term, is the responsibility of the proponent.

- 4-1 Within five years of commissioning the tailings storage facility, or at such later time considered appropriate by the Minister for the Environment on advice of the Department of Environmental Protection, the proponent shall prepare a plan which:
 - 1. describes the process for decommissioning and rehabilitation of the project area;
 - 2. provides for the long term management of ground and surface water systems affected by the tailings disposal area; and
 - 3. provides for the development of a 'walk away' solution for the decommissioned tailings storage facility,

to the requirements of the Environmental Protection Authority on advice of Department of Environmental Protection, the Department of Minerals and Energy and the Water and Rivers Commission.

Note: A "walk away" solution means that the site shall either no longer require management at the time the proponent ceases discharge operations, or if further management is deemed necessary, the proponent shall make adequate provision so that the required management is undertaken with no liability to the State.

- 4-2 The proponent shall implement the plan required by condition 4-1 to the requirements of the Environmental Protection Authority on advice of the Department of Minerals and Energy, the Water and Rivers Commission and the Department of Environmental Protection.

5 Reporting

- 5-1 Within five years following the commencement of the operation of the tailings storage facility, the proponent shall submit a report to the Environmental Protection Authority which includes the following:
1. description of the development of the tailings storage facility;
 2. details of the operation of the facility and issues arising from and variations required to its operation; and
 3. monitoring results.

Note: The Environmental Protection Authority will advise the proponent on the need for subsequent five year reports.

6 Time Limit on Approval

The environmental approval for the proposal is limited.

- 6-1 If the proponent has not substantially commenced the project within five years of the date of this statement, then the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment shall determine any question as to whether the project has been substantially commenced.

Any application to extend the period of five years referred to in this condition shall be made before the expiration of that period to the Minister for the Environment.

Where the proponent demonstrates to the requirements of the Minister for the Environment on advice of the Department of Environmental Protection that the environmental parameters of the proposal have not changed significantly, then the Minister may grant an extension not exceeding five years.

7 Compliance Auditing

To help determine environmental performance and compliance with the conditions, periodic reports on the implementation of the proposal are required.

- 7-1 The proponent shall submit periodic Performance and Compliance Reports, in accordance with an audit programme prepared by the Department of Environmental Protection in consultation with the proponent.

Procedure

- 1 Unless otherwise specified, the Department of Environmental Protection is responsible for assessing compliance with the conditions contained in this statement and for issuing formal clearance of conditions.
- 2 Where compliance with any condition is in dispute, the matter will be determined by the Minister for the Environment.

Note

The proponent is required to apply for a Works Approval for this project under the provisions of Part V of the Environmental Protection Act.

7. References

- Environmental Protection Authority (1991) *Application for exploration licences 63/280 & 63/281 Dalyup area, Esperance*: Report and recommendations of the Environmental Protection Authority. Bulletin 547. Environmental Protection Authority, Perth.
- Environmental Protection Authority (1994) *Boddington Gold Mine: Rehabilitation Strategy*: Report and recommendations of the Environmental Protection Authority. Bulletin 766. Environmental Protection Authority, Perth.
- Western Mining Corporation Limited (1996) *Mt Keith Nickel Project - Tailings Storage Upgrade, Consultative Environmental Review*, Western Mining Corporation Limited, Perth.

Appendix 1

Project Description

REF: WMC (1996), MT KEITH NICKEL PROJECT, TAILINGS STORAGE UPGRADE,
CONSULTATIVE ENVIRONMENTAL REVIEW, PERTH.

PAGES 16 - 20

3. PROJECT DESCRIPTION

3.1 The Centralised Discharge Storage Concept

3.1.1 Overview

The proposed TSF will consist of a perimeter containment embankment (3 m high on the western side rising to 5 m on the eastern side) carrying a ring main distribution line which will feed nine risers located centrally within the storage. The storage is circular, having an average diameter of 4,600 m, an area of approximately 1,700 ha, and an approximate 12 m to 14 m fall in natural surface elevation from west to east across the storage.

