YAKABINDIE NICKEL PROJECT
FEASIBILITY STUDY
CONSULTATIVE ENVIRONMENTAL REVIEW
VOLUME 1 OF 2

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20th April 1990

PROJECT YAKABINDIE NICKEL PROJECT
FEASIBILITY STUDY

CLIENT: DOMINION MINING LIMITED

PROJECT MANAGERS MINPROC JR JOINT VENTURE

LOCATION: YAKABINDIE VIA LEINSTER

SUBJECT: CONSULTATIVE ENVIRONMENTAL REVIEW

1.0 SUMMARY

1.1 Introduction

This report presents the results of environmental studies carried out for the Yakabindie Nickel Project near Leinster.

1.1.1 The Yakabindie Project

The proposed project comprises the mining by open cut methods of nickel ore which will be processed in a plant to be constructed adjacent to the open cut pit, and the transport of nickel concentrate to either Geraldton or Esperance. Tailings produced by the processing and waste rock from the mining operations will be disposed of at the site. The mining and processing will be carried out by a work force which will be housed on a site near the mining operations. Full details of the project descriptions are presented in Section 4.0 of this report.

1.1.2 Interactions with Mt. Keith Project

Interactions with the proposed Mt. Keith Project have been considered in this study, and the study team acknowledges that there are perceived advantages to the community and to the various proponents in sharing of certain infrastructure needs between the Yakabindie and Mt. Keith Nickel Projects. However, the following points as discussed in more detail in Section 4.5 and 5.7.4 should be noted:

(i) there is currently no interaction with the Mt. Keith Project in regard to existing facilities at the project site;

(ii) the potential for sharing support facilities is limited by market realities (refer to Section 4.5);

(iii) the projects are located some 36kms apart in a direct line, 40kms by road and neither project shares any common resource such as water supply location etc, other than the main Leinster Wiluna Road;

(iv) the proponents for the Yakabindie Project consider the environmental impacts of establishing a shared facility at some point between the projects will have a wider environmental impact than two separate project developments because of the need for additional corridors to accommodate powerlines, roads and water supply lines (refer to Section 5.7.4); and

(v) significant safety advantages exist in proximity of infrastructure particularly the airstrip which will not only serve the mine, but general aviation in the area.

1.1.3 Objectives of the Study

The objectives of this study are to assess the environmental and social impacts of the proposed project and detail management strategies to alleviate where possible and minimise the environmental and social impacts of the project. In order to assess the likely impacts of the project, studies of the existing environment have been undertaken. The results of these studies are presented in Section 3.0 of this report. Assessment of the impacts of the project and management strategies are presented in Section 5.0 of this report.

1.1.4 Study Guidelines

This study has been carried out using the guidelines as set out by the Environmental Protection Authority for this project. A copy of these guidelines is provided in Appendix A. The project has been discussed with the following Government Departments and Authorities by the Project Managers (Minproc JR) and/or the client (Dominion Mining Limited) and members of the study team.

(i) Department of Mines, Western Australia (DOM WA);

(ii) Environmental Protection Authority (EPA);

(iii) Department of Conservation and Land Management (CALM);

(iv) Western Australian Government Railways (Westrail);

(v) Main Roads Department (MRD);

(vi) State Electricity Commission of Western Australia (SECWA);

(vii) Western Australian Water Authority (WAWA);

(viii) Department of Resources and Development (DRD);

(ix) Marine and Harbours Department - Port Authority Esperance and Port Authority Geraldton; and

(x) Shires of Leonora, Esperance, Wiluna, Yalgoo, Cue, Mt. Magnet, Mullewa and Geraldton.

1.2 Existing Environment and Potential Impacts

The project area encompasses landforms and vegetation associations which are widely distributed in the Northern Goldfields region. Vegetation is largely Acacia and chenopod woodlands and shrublands dominated by Mulga Acacia aneura. Historical land use practices have resulted in a severe environmental impact with almost complete degradation of the understorey. However, the representation of the project area landform habitats, within conservation areas in the region is limited.

Seventy one vascular plant species were collected from the area. No "Declared Rare Flora" was present, although three species of uncertain status may require further investigation or special protection within specific localities. Faunal habitats are closely aligned with landform vegetation associations. The project area may support 101 species of bird, 15 native and 7 introduced mammal, 48 reptile and 7 amphibian. Three species gazetted as "rare or otherwise in need of special protection" are or have been present. They are the Lesser Stick Nest Rat (believed to be extinct), Peregrine Falcon and Alexandra Parrot. None of the proposed developments will adversely affect these species.

The adjacent Wanjarri Nature Reserve is of significance, being the only conservation area within the Northern Goldfields Region. This region is ecologically diverse, encompassing biotic assemblages which do not occur elsewhere and is an overlap zone between arid northern and mesic southern elements of both flora and fauna. Historically Wanjarri station was owned by Tom Moriarty who was a keen amateur naturalist. During the late 1960's the property was deemed nonviable as a pastoral area and offered to the then W.A. Department of Fisheries and Fauna as a nature reserve. The area was subsequently purchased and gazetted as a Class A Nature Reserve (A30897) for the purpose of Conservation of Flora and Fauna on July 18th 1971 and vested in the National Parks and Nature Conservation Authority. Currently the reserve is administered and managed by CALM. Recognition of the biological importance of Wanjarri lead to the EPA endorsement of Wangarri as a Class A nature reserve in 1975. This endorsement was upheld by State Cabinet.

The principle environmental impacts arising from the proposed project will be the loss of vegetated area, reduction in area of breakaway habitat and the impositions on the Jones Creek drainage system. The total area loss from the developments, (approximately 990 ha) over the envisaged life of the project is insignificant (less than 0.1%) in comparison to the ecological landform units represented. The impact on the fauna is generally secondary. There will be major local impacts initially with destruction of habitat and relocation of mobile species into adjacent habitats. Impacts will be minimised by staged clearing, limiting clearing to absolute essential minimum, fencing off the project areas and limiting road and track development.

The only factors which have the potential to impact the biota of Wanjarri Nature Reserve are dust, noise, minor erosional run-off from the eastern waste dump (the majority of run-off is away from the Reserve) and increased visitation by the public. The subsequent localised effects on adjacent vegetation within the reserve through excessive dust and erosion will be minimised by appropriate management methods. Employee education programmes and liaison with CALM will reduce the potential for adverse impacts associated with any increased visitation to the reserve. No other environmental impacts are perceived to impinge upon the integrity of the reserve.

prevent by moving dump S of climate

1.3 Environmental Monitoring and Management Programmes

The proposed development will impact on the existing environment. However, with adequate environmental monitoring and management programmes, these impacts will be minimised.

Environmental management and monitoring programmes and commitments for the project are summarised below.

(i) Environmental Officer

An environmental officer will be appointed to this project prior to the commencement of construction, and his duties will include:-

- design and implementation of the progressive rehabilitation programmes including research activities associated with the rehabilitation, fauna monitoring and feral animal eradication programmes within the project area, as required;
- environmental impact assessment and monitoring;

- act as an honorary warden for the Wanjarri Nature Reserve and set up in conjunction with CALM an education programme for all project employees for the protection of the Wanjarri Nature Reserve;
- liaise and report to Government Departments as required in relation to environmental matters.

(ii) Government

- comply with all relevant Acts and Regulations;
- submit an annual environmental report detailing impacts, management and monitoring programmes to an agreed format and content.

(iii) Water

- baseline studies are planned to obtain water quality and biological data for Jones Creek prior to the commencement of construction;
- groundwater levels and groundwater quality of the areas immediately downstream of the tailings to be obtained on a regular weekly basis and daily inspections of the tailings dam;
- monitoring of groundwater resources in the borefields and pit dewatering;
- water recovered from pit dewatering to be used in ore processing and dust suppression;
- creek diversions are planned to minimise erosion and sedimentation during peak flood flows;
- construction of silt traps downstream of waste dump and tailings dam.

(iv) Flora and Fauna

- monitor fauna within the project area;
- restrict non avian faunal access to potentially hazardous areas by fencing, if required;
- rehabilitation of waste dumps and tailings dam embankment as the project proceeds;
- feral animal eradication programme;
- maintain strict fire control procedures;
- no domestic pets within the project area (dogs, cats, etc);

(v) Waste Disposal

- bury all domestic wastes;
- sewage disposal in purpose built treatment plant for the main village and septic tank and leach drain as appropriate for the houses and main offices;
- waste dumps designed to blend into existing topography with measures to prevent wind and water erosion, siltation of drainage channels, and promote progressive rehabilitation;
- tailings dam design to maximise water return and tailings density by collection of water through the central decant and upstream toe drain with embankments designed to promote progressive rehabilitation;
- waste oils will be combined with fuel for the power station. Waste grease will be collected and transported off site for recycling.

(vi) Hazardous Substances

- Hazardous substances are dealt with in Section 5.4. Their transportation, storage and handling in accordance with the appropriate regulations;

(vii) Dust

- establishment of dust suppression programmes to comply with Mines Department Regulations and to minimise dust pollution of the project area and adjacent nature reserve;
- a dust monitoring sampler would be set up in the Reserve at a location agreed with CALM;

(viii) Noise

- monitor to ensure compliance with Government Acts and Regulations;

(ix) Adjacent Landuse

- monitor activities to minimise interaction with pastoral activities. Fencing will be provided as required around some or all parts of the development as agreed with the relevant authorities;
- provide a new access to the Wanjarri Nature Reserve complete with gate and appropriate fencing;
- institute, education programmes as part of the site induction for the Wanjarri Nature Reserve;
- no off road driving, hunting or possession of firearms permitted by employees as a condition of employment;

(x) Rehabilitation

- progressive rehabilitation of waste dumps and tailings dam embankments as the project proceeds with appropriate preparation techniques and vegetation species;
- pit decommissioning as appropriate and in accordance with the Mines Department Guidelines;
- removal of all buildings and equipment including water pipelines and power transmission lines on completion of mining and processing. Cap all pipes and boreholes and backfill costeans. Ripping and seeding of the ground with all sites to be left clean and tidy;

(xi) Aboriginal Interests

- submit applications to the W.A. Museum for Aboriginal Artefact sites which are to be disturbed;

(xii) Public Safety

- access to the mine site processing plant and village will be prohibited to the public, with signs, fences and gates installed where necessary;

1.4 Conclusions

The environmental management practices as outlined in this document will be implemented at the commencement of the project and regular monitoring will be undertaken to measure the effects of the project on the environment. These actions will limit adverse impacts from the project. This project will generate significant benefits for local communities, the State of Western Australia and Australia.

2.0 BACKGROUND DETAILS

2.1 Project Description

The project comprises an open cut pit occupying a surface area of 1.8 x $10^6 m^2$ (1.8km x 1.1km) with a planned depth of 350 metres and pit slopes of 45 degrees overall. This pit will produce 6 million tonnes of ore per annum and approximately 25 million tonnes of waste rock per annum. At this stage the planned mine life is 15 years.

Ore which with an average grade of 0.53% nickel will be treated at a nearby process plant. Processing briefly comprises crushing, grinding, conditioning with flotation agents, flotation, thickening of the concentrate and disposal of waste tailings. A detailed description of the processing is presented in Section 4.0. The mine project will operate with a workforce of approximately 260 who will be housed on a site near the operations. It is proposed to run the mine on a fly in/fly out basis, with permanent on site accommodation for senior staff and families.

The feasibility study is scheduled to be completed by the end of May 1990. With a favourable outcome of this study construction work is scheduled for commencement in early 1991 with production commencing in early 1992.

2.2 Location

The project is located in the East Murchison Mineral Field - Lawlers District, approximately 65km north of Leinster. Plates B1 and B2 show the location of the project which is within the Yakabindie Pastoral Station area and within the Leonora Shire.

Nearby mines include Bellevue (approximately 25km south of the project) and other mines in the Leinster and Agnew regions.

We understand that feasibility studies are also being undertaken for the Mt. Keith Nickel Project which is located 40kms to the north.

2.3 Ownership

The Yakabindie Project is owned by Dominion Mining Limited through its 100% owned subsidiary Dominion Resources Pty Ltd, Dominion Mining is located at:-

10 Richardson Street
West Perth WA 6005

The tenements which currently make up the Yakabindie Project are detailed in Table 1, and Plate B2 in Appendix B shows the layout of these tenements.

It should be noted that applications for Mining Leases 36/183 and 36/184 replace a number of Mining Leases and Prospecting Licences conditionally surrendered in favour of these applications. However, it is not anticipated that the Mining Leases will be granted for approximately 6 - 8 months.

Exploration Licences 36/136 and 137 will be transferred to Dominion Resources Pty Ltd following grant of E36/137. In the event development proceeds it will then be necessary to apply for General Purpose Leases and Miscellaneous Licences over parts of these Exploration Licences for infrastructure purposes (ie. tailings dams, bore field, etc).

TABLE 1. TENEMENT DETAILS - YAKABINDIE PROJECT

Tenements	Registered Holder	Date of Grant
Mining Leases		
36/183	Dominion Resources Pty Limited)	Application
36/184	Dominion Resources Pty Limited)	Application
Exploration Licences		
36/136	Dominion Resources Pty Ltd	17.01.90
36/137	Dominion Resources Pty Ltd	26.02.90

2.4 History

The Yakabindie Project (Six Mile Prospect) was discovered by the North American company Anaconda in the late 1960's.