3.1.2 Deposition Strategy

The tailings will be deposited mostly from the central risers. Some tailings may also be deposited from the ring main to seal and protect the upstream face of the perimeter wall, and to form an inward sloping beach. The tailings deposited from the central risers will form cone shaped mounds which will grow radially to eventually cover the storage area (Figures 5 - 7).

The formation of shallow beach slopes to cover as much of the natural surface as possible in Year 1 is considered advantageous. This will seal the floor of the storage with low permeability tailings and thereby further reduce the potential for seepage to groundwater. Therefore during operation of the tailings storage, the following average beach slopes are predicted:

- Year 1 - 1.5% to 2.0%;
- Years 2 and 3 - increasing from 2% to 2.5%; and
- Year 4 onwards - 2.5 to 3%

Discharge will be primarily from one central riser and up to eight subordinate risers. This number of risers is required to 'grow' the mounds in a stable and orderly manner. Deposition of the tailings will generally occur from 3 - 4 risers simultaneously. During riser changeover, risers will be flushed to prevent blockage.

3.1.3 Underdrainage

The tailings will mostly be pumped to the storage area in a water 'slurry' comprising approximately 45% solids. As the solids settle on the storage mounds, the slurry water (or supernatant water) will be recycled to the processing plant for further tailings transport.

A system of collector trenches and slotted pipe underdrains will be situated over the floor of the storage and used to collect both supernatant water and water expressed during tailings consolidation, and return it to the decant structure. The effectiveness of the drains will diminish with time due to tailings consolidation and subsequent decrease in permeability, at which time potential seepage is greatly diminished due to the sealing effect of the tailings.

The underdrainage system will also minimise the potential for seepage and assist the consolidation of the tailings.

3.1.4 Supernatant/decant Water

Supernatant water will be collected in a concrete sump and pumped via a pipeline to the existing return water pond, from where it will be reused in the process. The decant system is designed to minimise evaporation and the volume of standing saline water by maintaining the pond over a minimum area. During normal operation, there is no standing water except in the sump itself.

In order to promote supernatant run-off along the shortest route to the decant sump, deposition will be carried out such that the central cone is always higher than the outer cones, and the (outer) western cones are always higher than the eastern cones.

Data describing the quality of decant water is included in Appendix A.

3.1.5 Stormwater Retention

The perimeter embankment over the eastern (or downstream) section of the storage is designed as a water retaining structure, having an upstream impermeable clay zone, a central cut off trench incorporating a seepage interception drain and a downstream blanket drain (Figure 8). The central decant areas of the existing storage cells (Cells 1 and 2) could also be used to temporarily store water, as long as only the central part of each cell is used.

The TSF is designed with sufficient capacity to contain the run-off from a 1 in 100 year, 72 hour storm event without releasing water to the environment. An overflow structure is incorporated to handle a storm event in excess of this. Under such conditions the large dilution provided by natural run-off would reduce salinity to insignificant levels.

Stormwater will be retained in the storage and returned to the plant as required. Stormwater may stand in the storage for up to 6 months given that the volume of water expected from a 1 in 100 year 72 hour storm event would yield an initial ponded water depth of up to 4.5 m. A design freeboard of 0.5 m is provided for this major storm event. The salinity will be lower than normal decant water due to dilution.

3.1.6 Operation and Maintenance

The proposed TSF is designed for minimum maintenance. The storage will be monitored and managed to ensure that it runs correctly. Areas requiring maintenance are:

- internal drains, which will require periodic unblocking to ensure that no water ponding occurs;
- filters within the drainage system, which may become covered with tailings;
- the decant sump, which will require periodic cleaning; and
- the pumping and flushing systems.

Maintenance of perimeter drains will continue after decommissioning until vegetation is sufficiently established to no longer warrant it.

Access ramps will be provided into the body of the storage. It is envisaged that a long reach excavator or backhoe will be retained specifically for maintenance work.

After decommissioning, the stormwater will still be captured and retained within the TSF. Net evaporation at a rate of approximately 3.6 m per year will ensure that the stormwater pond, which will have a maximum depth of 4.5 m after a 1 in 100 year event, is evaporated within a year or two after the storm event.