Exploration activities to date, have included drilling programmes, geophysical testing, geochemical sampling programmes and a total of approximately 14 kilometres of grid lines have been cleared to enable these works to be carried out.

In 1971 the project was declared sub-economic following a pre-feasibility study carried out by CRA.

Improved understanding of water resources in the area, improvements in mining and processing techniques and improved nickel prices have upgraded the economic attractiveness of the project. A feasibility study is currently being undertaken to establish the viability of the project.

The feasibility study is being undertaken by a joint venture between Minproc Engineers Pty Ltd and J R Engineering Services Pty Ltd. Both organisations are substantial companies with considerable experience in engineering construction mining research and development. The address of the Joint Venture is:

Minproc J R Joint Venture
22 Stirling Highway
Nedlands WA 6009

2.5 Existing Facilities

Existing facilities at the site comprise an exploration camp consisting of several portable accommodation units, a core storage area and several water bores which have been installed and upgraded over the years.

Access to the project site is via the existing Leinster - Wiluna Road to a point is approximately 60kms north of Leinster. An existing access track leads to the site approximately 5kms north east from the main road.

The main road system in the area will be utilised to transport supplies to the site and concentrates from the site. These details are set out in Section 4.7.

Apart from the use of this main road system, there is no interaction with other mining projects (operational or otherwise) at this stage.

3.0 EXISTING ENVIRONMENT

A description of existing environment is presented in the following sections.

Details such as maps, plans, statistical data and lists of species for flora and fauna relevant to this section are presented in Appendix C.

3.1 Regional Setting

The topography of the general area is dominated by a north south trending ridge of hills, which to the south of the project area are known as Violet Range, beyond these hills the area is generally flat to the east and west.

Within the immediate project area (5km radius of the pit) the topography is dominated by low granitic hills to the north west which have moderately inclined to steep slopes, and an undulating crest surface. To the east the topography comprises a very gently inclined plain, with some low gently inclined to moderately inclined hills to the south east. A ridge gently inclined to moderately inclined is located to the south, with a very gently inclined to level plain to the south west, and west of the granitic hills.

Drainage comprises closely spaced to moderately spaced tributary patterns which drain to the east from the granitic hills and then south west into Jones Creek which flows away from the project area in a south westerly direction.

Drainage to the west of the granitic hills comprises closely spaced tributary and non tributary channels which flow to the west and south west. Stream flow is intermittent, and generally dependent upon storm conditions in the catchment areas.

A topographic map and aerial photographs of the project are attached in Appendix C1.

3.2 Geology

The project area lies within the Yilgarn Block, where the basement rocks comprise a series of north/north west trending greenstone belts enveloped by granites and gneiss.

The geology of the main project area is dominated by a north south trending band of volcanic (ultramafic) and sedimentary rocks, with igneous (granitic) rocks to the north west. These rocks are of Archaean Age and are surrounded by sediments of Quaternary Age with some Tertiary Laterite to the east of the project area.

The geology has been mapped at a scale of 1:25,000 by J Hallberg, and a copy of his map Kathleen Valley S.W. Number 3043-111 is presented in Appendix C2.

The geology of the Six Mile Well (Yakabindie) prospect, as established from widely spaced drilling, indicates the deposit is a low grade disseminated pentlandite orebody within serpentinised ultramafic host rocks. The main mineralised ore varies in width from approximately 90m to 200m over a strike length of approximately 1100m. Weathering extends to about 50 metres depth, though some oxidation effects may be apparent from 50 to 70 metres depth. The mineralisation dips steeply to the west. A sulphide ore resource of some 90 million tonnes is inferred to a depth of 350 metres, though the orebody is open at depth. Additional resources lie 1 to 2kms south of the Six Mile Well prospect in the Goliath North prospect, but these do not form part of this study.

3.3 Hydrology

3.3.1 Surface Water

The site of the proposed Yakabindie mine is drained by Jones Creek and its tributaries, which will be diverted away from the proposed mine operations. Streamflow is ephemeral in a reasonably dense network of streamlines. There are no flow measurement records for any streams in the vicinity of Yakabindie.

The catchment boundary for streamflow past a point close to Six Mile Well for Jones Creek and its major tributaries are shown on Figure 4 (Drawing No. 142.1/90/1-4) in Appendix C3.

Table 2 lists characteristics of catchments defined by points slightly above and below the confluence of the western tributary with Jones Creek and of the western tributary, as estimated from the Sir Samuel sheet topographic 1:250,000 map series, and topographic maps of other parts of the catchments.

For the design of diversion works, flood flows were calculated using high water marks from the January 1990 flood event and surveyed cross sections of Jones Creek and the western tributary. These flow calculations are given in Table 3.

Maximum flow (Q m^3/sec) were estimated from the cross-sectional area ($A_s m^2$), hydraulic radius ($R = A_s/P$ where P is the wetted perimeter), the downstream slope of the stream beds (S m/m) and the Manning roughness factor n, using the Manning formula for steady uniform flow:

$$Q = (1/n)\, A_s\, R^{2/3}\, S^{1/2} \qquad (1)$$

TABLE 2. CHARACTERISTICS OF CATCHMENTS

Catchment	Area A_C (km^2)	Stream Length L (km)	Average Stream Slope (m/km)
Jones Creek[1]	31.9	7.5	4.0
Jones Creek[2]	43	7.8	4.0
Western Tributary	4.8	2.5	12.4

[1] Above confluence with Western Tributary
[2] Calculated with Equation 1 ;and assuming n = 0.045.

The value n = 0.045 was used on advice from the Main Roads Department of WA. Table 3 presents the values of other terms used and the calculated flow rates.

TABLE 3. FLOW CALCULATIONS (STORM IN JANUARY 1990)

Catchment	Cross-Section A_s (m^2)	Wetted Perimeter P (m)	Hydraulic Radius R (m)	Stream Slope S(m/m)	Flow Rate[2] Q (m^3/s)
Jones Creek[1]	144	107	1.35	0.0013	140
Western Tributary	64	44	1.45	0.006	140

[1] Above confluence with Western Tributary
[2] Calculated with Equation 1 ;and assuming n = 0.045.

According to Australian Rainfall and Runoff (1987), the value of the Manning Roughness Factor (n) for these streams should lie in the range of 0.035 to 0.100. If the lowest value was appropriate, the calculated flow rate in each stream would be increased by nearly 30%. If the highest value was appropriate, the calculated flow rates would be reduced by 55%.

Full details of the above calculations are given in Appendix C3.

The design of the creek diversions has been based on this recent flood event (January 1990) which has an average recurrence interval of more than 100 years (probability of occurrence in any year of less than 1%). Details of design of these diversions are given in Sections 4.1.3.1 and Appendix D1.

The bed load of Jones Creek comprises sands, gravels, cobbles and boulders, and it is unlikely that this bed load will change since the proposed diversions will be mainly excavated in rock.

3.3.2 Groundwater

3.3.2.1 Project Water Requirements

- **Process Water - Saline**

The requirements for low-quality process water are up to 6×10^6 cu m/yr to support a projected throughput of 6×10^6 tpa. Salinities of about 20,000 mg/l TDS are understood to be suitable. Water of higher salinity will probably be usable, subject to the results of metallurgical test work. discharged where?

- **Process Water - Fresh**

For final washing of the ore concentrate, a fresh-water supply of approximately 200,000 m^3 per year is required. Such water needs to have a low chloride content.

- **Domestic Water - Fresh**

To support a workforce of 260 people, a domestic fresh-water supply of 60,000 m^3 year is required. Such water needs to have a salinity below 1500 mg/l.

3.3.2.2 Existing Groundwater Conditions

The region has two types of groundwater domains: bedrock outcrop areas and alluvial basins. Whereas the mine is located in a belt of mafic/ultramafic bedrock, the main groundwater exploration area lies in a broad, shallow basin. It is shown in Figure 1 (Drawing No. 142.1/90/2.1) in Appendix C3.

- Basins

The basins in the Yakabindie area contain sedimentary deposits - alluvium, calcrete, and eolian sands - to depths of up to 120 metres, generally overlying granitic bedrock. Groundwater occurs in sandy alluvium, calcrete and weathered granite underlying the sedimentary strata. Aquifer intervals are commonly separated by clayey alluvium of low permeability.

A programme of exploration drilling and test-pumping has identified two moderately-productive aquifers on lease number 36/136. The major aquifer lies within a palaeochannel of sand trending south-south-westwards from Dingo Creek to Townsend Well and may extend to the eastern end of Lake Miranda. A second aquifer of shallow calcrete underlies the east-west drainage through Townsend Well, Henry Well and Ingardella Bore.

Groundwater salinities range from fresh to saline. Values of salinity from stock bores/wells and some groundwater exploration bores are shown in Figure 2, (Drawing No. 142.1/90/2.2) in Appendix C3. It is seen that salinities are low in the higher parts of the catchments, and are high in the lower parts - reaching hypersaline in the sediments beneath Lake Miranda (which is ephemeral, saline).

Groundwater is presently used for stock watering. Several bores and wells tap both the shallow calcrete in the east-west drainage and alluvium/weathered bedrock elsewhere in the basin. The waters are suitable for stock, ie. less than about 8,000 mg/l. It is noted that the pastoralist's wells/bores in the east-west drainage supply stock-quality water because they tap only the top of the aquifer; there is saltier water at greater depths. Bores drilled in the east-west drainage as part of the present investigation extended deeper into the aquifer and yielded higher salinity water than the stock bores.

There is one major groundwater supply developed in the vicinity, for the Bellvue Mine. The borefield produces about 1,000 cu m/d (0.36×10^6 cu m/yr) and is located in alluvium, 7kms west of the western boundary of Lease E36/136.

The borefields for the Mt. Keith nickel project are located several tens of kilometres north of the present test area, from which they are separated by impermeable bedrock highs. Their locations are shown in Figure 2.

- Bedrock

Bedrock contains modest supplies of groundwater locally, in fracture zones that have adequate water storage capacity below the water table.

Mafic bedrock yields groundwater to Six Mile Well and bores/wells near Yakabindie Homestead. There is known to be a significant quantity of groundwater in mafic/ultramafic rocks at the Six Mile Prospect orebody, contained in fractured rock; this source has not yet been evaluated in detail. On the whole, there has been little development of mafic-bedrock groundwater for stock water supplies.

Granite bedrock such as that occurring east of the Prospect and north of the groundwater lease apparently yields water to one or two bores. This rock type is generally low-producing, and has essentially no significance in the present context. Any permeable weathered granite encountered beneath the alluvial basin will be evaluated in conjunction with the sedimentary aquifers.

In this area the bedrock groundwater is fresh to slightly saline. The occurrences of fresh groundwater in bedrock, such as near Yakabindie Homestead, are attributed to favourable local recharge conditions, elevated position, and moderately high permeability.

3.3.2.3 Existing Groundwater Use

The closest major borefield, supplying the Bellvue Mines, is 4kms from the nearest bore proposed for the Yakabindie Project. It is in a separate alluvial channel to the latter, although the aquifers are likely to be connected hydraulically. Simulation has indicated that there will be negligible drawdown interference (0.02m) caused by the proposed pumping. This prediction would be firmed-up after the testing of Area 2, and checked by monitoring during borefield operation.

A number of wind powered stock wells exist throughout the project site and these wells mainly draw from a thin layer of brackish groundwater overlying saline groundwater. Quantities of water drawn from these wells is negligible.

but still important for the pastoralist.

The largest user of groundwater in the area is expected to be the Mt. Keith Project, whose demand is said to be up to 17 x 10^6 cu m/yr. Three borefields have been proposed (Figure 2), the closest two being 12kms to the north and 17kms to the north-west of the Yakabindie lease area. In addition to lying at large distances away, the Mt. Keith borefields are separated from the present borefield by bedrock ranges and surface-water divides. There is no possibility of drawdown interference.

3.3.2.4 Proposed Borefield Development

A borefield to provide the saline process water supply of 6 x 10^6 cu m/yr is proposed to be constructed on Groundwater Exploration Lease E36/136 plus Area 2, which is an extension to the south-west (Figure 2). A licence is presently being sought for the additional area.

The preliminary design of the borefield is based on a drilling and test-pumping programme followed by hydrogeological assessment and mathematical modelling of the aquifer system. As the investigation programme covered only Area 1, the treatment of Area 2 has required extrapolation of hydrogeological information. Accordingly, the final details of the borefield layout await the results of field investigations in the extended area.

For planning purposes the borefield is designated to comprise 22 bores producing at an average of 490 cu m/d. The layout will be approximately as shown in Figure 3 although the pattern shown is somewhat stylised to conform with the computer model grid. Additional to the saline process-water borefield, two bores are proposed to be drilled for the fresh-water supply. Potential sites, not yet decided are: (1) along the eastern margin of the greenstone belt south of Six Mile Well, and (2) along Dingo Creek to the north-east of sites drilled to date.

3.3.2.5 Mine Dewatering

The mine at Six Mile Prospect is designed to be open-cut, and extend to 350m depth. There is local groundwater contained in fractured mafic and ultramafic rock, at least in the upper levels to about 80m depth.

Dewatering operations will be needed to control groundwater for mine workability and pit-wall stability. They will entail either borehole or in-pit pumping (or both) depending on the aquifer geometry and the scale of water inflows.

3.4 Climatology

The project area is dominated by the high pressure systems which give rise to the prevailing east west winds.

Thunderstorms generally account for most of the rain in the project area, with these storms generally occurring in the summer months. Rainfall is however variable from year to year with periods of drought which may extend over several years. Rainfall is occasionally influenced by rain bearing tropical cyclones.

The limited climatic data available for the project area is presented in Appendix C3, and is summarised below. It should be noted that this summary data is inferred for the project site, since the closest weather stations to the site are located at Leonora and Wiluna, 200kms south and 100kms north respectively.

The project is located in a semi-arid region of Australia where:-

(i) Mean Annual Rainfall is 230mm per year;

(ii) Mean Annual Evaporation is 3800mm per year;

(iii) Prevailing wind directions are east and west, with wind speeds generally less than 20km/hour.

3.5 Flora and Fauna

An intensive field survey of the project area was carried out by Ecologia Ecological Consultants in early February 1990 (Appendix C5). The principle aim was to document the existing biota, delineate the main ecological units, map the area and integrate previously published and unpublished information.

The project area includes geomorphological, vegetation and faunal assemblages which are widely represented in the Northern Goldfields Region. Relevant literature and field surveys have revealed no significant ecological condition in the area, except three plant species whose status is unclear and may require further investigation (Section 3.5.1). However the extremely limited representation of the project area landform habitats within conservation areas in the region is significant. Additionally the close proximity of the proposed developments to the adjacent Wanjarri Nature Reserve, a Class A reserve for the purpose of Conservation of Flora and Fauna, is a major consideration in any perceived environmental impacts and subsequent management recommendations.

Previous biological knowledge of the region is limited to broad-scale vegetation mapping (Beard, 1976; Carnahan, 1976), the Biological Surveys Committee survey (McKenzie et al, in press) and a long term systematic account of the birds of Wanjarri Station (Moriarty, 1972). In addition some opportunistic collecting has been carried out by officers of the Department of Conservation and Land Management and amateur naturalists. In all cases, virtually no details specific to the project area were available.

The area is characterised by the north south greenstone belt, the granite hill complex to the west and The Jones Creek drainage system. The vegetation is dominated by low open Acacia woodland and shrublands with a severely degraded understorey.

Based on the PSC Goldfields habitat landform classification system the following 5 landform habitat units and sub-units occur in the project area as referred to in (Table 4). Physiography is weakly correlated to underlying rock type.

TABLE 4. Landform Units in Yakabindie Nickel Project Area with approximate percent occurence

Landform	Code	Description	Percent
Breakaway	B	bluffs 3-4m high, gravelly loams on scree slope 12°-15°	7
Hills, granite	HG	greater than 30m high, gravelly skeletal soils, exposed rock	35
Undulating Plain, greenstone	UN	greenstone belt and joining colluvial flats with chert ridges 2-3m high	28
Drainage Line	D	The Jones Creek, eroded earth banks 1-3m high, sandy-gravel bed, semi-permanent water	10
Broad Valley	V	relief under 20m, sandy colluvium overlying granite	20

3.5.1 Flora and Vegetation

The project area falls within the Wiluna Sub-region of the Austin Botanical District of the Eremean Botanical province. Two broad scale vegetation types occur within the Yakabindie project area.

(i) Mulga Shrubland and low woodland, associated with lower plains, granite hills and valleys. These areas are dominated by Acacia particularly A. aneura.

(ii) Halophyte communities which include Acacia, Eremophila and Cassia chenopodiaceous woodland and shrubland vegetation.

However within the project area the five landform habitats which are present contain distinct vegetation associations.

Breakaways - principally low shrubs of Dodonea, Eremophila, Cassia and chenopods on the slopes with Callitris around the upper edges of the bluff.

Granite hills - taller shrub layer of Acacia with lower understorey of Eremophila species and ephemerals including a maiden hair fern.

Drainage lines - the most distinctive association, tall Red River Gum eucalypt woodland with dense shrub understorey of Acacia species.

Undulating plain - low open Acacia woodland with several Hakea species and various chenopods.

Broad valleys - low open shrublands dominated by smaller species of Eremophila and Cassia with very sparse larger Hakea and Acacia shrubs.

In total, 71 vascular plants were collected from the project area and identified to species level, with an additional 7 species determined to genus level only. No introduced weed species or cultivated plants were observed. Plants present in the area included members of 28 families, 16 of which were represented by only a single species. The genera most well represented were Acacia (11 species), Eremophila (11 species) and Cassia (5 species). By far the most common species in the area was Mulga Acacia aneura, which was present at all but five sites. The genus Eucalyptus was notably rare, represented only by three species, all of which were associated with drainage lines.

No plant species listed in 1989 CALM Declared Rare Flora Schedule were collected from the project area. However the following undescribed or imperfectly known species are known from the area.

Eremophila 'pungens' - A new species unpublished commonly associated with breakaways in the Wiluna-Laverton area. It is one of a species group related to E. georgi for which the status is uncertain.

Grevillea inconspicua - This species is on the CALM reserve rare and endangered list. The W.A. Herbarium contains a specimen collected near Six Mile Well. Despite an intensive search of the area, no Grevillea species was found at this locality. It is possible that heavy grazing may have removed the species from the area or that the search locality was incorrect.

Acacia aff. citrinoviridis - This species, abundant on the greenstone area just west of Goliath prospect, is of uncertain status for which geographic distribution and taxonomy are not known. The nearest other collection location is Windidda Station, 200km to the north east.

Comparison of the vegetation descriptions and species lists from the project area and Wanjarri Nature Reserve indicate that all broad vegetation types and consequently many species found during the Yakabindie survey are present in Wanjarri. However the present survey was carried out during a season when few if any ephemeral species are apparent or identifiable. Survey work in the area during favourable seasons would undoubtedly reveal other significant species or associations within particular habitats.

3.5.2 Fauna

Faunal habitats are closely aligned with landform - vegetation associations. The field survey recorded 45 species of bird, 8 native and 6 introduced mammals, 11 reptile and 2 amphibians. The survey added two species of reptile Diplodactlyus squarrosus and Varanus tristis, and one frog Limnodynastes spenceri which had not been recorded previously in the surrounding area. On the basis of literature searches and known habitat preferences in the project area may support approximately 101 bird species, 15 native and 7 introduced mammal, 48 reptile and 7 amphibians.

The drainage line habitat produced the richest faunal assemblages. The Jones Creek system provides a centre for resources for many nomadic and resident bird species. The tall River Red Gums contain numerous hollows for nesting and the upper storey is utilised for foraging by birds and bats. The dense understorey vegetation and aquatic environment provides niches for many species of invertebrate, frog, reptile and small mammal.

A distinctive faunal assemblage occurs in the granite hill area with rock inhabiting geckos, Euros and Echidnas. The small caves and overhangs provide refuge for Euros, Echidnas, bats, cave crickets and goats. The widely occurring low open Acacia woodland and shrublands are dominated by a highly mobile avian community and arboreal lizards.

Within the project area three species are gazetted as rare or otherwise in need of special protection. They are the Lesser Stick-nest Rat Leporillus apicalis, the Peregrine Falcon Falco peregrinus and the Alexandra Parrot Polytelis alexandrae.

Lesser Stick-nest Rat Leporillus apicalis - This large rat species is gazetted "rare, possibly extinct". It formerly ranged over much of central Australia as is evident by the nest remains found in small caves and breakaways, but has not been seen since 1933. However there are several unconfirmed reports of contemporary nests (Gratte, 1972). Within the project area the remains of two old nests and roosting sites were found in breakaways, indicating that the species did inhabit the area sometime ago.

Peregrine Falcon Falco peregrinus - Gazetted as "in need of special protection". This species is widely distributed throughout Australia. Its status is considered to be "generally uncommon, probably declining in settled regions; still well established in remote areas" (Pizzey, 1980). While occurring in the project area it is a wide ranging species and is not dependent on any habitat which is to be disturbed.

Alexandra Parrot Polytelis alexandrae - Gazetted as "rare and endangered". Moriarty (1972) recorded one individual from Wanjarri Station in over 30 years of observation. The species is rare, highly nomadic and irregular with the project area being on the western limits of its distribution (Pizzey, 1983). The species breeds in hollow eucalypts on water courses and the reduction in drainage line habitat is insignificant on both a local and regional basis.

The project lies on the immediate south western corner of Wanjarri Nature Reserve. This reserve exhibits a high species richness with 124 bird, 18 native and 7 introduced mammal, 3 frog and 52 reptile species being recorded. The occurrence of spinifex-sandplains, a landform habitat absent from the project area, on Wanjarri is a significant factor in this richness (Moriarty, 1972). This is reflected in the reptiles with 38% of the species recorded from Wanjarri occurring on this habitat. Additionally the area is an overlap zone between species which have predominately arid northern or mesic southern distributions, resulting in a species richness higher than adjacent regions. The relative richness of the area compared to other arid regions is illustrated by the avifauna with 124 species recorded on Wanjarri as against only 88 species at Mileura Station 320km to the north west (Davies, 1970).

3.5.3 Ecological Significance

The project area encompasses landform and vegetation associations which are widespread throughout the Northern Goldfields Region. Despite this only a small area representative of these associations is conserved within Wanjarri Nature Reserve, the only conservation area in the region. Thus the habitats which support the greatest biodiversity, such as the Jones Creek drainage system, or which are refugia for specialists species, eg. breakaways, remain of ecological significance.

The Jones Creek drainage system is of value for breeding and aquatic species. While no aquatic invertebrate survey was undertaken, Jones Creek being the largest watercourse between Leinster and Wiluna with semi-permanent water provides a refuge for many aquatic species during summer from which dispersal to other ephemeral drainage systems occurs during wetter periods.

The drainage line and breakaway landform habitats are in relatively good condition and most closely represent pre-pastoral settlement status, whereas the other habitats have been severely affected by disturbance. The conditions are a reflection of historical pastoral practices and timber cutting during the mining boom in the early 1900's. The result is a severely degraded understorey with evidence of little regeneration due to grazing pressures from feral herbivores, particularly goats.

Biota of significance which occur within the project area are the three plant species of uncertain status.

Wanjarri Nature Reserve is of significance being the only conservation area within the Northern Goldfields Region. The region is ecologically diverse, encompassing biotic assemblages which do not occur elsewhere and is an overlap zone between arid northern and mesic southern elements of both flora and fauna. Historically Wanjarri station was owned by Tom Moriarty who was a keen amateur naturalist. During the late 1960's the property was deemed nonviable as a pastoral area and offered to the then W.A. Department Fisheries and Fauna as a nature reserve. The area was subsequently purchased and gazetted as a Class A Nature Reserve (A30897) for the purpose of Conservation of Flora and Fauna on July 18th 1971 and vested in the National Parks and Nature Conservation Authority. Currently the reserve is administered and managed by CALM. Recognition of the biological importance of Wanjarri lead to the EPA endorsement of Wanjarri as a Class A nature reserve in 1975. The endorsement was upheld by State Cabinet.

4.0 PROJECT DESCRIPTION

The layout of project facilities has been selected to blend with existing topographical features, operate within the physical constraints of the topography and mining lease boundaries whilst maintaining economic distances for haulage of ore and waste rock and pumping of tailings slurry. Environmental concerns regarding the location of these facilities are addressed in Sections 4.1.5, 4.4, 4.5, 4.7 and 5.0.

Plate D1 shows the layout of project facilities.

4.1 Mining

4.1.1 Mining Method

The Yakabindie nickel deposit will be developed as an open pit mine using conventional large capacity diesel powered earth moving equipment (loaders, excavators, bulldozers, haul trucks). The pit will be developed as a series of cutbacks with initial predevelopment works directed at exposing the main sulphide orebody at a depth of about 70 metres. Oxidised and depleted ore from the surface to 70 metres depth will be separately stockpiled for possible future processing.

At this stage the ultimate pit is planned for a depth of 350 metres, though this may increase as the orebody is open at depth. A 200 metre buffer zone has been left between the presently planned final pit rim and any surface developments so that additional ore can be accessed by open pit development. The low grade nature of the orebody makes future underground mine developments unlikely.

Pending the finalisation of a geotechnical study, pit wall slopes have been designed at 45 degree overall, with a bench height of 15 metres.

Except for some preproduction excavation all mining will include drill and blast to achieve the required rock fragmentation.

Apart from the creek diversions which are detailed in Section 4.1.4, development of the pit will be via normal industry - wide open pit practices.

4.1.2 Mining Schedule

The pit will produce 6 million tonnes per annum of ore and approximately 25 million tonnes per annum of waste rock.

During the preproduction period contractors will carry out mine excavations with a gradual changeover to owner operations as production commences. Total preproduction is expected to be approximately 15 million tonnes.

4.1.3 Creek Diversions and Mine Facilities

During the preproduction period a bundwall and spillway diversion will be constructed on the eastern side of the pit to contain and divert runoff, in Jones Creek around the pit. Water behind the bundwall will drain through a channel cut to re-enter a tributary of Jones Creek a distance of some 200m downstream of the pit.