3.2 Design of External Stormwater Diversion System

3.2.1 Stormwater Management Requirements

Given the large areal extent of the proposed storage facility, particular attention has been devoted to stormwater management peripheral to the site. The facility potentially 'blocks' or interrupts the natural flow paths of stormwater drainage to the east of the facility.

In addition, the northern section of the facility is located 'downstream' of existing mine infrastructure, notably the two tailings cells, the east waste dump, and the mine pit. Therefore,

the stormwater management design also includes upgrading of existing drainage around the waste dumps, plant and pit.

The general philosophy of stormwater management is to ensure diversion of run-off around the northern and southern ends of the tailings facility with the objectives of:

- minimising the 'blocking' of natural drainage patterns to protect the downstream biological environment;
- avoiding the flooding of mine facilities, including the airport and Mt Keith Operations Village; and
- minimising erosion and sediment transport due to concentration of run-off in erosion-prone areas.

3.2.2 Design Approach

The stormwater drainage has been designed to cater for storms of 1 in 100 year Average Recurrence Interval (ARI). The drain locations are shown on Figure 9.

Methods for predicting peak discharge rates from catchments, and maximum volumes yielded, are described in Australian Rainfall and Run-off (AR&R) (Institution of Engineers, Australia, 1987). Required capacities of the drainage channels were determined using the Rational Method for the 'Arid Interior' as described in AR&R.

In the areas where estimates of run-off volume are more critical than rates of run-off, the AR&R method for predicting total rainfall excess was based on 'Arid Interior - Eastern Goldfields - loamy soil'.

In recognition of the fact that run-off prediction is not an exact science, a conservative approach has been adopted to drainage design and refinements will be made as further information becomes available.

3.2.3 Identification of Environmental Issues

Previous sections of this report have described the main elements of the proposed TSF and have also provided comparisons with the existing storage cell method in use at Mt Keith. In addition, the environmental benefits of the new storage method have been highlighted (refer Section 2.3).

The environmental issues which have been addressed during the design of the facility, and which require management attention during construction and operation, are identified below. This list of issues is intended to provide a background perspective to the remainder of the report, for example, the relevance of the various components of the existing environment described in Section 4, and the subsequent impact assessment and management sections.

In broad terms, the environmental issues associated with the new tailings facility are mostly the same as for the current two cell storages approved and in use at Mt Keith. The main difference relates to the increased scale of the proposal; the existing tailings cells occupy an area of almost 230 ha whilst the new facility will encompass an area of about 1,800 ha (including perimeter roads and drains).

However, it must be emphasised that the existing cell storage system would also require substantial enlargement to cater for future tailings output. In the event that this method was retained at Mt Keith, the final storage configuration would involve at least 8 cells encompassing an area of about 1,300 ha, as previously mentioned.

The environmental issues have been grouped according to whether they represent direct effects (at the facility site and due to operations within the site) or indirect effects (in areas peripheral to the storage site).