A tributary of Jones Creek on the western side of the pit will also require diversion. A bundwall will be constructed from waste rock during the mine life to ensure that flows in this creek do not enter the pit, a spillway cut is also planned for this tributary.

Design of the creek diversions and calculation sheets are presented in Appendix D1.

The design of the creek diversions has been based on a recent flood event (January 1990) at the site which has an average recurrence interval of more than 100 years (probability of occurrence in any year of less than 1%). Stream flows from this event are estimated to have reached $140m^3$/sec in both Jones Creek and the western tributary between the pit and proposed plant site.

4.1.4 Mining Equipment

The mine equipment fleet will comprise the following items:-

(i) 2 no. prime excavating appliances. These would be either rope shovels or large hydraulic excavators;

(ii) 9 no. 180 tonne rear dump off highway trucks rising to an eventual requirement of 18 units;

(iii) 1 no. large capacity wheel loader;

(iv) 3 no. bulldozers of varying capacity;

(v) 1 no. large road grader;

(vi) 1 no. blasthole drill;

(vii) 2 no. water trucks;

(viii) 2 no. fuel and lubrication service trucks;

(ix) 1 no. explosive trucks; and

(x) various light vehicles, pumps, lighting sets and other smaller ancillary equipment.

4.1.5 Waste Rock Dumps

Waste rock dump areas at Yakabindie are constrained as follows:-

(i) To the north by lease boundaries and the Wanjarri Nature Reserve (eastern waste dump).

(ii) To the north west and south west by topography.

(iii) To the south by Jones Creek and the David and Goliath orebodies, together with other prospective terrain.

(iv) Other constraining factors are the need for an appropriate plant site location, together with substantial tailings disposal areas.

The total dump capacity required for the current pit design is approximately 175 million cubic metres. Initially waste rock will be utilised to construct the creek diversion bundwalls and tailings dam embankments. Following this, waste rock will be trucked to the northern and eastern dump sites. The walls of the tailings dam will be raised by upstream construction methods using waste rock, with dumping of waste rock over the consolidated tailings towards the close of the mining operations.

The maximum design height of the waste dumps is currently 40 metres, constructed in 10 metre high lifts, with each lift having a 5m wide berm for rehabilitation purposes. Due consideration has been given to line of sight from the main road for design of the waste dumps. The final batters will be constructed to a 20 degree overall slope. Capacity of the eastern dump can be increased by further lifts.

The tailings storage areas will be eventually covered in waste rock with a 20 degree outslope facing Jones Creek and with a 100 metre buffer between the creek and the dump toe.

Water in waste dumps will be required for rehabilitation. Where seepage does occur, the toe drains will divert that water to the silt traps and sumps before any excess is discharged into existing drainage channels. A management plan for drainage, silt traps and sumps will be provided to the Mines Department prior to the commencement of construction for roads, waste dumps, plant site and tailings dam. Test work carried out to date on material from the orebody indicates that the potential acidic component of the leachate will be absorbed by waste rock. The waste rock contains high levels of carbonate which will absorb and neutralise potential acidic leachates from the waste dump. Further test work will be undertaken on the waste dump materials.

It should be noted that the eastern dump will be constructed such that drainage will be lead away from the Wanjarri Nature Reserve.

Full details of rehabilitation works are presented in Section 5.9 and a typical section of the rehabilitation works is given on Plate D15 in Appendix D1.

4.2 Ore Processing

4.2.1 Ore Processing General Description

Ore from the open pit is dumped into the Primary (Gyratory) Crusher, the product from which is conveyed onto the Coarse Ore Stockpile. Material from this stockpile is fed into a SAG Mill, where further size reduction takes place. Product from the SAG Mill flows via a trommel screen into a pump box and is then pumped over a Scalping Screen. Oversize from this screen is then fed back into the SAG Mill.

Undersize material is fed into the Ball Mills discharge sump which together with Ball Mill discharge is pumped to Hydrocyclone Classifiers. The underflow from the Hydrocyclones containing the relatively coarse particle fraction is recycled back into the Ball Mill. The overflow from the Hydrocyclone contain the fine particle fraction suitable for flotation. This material is fed into a Conditioning Tank, where various flotation reagents are added. Likely reagent consumptions are estimated to be:

(i)	Methyl Iso Butylcarbonol (MIBC)	0.5 tonnes/day
(ii)	Sodium Ethyl Xanthate (SEX)	12 tonnes/day
(iii)	Guar Gum Depressant	4 tonnes/day

The conditioned slurry is pumped into the Flotation Circuit from which a nickel rich concentrate is produced. This concentrate is pumped into a Thickener where a reagent which assists the separation of solids and liquids is added. This reagent is:

(iv)	Polyacrylamide (Flocculant)	20kg/day

The relatively clear thickener overflow is pumped to the Process Water Dam, where it is stored for reuse as process water in the plant. The thickener underflow is pumped into a High Pressure Filter for further separation of the solids and liquids. The filter cake is conveyed onto the Concentrate Storage Stockpile and the clean filtrate is pumped to the process water dam.

The waste tailings from the flotation circuit are pumped into a two Final Tailings Thickeners where a reagent which assists the settling of the solids is added. The reagent is:

(v) Polyacrylamide (Flocculant) 0.5 tonnes/day

The clear overflow from the thickener is pumped back into the process water dam. The underflow is pumped for disposal to the Tailings Dam.

The proposed Plant Layout is presented on Plate D2 in Appendix D1.

4.2.2 Dust Control

Dust suppression measures as required by the Mines Department Regulations will be enforced at both the mine and plant sites.

Clearing of sites will be staged, and kept to the minimum for essential use.

Haul roads and plant roads will be sheeted with local gravels and watered on a regular basis to suppress dust. Gravels utilised on these roads will be relatively durable, and free of fines to minimise dust levels and roads will be maintained on a regular basis. Water used for dust suppression will be of low salinity when available. It always. is anticipated water recovered from pit dewatering will be used for this purpose.

Trials will be carried out with dust suppressant materials (enzymes) mixed with water to minimise water use on roads and assist with dust suppression.

4.2.3 Chemical Handling and Storage

All reagents to be used in the processing operations will be transported, stored and handled in accordance with the regulations of the Mines Department and Health Department. Copies of the relevant product information and correspondence from the above Departments is included in Appendix D1.

Explosives will also be transported and stored in accordance with the Mines Department regulations.

Fuels will be stored in tanks fitted with excess flow valves and bunds will be constructed around the tanks to contain spillage. These bunds will be of a sufficient size to contain the whole volume of the stored mateials in accordance with government requirements and industry standards.

4.3 Concentrate Handling

After processing, the concentrate will be conveyed to a concentrate storage stockpile, which is located within a covered storage shed.

The concentrate will be loaded into purpose built containers at the time of transport from the site, by front end loaders.

These containers are approximately 2m deep, and will be covered with tarpaulins prior to leaving the shed for transport to the Port of export.

At the Port the containers will be removed from the transport vehicles and emptied into another covered storage shed. A conveyor will be utilised at the time of shipment to load the concentrate from the storage shed and into ship holds.

4.4 Tailings Dam

4.4.1 Location

The tailings dam is located approximately 300m south of the proposed plant site. Embankments of the tailings dam partially enclose a system of valleys within the granite outcrops to the south west of the pit. The main embankment runs parallel to Jones Creek in a north south direction.

4.4.2 Dimensions

The tailings dam has a storage capacity of approximately 80 x 10^6 m^3 with a predicted storage life of 15 years. The maximum height of the dam walls will be 39m with the top level of the dam being RL 555, the area occupied by the dam is approximately 310 hectares.

4.4.3 Design Details

Details of the design of this structure are presented in Appendix D2.

The layout of the tailings dam is shown on drawing number W1292-00/C-002, in Appendix D2 with sections of the wall construction shown on drawing numbers W1292-00/C-003APB. Details of the decant systems and underdrainage system are shown on drawings W1292-00/C-004 and W1292-00/C-005 respectively.

The objectives of the tailings dam design are to:

(i) Minimize environmental impact of the tailings disposal;

(ii) Maximise water return from the deposited tailings;

(iii) Maximise storage capacity of the tailings dam by depositing tailings in a manner to achieve high density tailings;

(iv) Allow staged embankment construction utilising mine waste;

(v) Limit seepage losses by utilising an upstream toe drain and by constructing relatively low permeability embankments with downstream catch drain;

(vi) Contain return water line spillages within the downstream catch drain system;

(vii) Contain tailings line spillages within the dam area and associated catch drain systems; and

(viii) Allow the tailings dam to function with minimal daily input, while maintaining the stability of the structure and maximising water return.

The tailings dam system incorporates the following features to achieve objectives listed above:

(i) Containment walls to be constructed of waste rock with a final overall slope of 20°, and berms at 10m vertical spacing using upstream construction. The tailings dam has a minimum factor of safety against slope stability failure of 1.9. The usual factor of safety required for these structures is 1.5;

(ii) Decant arrangements to collect supernatant water to return to the plant for use in ore processing;

(iii) Underdrainage to increase water return and minimise seepage as consolidation of tailings takes place;

(iv) Downstream toe drain to collect and contain any spillage; and

(v) Monitoring boreholes to monitor groundwater quality adjacent to the tailings dam.

4.4.4 Construction Methods

A starter embankment will be constructed from waste rock from the mining operations. As the tailings rises within the dam the embankment will be raised by upstream construction methods using waste rock.

Details of the construction method are given in the tailings dam construction manual in Appendix D.

4.4.5 Tailings Dam Operation

The tailings dam will be operated in accordance with strict operational procedures, as outlined in the operations manual presented in Appendix D. It should be noted that maximum water return is required from the tailings dam as an integral part of ore processing requirements. It is therefore not in the interest of the project to neglect the proper management of this structure.

Tailings will be deposited sub-aerially and spirally from numerous spigots around the embankment of the dam, with discharge being controlled to ensure uniform velocity from adjacent spigots. Spigots will be changed at regular intervals to adjacent spigots to ensure tailings are placed in discrete layers. To maximise the storage capacity of the dam, the drying time of the tailings will be maximised between successive depositions.

Supernatant water will be recovered from the dam and returned to the process plant via the decant system. To maximise water recoveries the ponds around the decants will be kept as small as possible.

Daily inspections of all tailings lines and water return lines and embankments will be undertaken.

A minimum of 0.5m free board must be maintained to accommodate storm events in excess of the 1 in 100 year event.

4.4.6 Tailings Properties

The following tailings properties are known at present, further testing is being undertaken.

- Salinity of Process Water 15,000 - 30,000 ppm TDS.
- Salinity of Tailings Return Water expected to be similar (15,000 - 30,000 ppm TDS).
- pH of Slurry ex plant 8.5 to 9.5.
- pH of Tailings return water 8.0 to 9.0.
- Heavy minerals

Ni	0.188%
Fe	4.17%
Cu	194 ppm
Pb	10 ppm
Zn	29 ppm
Cd	<1 ppm
As	<100 ppm
Se	0.2 ppm
Te	<0.1 ppm
Ag	<0.005 ppm
S total	0.489%
S as Sulphide	0.416%
MgO	39.1%

Preliminary results of acid neutralisation performance are given in on Plate D16 in Appendix D2.

4.4.7 Monitoring of Seepage

The geological conditions beneath the dam generally comprising fresh granite with tight joints, and seepage is unlikely to be at a level which will impact on the enviroment. Nevertheless groundwater monitoring will be carried out on a weekly basis, with the design of the dam including the installation of boreholes (drawing number W1292 -00/C-002 Appendix D2) into the natural groundwater table for water level and water quality monitoring. Results of this monitoring would be provided to the Mines Department. In the event that water quality changes occur, a recovery bore or seepage trench system will be installed, alternative tailings disposed techniques may be adopted, and an alternative tailings disposal site may be considered.

4.4.8 Tailings Dam Rehabilitation

The tailings dam embankments will be progressively rehabilitated along with the waste dumps. Details of the rehabilitation works are set out in Section 5.9.

4.5 Support Facilities

Plate D1 of Appendix D shows the location of all facilities associated with the project.

Details of the proposed layout of offices, workshops and power generation facilities are shown on Plate D2 in Appendix D1.

The proponents have examined the potential for sharing facilities with the Mt. Keith Project and the study team acknowledges that there are perceived advantages to the community and to the various proponents in the sharing of certain infrastructure needs between the Yakabindie and Mt. Keith Projects. However, it must be borne in mind that the nature of the business of winning, processing and selling

nickel concentrate is highly competitive and totally dependent on market forces. These market forces may dictate the slowdown or closure of one or both mines or possibly the delay in commencement of activity.

Given these uncertain conditions, it is unrealistic to plan or to demand that both projects locate their township, power station and airstrip at some mid-point between the mine sites. Further, the Mt. Keith Project may have the advantage over the Yakabindie Project due to starting operations some five months earlier and having infrastructure located to suit its needs.