1. Summary of Environmental Issues Related to Direct Effects

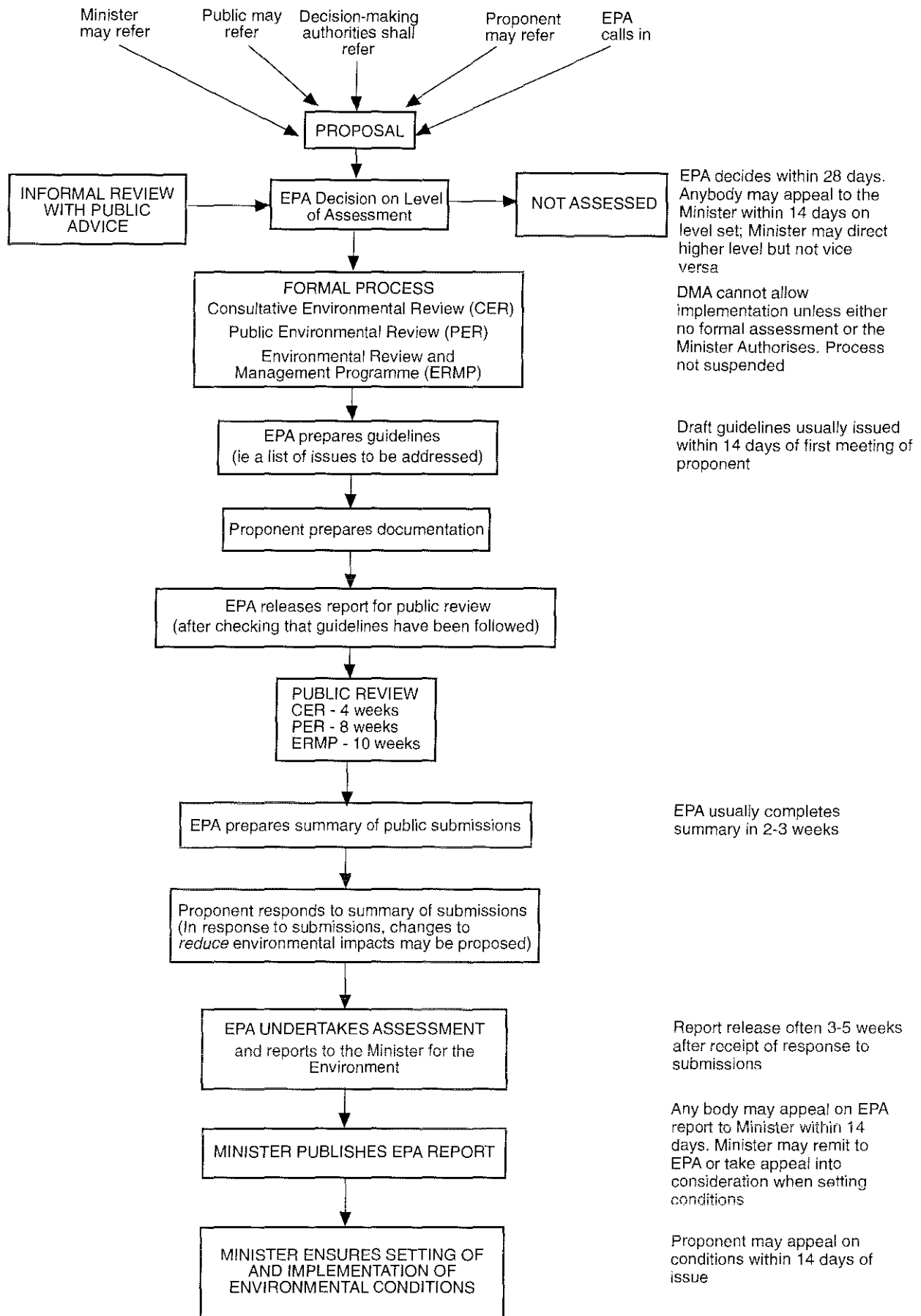
- Avoidance of sensitive or high conservation value environments (site selection);
- Loss of flora and fauna (or re-location of fauna) from the 1,800 ha disposal site;
- Integrity of regional vegetation associations and land systems (or land units);
- Potential seepage of tailings slurry water to underlying groundwater systems;
- Blocking of surface drainage patterns and capture of rainfall within the impoundment; and
- Post-mining land use - rehabilitation of site and restoration of landscape.

2. Issues Related to Indirect or Off-site Effects

- Changes to surface drainage patterns affecting biological environments in downstream areas of the catchment (drainage 'shadow' effects);
- Ensure protection of nearby Wanjarri Nature Reserve (eg potential hydrological changes - surface drainage, groundwater system);
- Potential for noise and dust emissions; and
- Long-term stability of tailings mounds (eg potential for liquefaction and loss of tailings from within the impoundment).