It is however, also unlikely that the Mt. Keith Project would invest in a large power plant to cater for the Yakabindie Project without a definite commitment from the proponents of the Yakabindie Project. There would also be a considerable economic cost to the Yakabindie Project in funding power and water supply lines from the Mt. Keith Project to the Yakabindie Site, as well as the costs associated with transporting the workforce to and from the site for day to day operations, not to mention the possible human cost in the event of emergencies.

Sharing of support facilities at this stage is impractical and will add considerable cost to the project.

4.5.1 Plant Site Support Facilities

The site office will need to accommodate some twenty people including mine management, administrative and clerical personnel. There will be a laboratory, workshop, warehouse, amenities block and car park on the main plant site along with security and first aid facilities.

Outside communication to the plant and village will be provided by Telecom and on site radio communication will be established.

4.5.2 Power Generation

Power will be provided by an independent power station (see Plate D2 in Appendix D1) located close to the plant (being the main load), and distributed to the process water borefield to the south and the village to the west. This power station will comprise 7 no. 7.5 MW diesel generators and will have a total capacity of 52 MW. At any one time 5 generators will be required to meet the needs of the project, leaving 2 generators for maintenance and emergencies.

A small emergency generator will be provided in the village to service the coolstore should the main power station be shut down.

Fuel for the generators will be stored in raised tanks fitted with excess flow valves and bunds will be constructed around the tanks to contain spillage. These bunds will be of a sufficient size to contain the whole volume of the stored materials in accordance with government requirements and industry standards.

Seven road trains per day will be required to supply fuel to the project.

Discussions are also in progress with a private consortium who propose to link the SECWA grid to the Yakabindie/Mt. Keith area.

SECWA was approached by Dominion, Australian Consolidated Minerals and Western Mining Corporation in 1989 to review the possibility of it providing grid power to the area, however this has proved too expensive and with too long a lead time for any of the main users.

4.5.3 Accommodation Facilities

Plates D17 to D21 shows the layout of the village facilities. These Plates are located in Appendix D3.

The proposed accommodation facilities are based on 10-12 pre-fabricated and site assembled houses for senior staff and families living permanently on site and nearby, a single persons' camp comprising some sixty, 4 person motel type units, clustered around a central recreation and messing facility. The sewage treatment plant for the village has a hydraulic capacity of 70,000 litres/day and comprises a main process unit, sludge bed, tablet chlorinator, and polishing pond from where waste water will evaporate. Details of this plant are attached in Appendix D.

A construction camp will be established on an area to the the south of the existing exploration camp.

4.5.4 Airstrip Facilities

A 1400m all weather airstrip is proposed, adjacent to the accommodation area. This airstrip will be designed suitable for upgrading to night operations, if required at a later stage, and equipped with a radio beacon for navigational purposes. The proposed airstrip will comprise a single runway and taxiing/parking area sheeted with local gravels. It is not proposed to seal the surface at this stage.

It is anticipated that some 80 personnel will be transported to and from the project each week involving 8 return flights. Additional flights are also anticipated for various visitors to the project.

There are also logistic and economic advantages in restricting the travel time for the fly in/fly out movement of staff over the life of the mine compared with, say, sharing an airstrip with Mt. Keith some 35km north of the Yakabindie deposit.

The safety advantages of having an airstrip close to the mine site must be highlighted, and in addition general aviation safety will be increased by having two additional airstrips in an area of intense localised rainstorms.

4.6 Workforce

The total planned workforce comprises 260 people.

Estimates of numbers of personnel involved in the project are shown on Plates D23 and D24 in Appendix D4.

A summary of the main categories of work and the numbers of personnel involved are detailed below:

• Mining	150
• Plant	85
• Administration	25

	260
	===

Fly in/fly out is proposed for non-senior staff ie. some 240 - 250 personnel at approximately 80 movements per week via the airstrip to Geraldton (mainly) and Perth - depending on the available labour pool in Geraldton.

The current restriction for continuous work on this site is 13 days and a special exemption would be requested from the Department of Mines to extend this to a 14 day cycle for fly in/fly out personnel only.

4.7 Transportation Corridors

4.7.1 Road Access

The proposed road access to the Yakabindie Project for traffic is via the main Leinster - Wiluna Road approximately 60kms north of Leinster, then onto a private road, for a distance of 5kms to the Mine Site.

The Leinster to Wiluna Road is unsealed, but classified by the Department of Main Roads as a Main Road under their care and protection. The road is sealed south of Leinster.

Access from the main road to the mine site will be via a private road which would be built, maintained and controlled by Dominion. The location of this road will be determined during the feasibility study.

Private access roads will also be constructed, maintained and controlled by Dominion in the accommodation area.

4.7.2 Shipment of Concentrates

At this stage two main options are open, and discussions with the Main Roads Department and Westrail are underway.

These options are:

(i) North through Wiluna to Meekatharra on unsealed main road, then south and west on sealed highway to Geraldton;

(ii) South on the main road to the railhead at Leonora for rail transportation to the Port of Esperance;

Transport by haulage operators on other routes may occur on an ad hoc basis.

tonnages? No trucks?

4.7.3 Power Transmission Corridors

Power will be generated at the main plant site and carried to the accommodation areas and borefields via transmission lines.

The location of these transmission lines are shown on Plate D22 in Appendix D3. Transmission lines will be supported by a system of poles and towers along a 7m wide cleared corridor which will also incorporate the water supply pipeline and an access road.

The possibility exists for grid power distribution. However, these negotiations are still in progress and the delivery of this power is beyond the scope of this project.

4.7.4 Water Supply Lines

Borefields for the project are located some 30kms to the south of the plant site.

The water supply line route is shown on Plate D22 in Appendix D3 and comprises an above ground pipeline, overhead powerline and gravel surfaced access road.

The disruption of overland water flow will be minimised by placing the road surface onto the same level as the existing ground and where the pipeline is laid on the ground surface such that surface drainage is disrupted a section of pipeline shall be raised as appropriate to the topography and at least every 50m to permit free passage of run-off.

Daily daily inspections and maintenance (as required) of pipelines will be carried out to minimise the risk of pipeline failure. A series of one way valves will be placed in the pipeline at strategic locations to limit draining of pipes in the event of pipeline failure or maintenance needs.

The water quality and quantity from the borefields will be monitored and in the event of a burst pipeline borefield pumps would be automatically shut down.

4.8 Resource Requirements

At this stage no other resources are required for the project.

Gravel / construction mat. ? ensure it comes from - from cleared areas.

4.9 Housing and Accommodation

4.9.1 Operational Workforce

The housing and accommodation facilities comprise 10-12 prefabricated houses for senior staff and families permanently living on site, and a single persons village comprising 60, 4 person motel type units clustered around a central recreation and messing facility. Each person will have private shower and toilet facilities.

The village will be provided with facilities for swimming and active recreation along with barbecue and entertainment areas. It is proposed that basic stores will be available at the village augmented by shopping and school facilities at Leinster. The number of private vehicles on site will be minimised due to the proposed fly in/fly out nature of the workforce.

The proposed layout of the village is shown on Plate D17 with the proposed layout of the housing shown on Plate D20 in Appendix D3.

4.9.2 Construction Workforce

A construction camp will be established on an area to the the south of the existing exploration camp, which will form part of the east waste dump at a later date.

Peak construction workforces is expected to be 220. The construction camp will be occupied for a period of approximately 12 months.

Education/ conduct of construction force

5.0 ENVIRONMENTAL IMPACT AND MANAGEMENT

Dominion recognise the development of this project will impact on the environment, and the various facets of the proposed development have been planned to minimise this impact.

Dominion proposes to appoint an environmental officer who will have the following responsibilities:-

(i) design and implementation of the rehabilitation programmes including research activities associated with the rehabilitation fauna monitoring and feral animal eradication programmes within the project area as required;

(ii) environmental impact assessment and monitoring (air, and water quality, noise and dust control);

(iii) act as an honorary warden for the Wanjarri Nature Reserve and set up an education programme for all project employees during induction for the protection of the Wanjarri Nature Reserve;

(iv) liaise with Government Departments as required, in relation to environmental matters; and

(v) seek advice of specialist consultants on an as required basis.

It is understood that CALM are proposing a joint Management Liaison Committee for Wanjarri, with representatives from CALM, DOMWA, EPA, Dominion and Mt. Keith. Dominions representative on this proposed committee would be the Environmental Officer. It is envisaged that

such a committee may need to meet on a monthly basis at or near Wanjarri, and Dominion would be willing to provide facilities for these meetings at their administration centre on the project site.

5.1 Water

5.1.1 Surface Water

The proposed project will involve the disruption of natural drainage channels in several areas.

Diversions to Jones Creek and its western tributary will be constructed to divert drainage away from the proposed open cut pit. Drainage from the catchment area upstream of the waste dumps will be blocked, however only to a minor extent. Drainage from the catchment area in which the tailings dam is to be built will be recovered by the decant system and utilised in mineral processing.

The impact of the diversion of the creek systems will not be significant since the proposed diversions have been designed to match the gradient within the existing channel, ensuring that velocities during peak flows in the diversions are for all practical purposes the same as would occur in the natural channel. This will ensure the equilibrium of the stream systems within the diversion is similar to the natural drainage system, as far as possible. The downstream end of the diversions have been widened, and a stilling basin will be constructed. Causeways will also be constructed to allow the proposed haul roads to cross the creeks. These causeways are designed such that they will not present a significant barrier to stream flow during floods, and it is accepted that this causeway and stilling basin will require maintenance following flooding for the life of the project. after ?

The impact of placing waste dumps over drainage lines will be small since the proposed waste dumps will occupy the majority of the catchment area of the effected drainage lines. The catchment areas affected represent very small proportions (approximate total 3.0% - northern waste dump) of the overall upstream catchment of the Jones Creek system, and (less than 1.0% - eastern waste dump) of the overall upstream catchment of the Lake Miranda drainage system. Therefore these dumps and the disruption to drainage will have little impact on downstream users. Management practices for the waste dumps are outlined in Section 5.9.

The impact of collecting rainfall run-off within the tailings dam from the catchment upstream of the tailings dam will also be small since the area of the tailings dam and catchment is a very small proportion (approximately 4.0%) of the overall upstream catchment of the Jones Creek system, and therefore will have little impact on downstream users. Management practices for the tailings dam are outlined in Section 4.9.

5.1.2 Groundwater

Details of the project requirements and sources to be used are set out in Section 3.3.2.

A process water dam will be constructed in the plant area to accommodate water from the borefields, pit dewatering and tailings dam return water. A groundwater management programme will be adopted to balance the project requirements from the borefields with the quantities of water recovered from the tailings dam and the mine dewatering. Where possible, make-up water from the borefields will be reduced.

5.1.2.1 Effects of Borefield Operation

The water level drawdown resulting from borefield operation has been modelled where possible using aquifer parameters calculated from pumping tests in the present system.

Simulation was effected with the programme MODFLOW (McDonald and Harbaugh, 1984).

The grid size was 1km x 1km and the area covered was 15km x 18km.

Twenty-two bores in Areas 1 and 2 (Figure 3) were assigned the average pumping rate of 490 cu m/d, giving a total production of 10,800 cu m/d. A pumping period of two years was adopted, to indicate the long-term effects. Beyond that time, the system is expected to reach more or less steady state, by the adjustment of recharge and evapotranspiration rates. Annual recharge (to the aquifer system was assigned the value 18mm per year over the borefield area; this is a reasonably conservative value considering the average annual rainfall of 207mm and the fact that much of the area is low-lying and carries ponded surface water after rainy periods. Significant recharge was indicated by rises in groundwater level of about 0.5m, following heavy rainfall in January - February 1990.

Contours of model-calculated water-table drawdown are presented in Figure 3. They show the following features:-

(i) Generally, the drawdowns in the area containing the borefield are between 2m and 6m. The largest drawdown is 7m, in one of the cells containing a production bore.

(ii) Because the productive aquifer is an alluvial channel deposit surrounded by material of low permeability, the drawdown will extend very little distance from the channel itself.

(iii) The existing bores/wells that might be affected by drawdown are listed below, with estimate of drawdown values.

Townsend Well	1.9m
Bellevue Borefield	0.02m
Paddy's Knob Bore	1.6m
Miranda Well	0.04m

The values are approximate, and will be modified by seasonal effects, especially rainfall. They indicate that only Townsend Well and Paddy's Knob bore are likely to be affected by significant drawdown of this scale. mitigated

5.1.2.2 Groundwater Quality

As described in Section 3.3.2.2, the stock wells in the east-west drainage draw from a thin layer of brackish groundwater overlying saline groundwater. It is possible, but not expected, that pumping from the Yakabindie Project Borefield will cause a depletion of the freshwater at Miranda Paddy's Knob, Townsend and Henry Wells. These water points will be sampled regularly during operation of the borefield, to check for any such salinity increase.

The water produced from Area 1 of the Yakabindie Project borefield is expected to have a salinity of about 20,000 mg/l TDS. That from Area 2 will be more saline, probably in the range 20,000 to 80,000 mg/l. Because water might be drawn from aquifers beneath Lake Miranda, there is a possibility that salinities may rise in the long term. Any such effects will need to be monitored.