Appendix 2

Environmental Impact Assessment flow chart



Appendix 3
Summary of submissions

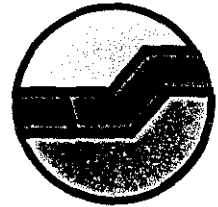
- The CER suggests the area is insignificant in relation to similar land systems in the north eastern goldfields. It is however, desirable that disturbed areas are minimised. It may be more desirable to deposit tailings into acidic sand plain areas rather than shallow red earths.
- Conventional methods involving some 8 - 10 cells would have totalled 1300 hectares. The proposal requires disturbance to 1800 hectares, which would be more difficult to manage, and increases the actual area required?
- Materials presented at page 13 do not explain which of the sites mentioned at Figure 4 has been selected.
- What sort of perimeter fence is proposed?
- What will be the aims of the monitoring programmes associated with the redirection of surface water flow systems, and when will baseline data be collected?
- How will stormwater be redistributed across slopes that are deprived?
- Page 16 of the CER suggests that some tailings 'may' be deposited to seal the upstream face of the perimeter wall. If this is a good idea surely it should be planned to be done, not left as a vague possibility?
- Where will the cleared vegetation be placed? Is clearing really needed as patches of bush can provide a foci for stability, recolonisation, and organic matter within the otherwise barren tailings area.
- The long term storage of topsoil in 2 metre high stockpiles may well sterilise and waste the lower 1.5 metres of such heaps.
- Whereas the topsoil dump storage proposals are exemplary, a problem exists with extant vegetation. The option of leaving vegetation in situ to decompose has not been considered as an alternative to burning or mulching.
- What habitat species are likely to be established following decommissioning?
- There is no evidence that 2 metre high topsoil stockpiles will retain biological activity into the future. As much of the material that can be used elsewhere in the lease should be used rather than stockpiled. The bund function of topsoil is not well argued. It is likely that spillages and surface leaching may contaminate these reserves.
- What grass species would be utilised for topsoil management?

- Details of mine / village potable water sources and make-up process water sources were not included in the CER.
- Agreement should be reached with the Water and Rivers Commission on the requirements for groundwater monitoring within the project area.
- The new dam abuts the existing tailing cells 1 & 2 (immediately to the south). Existing monitoring bores will require sealing-off with gout prior to commencement of operation of the new TSF.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

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Please address all correspondence to Executive Director, P.O. Box 104, COMO W.A. 6152

Your Ref:

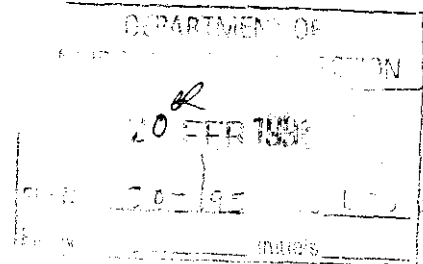
Our Ref: PO14A w144

Enquiries: Frank Batini

Phone: 334 0368

The Chairman
Environmental Protection Authority
Westralia Square
St George's Terrace
PERTH WA 6000

ATTENTION: Ms Brigid Todd



MT KEITH TAILINGS DAM CER

CALM has consulted with Western Mining Corporation (WMC) during the development of this document. This has included:

- field visits and discussions on site, including a brief field inspection for declared rare flora by CALM during 1995;
- informal comment from CALM's Kalgoorlie office to WMC following that visit;
- an inspection regarding salvage of timber;
- indepth discussions with WMC on the CER in Perth on 7 February 1996 and at Kalgoorlie on 8 February;
- a field visit to Mt Keith (CALM Perth and Kalgoorlie staff) with WMC staff on 14 February 1996.

CALM believes that areas of concern, such as declared rare flora and fauna, water shadow effects and potential for leakage, have been addressed in the CER and that appropriate commitments have been made by WMC. CALM also believes that WMC's site selection process was rigorous.

CALM is well aware that tailings dam storage is required for the Mt Keith mine. The design proposed appears to be a substantial improvement over the standard paddock design for tailings dams.

I wish to advise the EPA that CALM and WMC have recently signed a Memorandum of Understanding for co-operative management in the Mt Keith/Wanjarri Nature Reserve area. A copy of this MOU is attached for your information. The first meeting of the management committee to implement the MOU was held at Mt Keith on 14 February 1996.

I believe this is a significant achievement. The environmental benefits of this approach will greatly outweigh any detrimental effects from the tailings dam proposal.

Kerran McDan

for Syd Shea
EXECUTIVE DIRECTOR

16 February 1996
FB EPBRANCH-FLW144

Enc

cc Dr R Steedman, Chairman EPA

094791

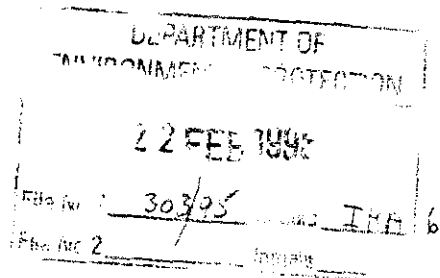
FAXED



National Parks and
Nature Conservation Authority

The Chairman
Environmental Protection Authority
8th Floor, Westralia Square
141 St Georges Terrace
PERTH WA 6000

Attention: Ian Harvey



Dear Sir

PROPOSED DEVELOPMENT OF NEW TAILINGS STORAGE FACILITY AT MT KEITH NICKEL MINE, WILUNA

Thank you for forwarding to us a copy of the Mt Keith Nickel Project Tailings Storage Upgrade Consultative Environmental Review. The CER was discussed at a recent meeting of the National Parks and Nature Conservation Authority (NPNCA). I have also attended a briefing by Western Mining Corporation (WMC) on the CER in Perth on 7 February 1996.

The Authority believes that the environmental impacts of the proposal have been addressed adequately and appropriate commitments made by WMC in the CER. Environmental impacts upon the nearby Wanjarri Nature Reserve are expected to be minimal.

Yours faithfully

Tom Day
CHAIRMAN

20 February 1996

CRN 94900
~~CONFIDENTIAL~~ INFO

Appendix 4

Proponent's response to issues raised in submissions

- Disturbance will be kept to the minimum required for construction and operation of the facility.

The reasoning behind the second part of this comment is unclear, but it is assumed to be for neutralisation of alkaline tailings material (pH 8.9). The sand plain areas of this region approach neutral (pH 6 - 7) and are less acidic than the shallow red earths, which have a pH range of 4.5 to 6.0.

The siting of the facility is based on a number of factors as outlined in Section 2.4.1 of the CER.

- It is agreed that this occupies a greater area than a conventional storage. This is because the outer embankment is not a structural barrier designed to confine the tailings material horizontally. Tailings material in this facility will settle on gentle slopes, at its natural beaching angle.

The advantages of not confining the tailings horizontally are:

- Increases short and long term stability.
- Reduced likelihood of developing an internal water mound within the tailings and associated reduced risk of seepage to groundwater.

- The facility is located in the area of the eastern site.

The eastern site does include the existing tailings disposal areas, for which the alternative site selection investigations were originally undertaken.

Sections of the proposed tailings storage facility (TSF) do extend beyond the boundary of the area marked as the Eastern site in Figure 4. Geotechnical, hydrogeological and environmental investigations were also extended beyond the marked 'eastern site' area, and beyond the perimeter of the proposed TSF.

The eastern site is preferred on the basis of those factors outlined in Section 2.4 of the CER.

- The perimeter fence will be a stock fence, and will be located at the crest of the embankment and encompass the whole perimeter of the proposed TSF. The approximate location of the fence is shown in Figure 8 of the CER.

- Some baseline studies of vegetation and invertebrates have been undertaken over the Mt Keith mine site.

Vegetation and invertebrate monitoring points will be located both downstream and upstream (control) of the proposed TSF. These will be sited within comparative land units and habitat types.

The aim of this monitoring programme will be to detect any changes in vegetation-habitat health, which may be attributable to the proposed TSF.

- The surface water management strategy is outlined in Section 6.3 of the CER. It is not expected that any slopes downstream of the structure will be deprived of surface water because the proposed TSF is situated in a gentle valley - not at the headwaters of the catchment. The diffuse release of surface water will be via level sill drains constructed on

the contour, which are designed to prevent channelled flow. These types of structures are widely utilised to achieve this throughout arid areas of Western Australia.