5.1.2.3 Other Borefields

The closest major borefield, supplying the Bellevue Mine, is 4km from the nearest bore proposed for the Yakabindie Project. It is in a separate alluvial channel to the latter, although the aquifers are likely to be connected hydraulically. Simulation has indicated that there will be negligible drawdown interference (0.02m) caused by the proposed pumping. This prediction would be firmed-up after the testing of Area 2, and checked by monitoring during borefield operation.

The largest user of groundwater in the area is expected to be the Mt. Keith Project, whose demand is said to be up to 17 x 10^6 cu m/yr. Three borefields have been proposed (Figure 2), the closest two being 12kms to the north and 17kms to the north-west of the Yakabindie lease area. In addition to lying at large distances, the Mt. Keith borefields are separated from the present borefield by bedrock ranges and surface-water divides. There is no possibility of drawdown interference.

5.1.2.4 Mine Dewatering

The mine at Six Mile Prospect is designed to be open-cut, and extend to 350m depth. There is local groundwater contained in fractured mafic and ultramafic rock, at least in the upper levels to about 80m depth.

Dewatering operations will be needed to control groundwater for mine workability and pit-wall stability. They will entail either borehole or in-pit pumping (or both) depending on the aquifer geometry and the scale of water inflows.

The lowering of water levels at the mine will create a local cone of depression in water levels in the adjacent bedrock. This is not seen to be a significant environmental issue because:

(i) local aquifers are relatively small and low-yielding, being restricted to shear zones within the crystalline bedrock, in this regard it has been noted that no artesian flows have been recorded in the area.

(ii) the bedrock has low bulk permeability, therefore the cone of depression will be steep-sided and localised. Unless a major permeable shear zone is discovered in the vicinity of the mine, it is not likely that drawdown effects would extend beyond one or two kilometres along strike, and to much smaller distances across strike.

(iii) the only well that will be affected is Six Mile Well, which will become redundant because of the mining operations. Replaced

All water recovered from dewatering will be used for project needs.

In the event that the volume of water recovered from the mine dewatering is greater than anticipated, the quantities of make-up water pumped for the borefields will be reduced.

5.2 Flora and Fauna

The principle impacts from the construction of the proposed developments will be the loss of vegetated area, reduction in area of breakaway habitat and the impositions on the Jones Creek drainage system. The area loss from the developments (approximately 990 ha) is insignificant (less than 0.1%) in comparison to the ecological landform units represented. The area is already of a degraded nature due to historical pastoral practices.

The Jones Creek drainage system is the only ecological unit which may undergo significant alteration from the proposed developments due to siltation and leaching from waste dumps.

Siltation is expected to be minimal since the environmental management plan for the project calls for the construction of silt traps down stream of the waste dumps, tailings dams and on all road drainage. The arid climate of the region and the low sulphide content combined with the relatively high carbonate content of the waste rock are such that the potential for adverse leachate from the waste dumps will be minimal. Seepage from the tailings dam is expected to be minimal being limited by the installation of decants and an upstream toe drain within the dam. The geological conditions beneath the dam are unfavourable for seepage, generally comprising fresh granite, with tight joints. Nevertheless groundwater monitoring would be carried out on a regular basis. In the event that water quality changes occur, a recovery bore or seepage trench system will be installed, alternative tailings disposal techniques may be adopted, and an alternative tailings disposal site may be considered.

Long term tailings seepage management?

Pit Area - all vegetation will be cleared from the pit area. Reduction in size of pit to minimum essential will minimise impact to the undulating plain greenstone Acacia woodland in this area. Major impact will occur locally to the Jones Creek drainage system involving the removal of approximately 3km of the main creek bed and 4-5km of the western tributaries. The Jones Creek bundwall and spillway diversion will cut through adjacent laterite plain with low open Acacia woodland. Open pit mining requires total removal of surface features, however, the impacts are deemed not significant for these widely distributed vegetation associations. Modification to the Jones Creek while extreme over a short distance is of significance only at the local level. No fauna species will be adversely affected by this development. Only a single plant species, Grevillea inconspicua, currently on the CALM reserve "rare and endangered" list may be affected by the pit and creek diversion. This species was reported by CALM Herbarium officers to occur on the south eastern edge of the pit approximately 100m south of Six Mile Well. Despite an intensive survey of the location the species was not found.

Tailings Dam - This area encompasses low open Acacia woodland on the lower slopes of granite hills and undulating granite plain. Vegetation will be removed from the embankment area while left in situ within the impoundment area allowing progressive relocation of fauna as material accumulates. With decommissioning the impoundment will be rehabilitated. Impact of this development is limited to an abundant habitat with no flora or fauna of significance being adversely affected.

Waste Dumps and Plant Site - two waste dumps will be constructed, a northern and eastern:

(a) the eastern dump will involve the removal of low open Acacia woodland and the interruption of some minor drainage lines. No significant impact will occur other than the removal of local vegetation. A consideration regarding the location of the dump is the close proximity to Wanjarri Nature Reserve. Potential impacts to the reserve include dust, leaching and erosional run-off. It is widely recognised that erosional run-off material has a drastic adverse effect on adjacent native vegetation. Construction design, rehabilitation and management outlined in Section 5.9 will maintain the integrity of the reserve.

(b) northern waste dump and plant site - these two development sites will impinge upon an area of breakaway habitat for approximately 1.5km. Degradation to this habitat will occur on a local scale and may impact the only known population of the Little Cave Eptesicus (bat) Eptesicus pumilus within the project area. However this will not affect the status of this common widespread species regionally. The shrub Eremophila 'pungens' with uncertain conservation status, occurs on these sites and will be reduced in local population size. Removal of the chenopod shrubland will not significantly affect any other flora or fauna.

erosion potential ?

Support facilities - the campsite and airstrip are situated within a severely degraded low shrubland. Past intensive grazing has reduced the vegetation to predominately unpalatable Eremophila species with little or no understorey. No flora or fauna of significance occurs in this area and it is considered the developments will make little impact to the environment other than local vegetation removal. Development of an extensive vegetation community surrounding the village may actually enhance the attractiveness of the area for the fauna, particularly birds. The re-introduction and establishment of local native flora will be carried out with planting in the village co-ordinated by the Environmental Officer.

The impact on the fauna is generally secondary. There will be major local impacts initially with destruction of habitat and relocation of mobile species into adjacent habitats. Impacts will minimised by staging clearing, and limiting clearing to absolute essential minimum, fencing off dangerous areas and limiting road and track development. Some bird mortality may occur during the project life as a result of birds gaining access to open water surfaces on the tailings dam.

No specific measures can be undertaken to minimise the impact on avian fauna due to low population densities and the large size of the project area. The saline nature of the tailings dam will deter the presence of most species.

Increased traffic may cause localised death of larger mobile species, predominately kangaroos and monitor lizards.

A fauna monitoring programme for the project area will be devised in consultation with CALM. The programme will be centred on biannual sampling permanent monitoring quadrates which will contain trapping grids of pit/drift fence and Elliott box traps, bird observation grids and opportunistic collecting sites. Data collected will be both qualitative and quantitative analysis of species presence and habitat utilisation patterns. Monitoring quadrates will be located throughout the project area within all major landform habitat types and adjacent to impact areas. why?

The only factors which may impact the biota of Wanjarri Nature Reserve are dust and increased visitation by the public. The subsequent localised impact on adjacent vegetation within the reserve through excessive dust will be minimised by methods detailed in Section 5.5. Employee education programmes and liaison with CALM will reduce the potential for adverse impacts associated with any increased visitation to the reserve (Section 6.3.2). No other environmental impacts are perceived to impinge upon the integrity of the reserve.

Dominion will construct an alternative access route to the Wanjarri Nature Reserve away from the project area. The fly in, fly out nature of the project will minimise the mobility ot the workforce.

5.3 Waste Products

5.3.1 Domestic Waste

At this stage it is proposed to bury all domestic wastes on the project site within the waste dumps.

5.3.2 Sewage

A sewage treatment plant installed at the village. Liquid effluent from this treatment plant is piped to the polishing pond via a chlorination unit, and from there will evaporate. Solid effluents will be transferred to the sludge drying area, from where it would be collected for use in vegetation planting or rehabilitation work.

Sewage disposal from the houses occupied by the senior staff and from the mine administration offices will be by septic tank and leach drain and will conform to the appropriate standards of the Leonora Shire.

Sewage disposal from the construction camp will also be by septic tank and leach drain and will conform to the appropriate standards of the Leonora Shire.

5.3.3 Waste Dumps

Waste dumps have been planned to blend as far as possible into the existing topography. They have been located and planned such that the visual impact is minimal from the main road.

Slopes of the waste dumps will not exceed 20° and fresher rock will be used on the outside slopes to minimise wind and water erosion.

Contour drains leading to silt traps will be constructed downstream of the dumps, parallel to the contours to collect any fines which may be washed out of the dumps (A management plan for drainage, silt traps and sumps will be provided to the Mines Department prior to the commencement of construction for the waste dumps). The tops of the dumps will be sloped towards the centre of the dump to retain moisture within the soil for plant growth, during rehabilitation.

Rehabilitation of the waste dumps will be carried out progressively as material is being placed onto the dumps. Details of this rehabilitation are set out in Section 5.9.

5.3.4 Tailings Dam

The tailings dam has been designed to maximise water return and maximise tailings density within the storage area. In order to achieve this objective the ponds around decant structures will be kept as small as practically possible.

Water recovered from the decant and upstream toe drainage system will be returned to the plant for reuse in processing.

The tailings dam design calls for the installation of downstream monitoring boreholes (drawing number W1292-00/C-002 Appendix D2), and the groundwater level and groundwater quality from these boreholes will be checked on a weekly basis, with results provided to the Mines Department.

The tailings dam will be constructed from waste rock using upstream construction methods. It is planned that as the height of the tailings dam is increased, waste rock will be dumped against the downstream face for contouring and rehabilitation in the same method as for the waste dumps. Slopes will not exceed 20°, and fresher rock will be used on the outside slopes for erosion protection.

The downstream toe drains and associated bund will act as contour drains for any fine materials washed from within these embankments. Excess water within this drainage system will drain to silt traps, and then into the return water sump.

This downstream toe drain and associated bund will also contain any spills from the return water line since this line will be located upstream of this structure. The water return line will be fitted with pressure transducers for automatic shut off and one way valves to limit drainage of this line in the event of pipe breakages.

The tailings line will be located on the elevated upstream edge of the crest to ensure that spillage from tailings line breakages flow into the dam.

Closer to the plant a bund will be constructed which connects to this downstream toe drain system ensuring that pipeline breakages between the plant and tailings dam are contained within this system.

Utilising the method of tailings deposition as proposed in the tailings dam operations manual, will ensure that at the completion of the mining operations, the surface of the tailings will have a gentle slope towards the decant structures. This surface will then be covered with a layer of waste rock. The decant systems will be left open to ensure that water cannot pond on the tailings surface and is drained away. No long term maintenance will be required for the decant system since the internal risers will be supported by gravel which is placed in the annulus between the internal riser and the external concrete pipe. The tailings will gradually drain with time to an increasingly more stable material. Any toxic leachates from the tailings will be either directed into the abandoned open pit, or neutralized by passive methods such as carbonate rock filters. Test work on the toxicity of the tailings is currently being carried out, and the results of these tests will determine the method of leachate disposal. Preliminary results are provided on Plate D16 in Appendix D2.

Rehabilitation of the tailings dam embankment will be carried out progressively as the tailings dam wall is raised and waste rock is placed and contoured. Details of this rehabilitation are set out in Section 5.9.

5.3.5 Waste Oils and Greases

Waste oils will be combined with fuel for the power station. Waste grease will be collected and transported off site for recycling.

5.4 Hazardous Substances

Hazardous substances comprise the following materials which will be packed and marked for transport with UN specifications:

(i) Xanthates (SEX/SIBX/PAX - UN No. 2813 HAZCHEM 4WE Hazard; 4.3 Dangerous when wet and 6.1.A poisonous (Toxic));

(ii) Frothers;

(iii) Explosives;

(iv) Diesel Fuel.

The chemicals listed in (i) and (ii) above will be utilised in the processing operations and will be discharged with the tailings slurry into the tailings dam where they will constitute less than 0.1% of the total materials deposited in the dam.

These materials will be transported, stored and handled in accordance with the regulations as laid down by the Mines Department and Department of Health and Safety.

5.5 Dust

The close proximity of the project site to Wanjarri Nature Reserve and the predominant east west wind patterns, dictates the control of dust generation in order to protect the integrity of the reserve. The duration of potential dust generation from the waste dumps will be minimised under the progressive rehabilitation strategy outlined in Section 5.9.1, whereby topsoil, where available, is spread over the terraces and revegetated progressively as the waste dumps rise.

During construction, contractors will be controlled to ensure dust is minimised and all appropriate regulation and dust suppression measures will be enforced, including restrictions on access and site travel to ensure minimal disturbance to areas which will not form part of the project.

It is proposed to commence dumping from the outside of the waste dumps, building each terrace to full height before dumping in the centre of the terrace. This will limit dust movement since the same dump face will always be exposed to the area outside the dump, and rehabilitation can be commenced whilst the infill dumping is undertaken.

Normal dust suppression measures - damping down, will be enforced at the mine and processing plant as required by Mines Department and Occupational Health and Safety and Regulations during operation and construction of the project respectively.