- The perimeter wall storage volume is generally reserved for deposition of tailings that is not suitable for pumping up the risers, or for deposition in the event of local power failure. The benefits of discharging via the central risers greatly outweigh those of using the perimeter wall, which is designed to be used as a backup system only.
- Cleared vegetation will be stockpiled on top of topsoil stockpiles.
Clearing is needed to install the designed underdrainage system. Patches of trees and bushes left in place would interrupt water recovery and cone formation. They would also soon die on contact with saline process water.
- Long term topsoil storage and management may increase the likelihood of re-introducing biological activity into the soil.
- Stockpiled vegetation (unmulched) will assist in providing fauna habitat.
Vegetation left in situ would be sterilised by saline process water.
- Revegetation will utilise locally occurring species including *Acacia aneura* (mulga), and several other species from the shrub, middle and upper storeys.
- The topsoil is not required to function as a bund, as it is only stockpiled against an engineered stormwater diversion bund. Furthermore, sufficient clearance will be maintained between the toe of the topsoil stockpile and the sedimentation trench to ensure that there will not be contamination of the pile.
- Local fast growing leguminous species will be utilised in topsoil management. Local 'grass' species and spinifex will be utilised on topsoil dumps and the perimeter embankment.
- As requested, a sketch of the location of the village potable water borefield is attached. We note that there is no impact anticipated upon the village potable borefield as a result of this tailings storage facility. The process water borefield is over 20 kilometres away from the TSF and hence has not been considered in the analysis.
- During our meeting with Water and Rivers Commission it was clarified that the bores within the 2.5 kilometre radius of the external wall of the TSF were specifically Howards Well and Two Tank Well. Both bores are believed to be operational and consequently WMC will include them in the monitoring programme from the TSF. WMC agrees with the monitoring programme proposed by WRC which is specifically as follows:
 - quarterly checks of pH and EC for all monitoring bores;
 - annual check of chemical analysis of monitoring bore samples;
 - EM survey every two to three years.

The monitoring bores proposed by WMC are schematically shown on the submission from Woodward Clyde. Note that these bores are indicative in location and number only, as it is proposed that a baseline EM survey be performed to ensure that the monitoring bores are located in the optimum position. The monitoring bores will generally consist of a cluster of bores at varying depths. The final detail is subject to detail design.

Furthermore WMC undertakes to install monitoring bores within the perimeter of the TSF for early monitoring in the first five years of operation of the TSF. The purpose of these monitoring bores is to provide an early indication of any potential seepage problems so that a seepage management plan can be implemented well in advance of any seepage plume migrating outside of the storage area.

- WMC confirms that the existing bores south of tailings cells one and two, and all other bores within the perimeter of the TSF will be sealed off prior to encroachment of tailings or decant water.

Appendix 5

List of submitters

John Fox, Mulga Research Centre
Scholz Environmental Consulting Pty Ltd

Shire of Wiluna

Department of Conservation and Land Management
National Parks and Nature Conservation Authority
Water and Rivers Commission
Water Corporation