5.5.1 Tailings Dam

The tailings disposal site is unlikely to generate dust since the tailings are deposited wet around the perimeter of the storage spreading across previously deposited tailings. The tailings discharge points are changed on a regular basis ensuring that the tailings storage will remain wet through the life of the mining operations. On completion of mining the tailings area will be covered by competent waste rock, thereby protecting the finished tailings surface from wind erosion.

Embankments will also be constructed of waste rock to prevent the formation of dust during mining and after mining ceases.

5.5.2 Waste Dumps

Slopes of waste dumps will be covered by waste rock to prevent wind erosion.

The upper surfaces of the waste dumps will be subjected to a ripping programme at the end of the operational life of each level. This ripping will break up the normal traffic compacted surface which allows fines to accumulate during operational life and brings rock materials to the surface, aiding moisture infiltration, which will carry fines into the waste dumps. Ripping also assists with rehabilitation requirements as set out in Section 5.9.

5.6 Noise

All mining and processing operations will be subject to compliance with various Government Acts and Regulations covering noise. To minimise blast noise impact, blasting where possible will be scheduled during optimal meteorological conditions.

Process plant noise levels will generally not exceed 85db with the exception of the crusher and mills where noise levels will exceed 85db and ear protection will be mandatory. Cabin noise on mobile equipment will also be restricted to below 85db.

There will be a temporary localised impact on faunal populations and distribution, as shown from studies of other mining sites.

The only fauna which will respond to noise are large mobile species such as macropods and birds. The result of localised noise would be the avoidance of the noise origin area. This behaviour would be beneficial to the fauna by avoiding potentially hazardous areas. Monitoring fauna response to noise is confounded by other factors such as habitat disturbance, mining activities and continual human presence. It is considered that no significant impact will occur to the biota through noise.

The accommodation sites are located approximately 3 to 4kms to the south west of the mining activities. This site is also separated by a range of hills which are up to 50 metres above the general ground level at the accommodation site. Given the location of the site, and the prevailing wind directions the volume of noise generated by the project is unlikely to be significant outside the immediate vicinity of the mining operations, and particularly at the accommodation site. Intermittent noise can be expected at the accommodation site from aircraft movements and blasting operations at the mine site.

5.7 Infrastructure

5.7.1 Power Supply

The proposed power transmission routes are provided on Plate D22 in Appendix D3.

Power generation will be carried out at the plant site.

The powerline to the camp will follow the main access road towards the Leinster Wiluna Road, and then to the village.

The powerline to the borefields will follow the waterline from the borefields, together with a service road, to minimise clearing requirements.

Both powerlines will cross land which is used for pastoral activities, and the impact on these activities will be negligible.

5.7.2 Accommodation Facilities

Impact from the accommodation facilities will generally be limited to the immediate vicinity around the camp due to the nature of the proposed fly in/fly out operation, which will restrict the number of private vehicles on the site, thus limiting the mobility of the workforce. The fly in/fly out operation also restricts the number of hours available to pursue leisure activities, since on completion of the rostered number of shifts workers will be transported out of the area for leisure activities. Recreational activities such as off road driving, hunting by employees etc will not be permitted and the keeping of domestic animals (dogs, cats, etc) will also be prohibited.

5.7.3 Airstrip

The presence of the airstrip will result in intermittent noise level in its immediate vicinity.

Routine aircraft movements, comprise 8 flights in and 8 flights out per week and additional movements are expected.

Given that the airstrip may have a maximum of 4 flights per day, and that the duration of the noise during aircraft movements is short, the impact of intermittent noise from this source is unlikely to be significant.

5.7.4 Sharing of Infrastructure Facilities

The reader is referred to Section 4.5 of this document which addresses in detail the consideration given to sharing of facilities with the Mt. Keith Project.

In addition to the increased capital costs in some areas and logistic problems associated with the sharing of facilities there are a number of environmental impacts which need to be considered.

These are outlined as follows:

(i) In addition to the area to be disturbed by the project, further disturbance would be required to create a power supply corridor and associated maintenance track between the two projects.

This corridor would be significant to accommodate a transmission line of sufficient capacity to keep both projects operational.

(ii) It is unlikely that either party would agree to establish accommodation and airstrip facilities adjacent to one or the other project. If one of the projects were not viable at a later date, the other may be left with a distinct logistics disadvantage. In the event a compromise was reached to establish joint facilities, it is likely that these facilities would be established at some mid-point between the projects. This would result in the impacts of the projects being felt in another (third) location. Additional roads, power and water line corridors would have to be constructed for a new camp location.

The environmental impacts on this new area will be more significant than the impacts on the proposed small area adjacent to the project sites, which is at present degraded pastoral land.

(iii) The safety advantages of having an airstrip close to the mine site must also be highlighted.

5.8 Adjacent Land Uses

5.8.1 Pastoral Activities

Although part of Yakabindie Station, there is no permanent surface water at the site. All water is produced from bores operated by windmills. Feed for sheep within the area of the proposed pit, plant site, waste dumps and tailings dam area is limited by the nature of the ground which is covered by significant outcrops of rock and a surface of gravels and cobbles.

The proposed airstrip site and accommodation sites have some feed, but this is sparse, and dependent on regular rainfall for its maintenance.

There will therefore be some disruption to pastoral activities, namely the loss of approximately 40 hectares for grazing purposes.

Relations with the pastoralist are extremely good and ongoing discussions will be held to minimise to the impact of the mining activities. Fencing of all areas of activity may be required to prevent grazing animals from entering the sites, and additional stock watering points will be provided where wells are affected by project dewatering.

5.8.2 Conservation Activities

The only factors which may impact the biota of Wanjarri Nature Reserve are dust and increased visitation by the public. The subsequent localised impact on adjacent vegetation within the reserve through excessive dust will be minimised by methods detailed in Section 5.5. Education programmes for employees during site induction and liaison with CALM will reduce the potential for adverse impacts associated with any increased visitation to the reserve (Section 6.3.2). No other environmental impacts are perceived to impinge upon the integrity of the reserve.

Conservation activities within the reserve will be enhanced with the appointment of the Environmental Office who will be an honorary warden for the Wanjarri Nature Reserve.

Dominion will construct an alternative access route to the Wanjarri Nature Reserve away from the project area. The fly in/fly out nature of the project will minimize the mobility of the workforce.

5.9 Environmental Management and Rehabilitation

As stated earlier, Dominion proposes to appoint an Environmental Officer who will have the responsibility for rehabilitation programmes for the waste dumps and tailings dam, monitoring air and water quality and noise and dust control, act as an honorary warden for the Wanjarri Nature Reserve and liaise with Government Departments as required in relation to environmental matters.

Details of the proposed environmental management and rehabilitation procedures to be actioned and monitored as appropriate by the Environmental Officer are outlined in the following sections. Management procedures for certain aspects of the project have been outlined in earlier sections and the reader is referred to those sections for details of the proposed management practices.

5.9.1 Management Practices

5.9.1.1 Surface Water - Water Quality

Baseline surveys of the biology and water quality of the Jones Creek system and existing groundwater resources will be undertaken prior to commencement of construction works.

- **Catchment Management - Erosion/Siltation Prevention Measures**

For those catchments which will be affected by the construction of waste dumps and tailings dams a management plan will be prepared to

the satisfaction of the District Mining Engineer and a number of management practices will be put in place prior to construction, and these are as follows:

Save + re-use topsoil.

(i) area of disturbance to be minimised by clearing only those areas required for immediate use;

(ii) construction of contour drains and silt traps downstream of these structures. For the tailings dam this will also double as the downstream toe drainage system;

(iii) rock materials will be placed on the slopes to prevent water and wind erosion of slopes;

(iv) installation of berms; and

(v) upper surfaces of these structures be will sloped towards the centre of the structure, thus eliminating run-off from these structures.

- **Catchment management - Water Quality Monitoring**

Monitoring boreholes installed downstream of the tailings dam will be regularly checked at weekly intervals for water level changes and water quality changes. The location of these monitoring boreholes is shown on drawing number W1292-00/C-002 Appendix D2. Groundwater samples will be tested by an independent laboratory in Perth.

In the event that water quality changes occur, a recovery bore or seepage trench system will be installed, alternative tailings disposal techniques may be adopted, and an alternative tailings disposal site may be considered. Studies of the tailings dam site are yet to be completed, however early results indicate that seepage

losses are likely to be very small since the majority of the tailings disposal site is underlain by granite which is relatively fresh, with a very tight closed joint system.

5.9.1.2 Groundwater Management

The environmental management procedures recommended and outlined in Section 5.1.2 include:-

(i) measure the rates of groundwater extraction;

(ii) evaluate the extent and depth of drawdowns in and around the borefield;

(iii) monitor the quality of groundwater produced from the production bores and stock bores/wells in the vicinity.

These procedures will allow identification of any impact on local water resources with respect to other users and effects on vegetation. Remedial measures would be taken to correct any significant adverse effects. These include the provision of alternate water supplies to maintain stock watering points, as outlined in Section 5.8.1.

5.9.1.3 Waste Products

The reader is referred to Section 5.3.

5.9.1.4 Hazardous Substances

The reader is referred to Section 5.4.

5.9.1.5 Dust

The reader is referred to Section 5.5.

5.9.1.6 Noise

The reader is referred to Section 5.6.

5.9.1.7 Infrastructure

The reader is referred to Section 5.7.

5.9.2 Rehabilitation

Rehabilitation of disturbed areas with indigenous flora is a necessary part of mining operations. Many ecological and aesthetic benefits result from such treatment while good planning and careful implementation of the work from the commencement of mining ensure its cost effectiveness.

Rehabilitation of mine sites in arid areas has been successfully carried out at a number of operations in the Pilbara and Goldfields and new techniques are regularly being developed.

5.9.2.1 Aims of Rehabilitation

The overall objective of the rehabilitation is to return the land to the current land use.

The rehabilitation programme incorporating the latest developments and appropriate techniques for the project area will be developed prior to mining and updated annually in consultation with CALM and other relevant authorities.

The revegetation programme will be aimed at establishing plant cover including a range of species which is self-sustaining and similar to that in surrounding areas. A self-sustaining community is desirable to reduce long term cost and time commitments and to create a suitable environment for local fauna.

The re-introduction and establishment of local native flora aids in minimising the visual impact of mining works as well as providing suitable faunal habitat.

Success criteria for rehabilitation will be based on the distribution and variety of species as currently exist at the site.

5.9.2.2 Rehabilitation and Decommissioning Programme

Rehabilitation of waste dumps and the tailings dam will be commenced as soon as practical and carried out progressively over the life of the project. The details of the rehabilitation for the waste dump and tailings dam embankment are given in Section 5.9.2.3.

On completion of ore processing operations the tailings dam will be covered with a layer of waste rock. The surface of the tailings will have a gentle slope towards the decant structure to facilitate drainage. The decant system will be left open to ensure that water cannot pond on the tailings surface and is drained away. No long term maintenance will be required for the decant system since the internal risers will be supported by gravel which is place in the annulus between the internal riser and external concrete pipe. The tailings will gradually drain with time to an increasingly more stable material. Any toxic leachates from the tailings will be either directed into the abandoned open pit or neutralized by passive methods such as carbonate rock filters. Test work on the toxicity of the tailings is currently being carried out, and the results of these tests will determine the method of leachate disposal.

The plant site, accommodation sites, roads and the airstrip shall be rehabilitated on completion of mining, with all structures (including power transmission lines and water pipelines) and equipment removed to ground level; all pipes, pits, holes etc, sealed and the ground at each site ripped and seeded for regeneration.

All sites will be left clean and tidy.

Diversion bunds and channels will be left with slopes reduced to 20°, and seeded for regeneration. These diversion structures will be a permanent feature on the landscape, to prevent Jones Creek emptying into the abandoned open cut pit, thereby affecting both the aquatic environment downstream and downstream use of the creek.

The rehabilitation of the open cut pit is not economically feasible during the operation of this pit as the ore body is open at depth. However, should mining operations continue on other adjacent pits, this main pit would be used as a waste rock dump. In any event on completion of mining the pit would be left in accordance with the details as laid out in the Department of Mines interim guidelines on safety bund walls around abandoned open pits.

5.9.2.3 Vegetation Rehabilitation

- **Site Characteristics**

Revegetation of arid areas is made more difficult than that of wetter areas by a number of factors. These include:

(i) low and uncertain rainfall;
(ii) sparse, and often depauperate in species, natural vegetation;
(iii) poor soils;
(iv) the effect of seed and seedling predators and grazers;

Site conditions at waste dumps vary further from those applicable in the general area. The height and slope of the dump provides an exposed and generally unfavourable habitat for plant growth due to the difficulties in water harvesting and, conversely, possible problems with erosion after seasonal heavy rainfall. Slopes on the leeward side of prevailing hot easterly and northerly winds may be more favourable for plant establishment.