Appendix 6

Proponent's list of environmental management commitments

Summary of Environmental Commitments

Issue	Objective	Commitments	Timing	Whose requirements	Specification
1. Security of remnant vegetation/land systems of region	Protect the ecological values of affected land systems and associated vegetation, habitats and fauna	Minimise clearing of vegetation and rehabilitate areas no longer required for operations	Pre- and post-construction	DME, DEP	Compliance with tenement conditions
		Contribute to co-ordinated management in north-eastern Goldfields with other land users	Ongoing	CALM, WADA	Consultation ongoing
2. Protect or enhance conservation values of Wanjarri Nature Reserve	Protect the ecological values of Wanjarri Nature Reserve from direct and indirect disturbance	Manage surface drainage and groundwater quality, to minimise impact on Wanjarri Nature Reserve	Ongoing	CALM	Minimal impacts on Wanjarri
		Contribute to management of Wanjarri Nature Reserve, in accordance with existing Memorandum of Understanding with CALM	Ongoing	Signatories of the Memorandum of Understanding	Improved management of Wanjarri Nature Reserve
3. Groundwater resource	Protect the water quality and long term yield of superficial and palaeochannel aquifers	Design and construct TSF to most stringent guidelines from DME.	Construction	DME	DME guidelines
		Manage TSF to minimise risk of seepage	During operation	WRC and DEP	Comply with ANZECC Guidelines for Groundwater Protection in Australia
		Implement monitoring programme to detect and monitor saline seepage out of TSF. If seepage is detected, formulate response plan	During and after construction	WRC and DEP	No change to existing and future beneficial uses
4. Surface drainage	Maintain as far as possible the pre-existing flow patterns, and protect downstream vegetation from the effects of saline runoff.	Design stormwater diversion drains to replicate as closely as possible the natural drainage patterns downstream of the TSF	Before and during construction, and ongoing	WRC	Minimal impact on vegetation and soil structure as indicated by vegetation and erosion monitoring
		Implement a soil erosion monitoring programme. Should accelerated soil erosion be detected as a result of TSF, implement a remediation programme.	Ongoing	DME (reported in annual environmental report)	Erosion minimised in comparison with control plots
		Implement a vegetation monitoring programme. Should changes in vegetation be detected as a result of the TSF, implement a remediation programme	Ongoing	CALM and DEP	Downstream net vegetation loss minimised in comparison with upstream monitoring plots
5. Implement an Environmental Management System	Develop an Environmental Management System (EMS) to ensure sound management of TSF and environment	Identify and implement an EMS. Update existing Environmental Management Programme (EMP) to include matters relevant to the TSF	EMP updated within 12 months. EMS implementation ongoing	In accord with Australian Standards including independent auditing	Compliance with intent of Interim Australian Standards 14001 and 14004

Issue	Objective	Commitments	Timing	Whose requirements	Specification
6. Site selection process	Select most appropriate site on environmental criteria	Siting will take into account all environmental aspects including hydrology, hydrogeology and significant features	Preconstruction		No impact on ecologically significant areas or restricted habitats
7. Plants and animals	Protect rare and priority species	Assess TSF site for Declared Rare Flora and priority listed species	Preconstruction	CALM	Compliance with <i>Conservation and Land Management Act 1984</i> .
		Conduct trapping programme over TSF for mulgara. If any are trapped, implement relocation programme	Preconstruction	CALM	Successful relocation of mulgara, if present
		Fund and conduct long term research into distribution and ecology of mulgara in north-eastern Goldfields	Ongoing	CALM	Improved understanding of mulgara ecology
8. Rehabilitation	Provide stable landforms and self-sustaining vegetation cover through progressive and final long term rehabilitation.	Prepare draft rehabilitation programme, updated as required to reflect results of rehabilitation trials and advances in knowledge of rehabilitation techniques. Submit final rehabilitation plan prior to implementation	Draft rehabilitation plan within two years. Updates and trials ongoing.	DEP, CALM and DME	Stable, non-polluting aesthetically acceptable landform.
9. Ensure integrity of facility to extreme events	Design and construct safe facility	Design and construct TSF in accordance with most stringent geotechnical guidelines	Design stage and during construction	DME	Compliance with DME Guidelines for Tailings Storage Facilities
10. Other	Avoid disturbance to Aboriginal heritage sites	No Aboriginal heritage sites will be disturbed without permission from the Minister for Aboriginal Affairs. If any previously unrecorded sites are found, all work in immediate vicinity will cease and appropriate procedures adopted	Ongoing	Dept of Aboriginal Affairs	Compliance with <i>Aboriginal Heritage Act 1972</i> .
	Minimise dust	Minimise clearing and stripping and implement dust control strategies during construction. Establish vegetation cover on topsoil piles and perimeter walls.	During construction and ongoing	DEP and DME	Compliance with <i>Environmental Protection Act 1987</i> Licence conditions, and <i>Mines Safety and Inspection Act</i>

REGULATORY AUTHORITIES

WADA	Department of Agriculture
CALM	Department of Conservation and Land Management
DME	Department of Minerals and Energy
WRC	Water and Rivers Commission
DEP	Department of Environmental Protection