- **Vegetation and Topsoil Salvage**

In areas to be disturbed all vegetation, litter and topsoil (where present) will be salvaged. This material provides a mulch of crushed vegetation and topsoil which will greatly assist later revegetation programmes. Topsoil where present will initially be stripped to a depth of 5cm, with a second pass stripping topsoil to a depth of 15cm. The topsoil/vegetation material will be removed progressively in front of advancing overburden dumps and be immediately redeployed where possible and reapplied to conform to natural thickness. Immediate redeployment ensures maximum benefit from seed, nutrients and soil bacteria contained within the material. Where this is not

possible the material will be stockpiled for minimum time periods in shall piles which are surfaced ripped, seeded and fertilised. This will assist in maintaining biological activity within the soil. Subsequent plant growth produces a seed store and reduces wind and water erosion. Stockpiles will be located in areas specifically reserved for this purpose or immediately adjacent to redeployment areas for short term storage.

- Site Preparation

The waste dumps are being constructed with overall slopes of not more than 20°, and with the upper surface of the dumps sloped to the centre of the dump at not greater than 1 in 200.

Compacted terraces and slopes (where possible) shall be ripped to a minimum depth of 300mm and, where possible, windrowed along the contour into mounds of no less than 300mm. Windrowing is necessary to collect water from the sparse rainfall and to prevent erosion down the slopes. Overall slopes shall be no more than 20°. On the slopes, moonscaping shall be carried out on an irregular pattern. The presence of any depressions, mounds, shrub or log litter aids in collecting water and protecting seeds and seedlings and has been found to be a significant factor in successful mine site rehabilitation (E.M. Mattiske, personal communication).

A pre-seeding mulch containing crushed litter and/or topsoil from areas cleared for mining will be applied if available. Litter and topsoil should ideally be obtained from areas on natural slopes or rises as plants which require extra moisture and which are normally present in shallow drainage areas (eg. Acacia aneura) will not be suitable for the exposed, dry slopes of the waste dump.

Fencing of newly rehabilitated areas may be carried out using steel pickets, wire strand, netting and barbed wire as appropriate.

- Species Selection

Species used in revegetation should include as many species which are adapted to the local conditions as is possible. A range of species from tall shrubs to annuals, herbs and grasses should be suitable with tree species confined to the base of the dump where the run-off is likely to be greatest.

Selection has often been subject to availability and condition of seed. Some seed may be obtained through larger seed merchants but ideally should be provided by local collectors. This may be achieved by purchasing supplies from known nurserymen or collectors in Kalgoorlie or engaging contractors under supervision of the Environmental Officer to collect from the areas around the mine site. The latter method is often more suitable as seed is fresh and plants are well adapted to local conditions and soil types. A licence will be obtained from CALM for seed collection activities.

Suggested species are:

SHRUBS	HERBS AND GRASSES
Acacia kepeana	Ptilotus spp.
Acacia quadrimarginea	Podolepis capillaris
Acacia tetragonophylla	Sclerolaena spp.
Cassia spp	Cymbopogon ambiguus
Santalum spicatum	Eragrostis sp.
Hakea arida	
Hakea suberea	
Dodonaea spp.	
Hibiscus leptocladus	
Sida calyxhymenia	
Maireana spp	
Scaevola spinescens	

The above list includes species and genera which are generally known to regenerate easily from seed. Many of the grass and herb species are disturbance opportunists which easily re-establish in cleared areas. However, as the area to be revegetated will have been long altered from its original state and seed supply from natural vectors such as wind and animals is less likely, seeding will be required.

Tree species such as Eucalyptus camaldulensis (Red River Gum), E. intertexta, E. striaticalyx, Callitris column, Brachychiton gregorii (Kurrajong) and Pittosporum phylliraeoides (Desert Oak) may be suitable for areas at the base of the waste dump or in other disturbed areas near drainage lines where they can be watered until established.

- Seed Pre-Treatment

Hard seeded species such as Cassia and some Acacia species require boiling to assist germination. Good results have been shown in arid area rehabilitation when seeds are pretreated in this way. Other methods include seedcoat scarification and acid treatment but boiling is the easiest and most effective treatment in most cases. Experimentation could be carried out with the species to be used.

- Irrigation

Studies on sprinkler irrigation of seeded areas in arid land revegetation have shown that watering causes more rapid establishment of species, but favours early colonising plants, thus reducing the overall range of species established. It is believed that although irrigation is necessary for establishing planted nursery stock and particularly trees, its use in seeded areas is not essential over the long term. If a quick result is required this technique may be employed, with irrigation from fresh (low salinity) water sources.

- Monitoring

Monitoring of revegetated sites is useful to gain further knowledge of the success of techniques and species, which can then be applied to further rehabilitation work. Monitoring of seeded areas should be carried out at intervals of approximately 6 months over a period of not less than 3 years. Such a time scale is necessary to account for variable seasonal rain and the effects of drought periods on established seedlings.

Follow up work may include the addition of soil stabilising litter where necessary, re-seeding of failed areas and further ripping or other soil disturbance to recreate suitable conditions.

5.9.3 Feral Animal Eradication

The eradication of feral grazing animals from the project area will significantly enhance vegetation rehabilitation of disturbed areas and the remaining natural vegetation. Eradication would thus benefit the surrounding environment, as well as being a cost effective method for reducing damage to revegetation areas, as opposed to other methods such as fencing. An eradication program can be devised in consultation with CALM and the APB. Specific target species will be:-

(i) Goats;
(ii) Rabbits;
(iii) any other feral herbivores; and
(iv) any feral predators, foxes and cats.

Eradication of feral goat populations should be undertaken by a controlled shooting programme while local rabbit populations may be poisoned with 1080 in accordance with APB guidelines.

The feral animal eradication programme may be the responsibility of the proposed Project Environmental Officer.

6.0 SOCIAL IMPACTS

6.1 Aboriginal Sites

The project will comply with the provisions of the Aboriginal Heritage Acts (1972 -1980).

Ethnographic and archaeological surveys have been carried out for the project.

The results of these surveys are attached in Appendix E.

Four archaeological sites have been located in the project area, and an application has been made by Dominion to the WA Museum to disturb these sites. A response to this application is yet to be received. It is understood however, that the archaeological sites are not considered significant, and it is expected that approval will be given to disturb the sites.

Two ethnographic sites have been located to the north west of the project area and are clear of all proposed development.

6.2 Heritage

There are no items of European heritage within the proposed project site.

6.3 Social Environment

6.3.1 Positive Social Impacts

The Yakabindie Project will have a number of positive social impacts for the State of Western Australia, Local Government and nearby communities which will result in significant economic benefits.

The overall cost of development of the project will exceed $200 million over an 18 month period. Experience with previous mining activities indicated that a substantial proportion of this overall investment, estimated at approximately 50% will be spent on goods and services sourced in WA. The construction workforce is expected to peak at 220 people.

Mining equipment purchased for the project, will benefit plant and equipment distributors component manufacturers and service organisations within Western Australia.

The project will employ a workforce of approximately 260 people directly and substantial numbers of people indirectly through the provision of goods and services for the project. Some of these services will be sourced from Kalgoorlie.

This project will provide a boost to the town of Leinster, as families permanently based at the site will use existing shopping facilities for procurement of groceries etc.

In the event that discussions with Westrail are successful, concentrates will be transported by rail from Leonora to Esperance. This would benefit Leonora and Esperance. Rail facilities between these centres will be utilised more frequently, with additional personnel employed in each centre to service this requirement. In the event that these discussions are unsuccessful concentrates will be shipped to Geraldton, with the associated benefits of employment and investment in loading facilities going to that area.

The Wanjarri Nature Reserve will also benefit by having an honorary warden located adjacent to the Reserve. At the moment this Reserve is administered from the Kalgoorlie Office of CALM, and trips by CALM officers to the site are on a bi-monthly basis.

6.3.2 Negative Social Impacts

The Yakabindie Project will have some negative social impacts and these include:-

(i) proximity of the mining project to a nature reserve; and

(ii) increased use of public roads.

6.3.2.1 Proximity of the Project to the Nature Reserve

Dominion recognises the proximity of the mining project to the Wanjarri Nature Reserve may presents a number of problems during the construction and operational periods. These include dust, disturbance of fauna, increased access to the reserve by personnel involved in the project and disruption of access roads to the reserve by the mining operations and noise.

Dominion proposes to address these problems in the following manner.

- The appointment of an Environmental Officer for the project prior to the commencement of construction (who will be an honorary warden for the Wanjarri Nature Reserve) to oversee and enforce dust abatement measures and rehabilitation works will reduce the effect of dust on the reserve. It is anticipated that the dust problem will potentially be at its highest level during the construction period of 12 months, when the open pit area is stripped, plant, tailings dam and waste dump sites are stripped. Adequate watering during this construction period as well as limiting stripping to only those areas required for safe and efficient operations should alleviate much of the problem.

- Access to the Nature Reserve by personnel involved in the project would be discouraged, but cannot be prevented. However, educational programmes will be put in place to ensure that all personnel employed on the project are aware of the need to conserve the values of the Reserve. The appropriate time for these educational programmes is during the on site induction courses, and representatives of CALM will be consulted in the preparation of the induction material. No guns or domestic animals (dogs, cats etc) would be allowed within the project area as a condition of employment.

- The main access to the reserve is via the track that leads to the Six Mile Well (the Yakabindie Project Site). Dominion will close this road with the agreement of CALM officers and relocate the access to the Nature Reserve to the south, along another existing track which leads to the boundary of the Reserve.

- It is anticipated that noise levels from the plant will be minimal and will not significantly effect the Nature Reserve but may result in a localised disturbance of fauna habitat closer to the mining site.

- It is understood that CALM are proposing a joint Management Liaison Committee for Wanjarri, with representatives from CALM, DOMWA, EPA, Dominion and Mt. Keith. Dominions representative on this proposed committee would be the Environmental Officer. It is envisaged that such a committee may need to meet on a monthly basis at or near Wanjarri, and Dominion would be willing to provide facilities for these meetings at their administration centre on the project site. Any management proposals from this Committee which directly affect the Wanjarri Nature Reserve from the activities of the Yakabindie Project will be submitted to management for consideration and action as appropriate.

6.3.2.2 Public Roads

Use of public roads will increase as the result of road transport from this project.

Due to the proposed fly in/fly out nature of the operation, private traffic increase will be minimal. The main increase in road usage will result from the fuel and concentrate transport requirements.

As discussed in Section 4.7.2, there are two options under consideration for the export of the nickel concentrate. These are:

(i) via the Port of Geraldton; and

(ii) via the Port of Esperance.

~ 6 day

Transport of the concentrate to Geraldton would invlove 42 road train trips per week using a truck configuration of a rigid and two dog trailers, via Wiluna and Meekathatta.

The Esperance option will require 3 road trains (prime and 3 trailers) doing a toral of 42 trips per week to the rail head at Leonora. Then the concentrate would be railed to Esperance.

3 day

The estimated fuel demand for the project's power station is some 220 tonnes per day. This will involve a maximum of 22 fuel deliveries per week from Geraldton. This would be reduced if fuel was transported from Leonora.

Other village and minesite consumables will require an estimated 4 deliveries per week.

7.0 SPECIFIC COMMITMENTS

Dominion undertakes to fulfil the following commitments to protect the environment and public during the life of the Yakabindie Project from commitment to proceed with the project to decommissioning following the completion of mining, and while ever Dominion holds the leases on which project activities have been undertaken.

7.1 Government Acts and Regulations

- Comply with the requirements of all applicable Acts and Regulations.

7.2 Environmental Management

7.2.1 Environmental Officer

- Appoint a Project Environmental Officer prior to the commencement of construction whose duties include:
  - Environmental impact assessment and monitoring;
  - Establish rehabilitation programmes;
  - Establish feral animal eradication programmes;
  - Establish fauna monitoring programme;
  - Liaison with CALM and APB;
  - Carry out the duties of an honorary warden for the Wanjarri Nature Reserve;

- Set up an educational programme as part of the site induction of employees for the protection of the Wanjarri Nature Reserve;

7.2.2 Environmental Management Programmes

- Carry out baseline survey of Jones Creek aquatic biology and water quality as soon as possible prior to commencement of construction;

- Carry out baseline groundwater quality survey as soon as possible prior to commencement of construction;

- Monitor the water quality of Jones Creek during the life of the project;

- Minimise clearing of land consistent with safe and efficient operations as detailed in Sections 4.2.2, 5.2 and 5.5;

- Construct waste dumps to blend into the surrounding landscape as detailed in Sections 4.1.5. and 5.3.3;

- Install silt traps to collect run-off from roads, waste dumps and tailings dam and prevent sediment from entering the drainage channels in accordance with the management plan for drainage to be provided to the Mines Department prior to commencement of comstruction;

- Carry out progressive rehabilitation of the waste dumps and tailings dam embankments and rehabilitate to the level of the existing land use in accordance with the rehabilitation programme as detailed in Section 5.9.2;

- Prohibit domestic pets in the project area as a condition of employment;

- Prohibit off road driving and shooting by employees as a condition of employment;

- Maintain strict fire control procedures;

- Provide a new access route for the Wanjarri Nature Reserve utilising an existing track to the south of the site;

- Restrict human and non avian faunal access to potentially hazardous areas by fencing if required;

- Set up a groundwater monitoring programme for the tailings dam as detailed in Sections 4.4.7 and 5.3.4;

- Control dust in the project area as detailed in Sections 4.2.2, 5.2 and 5.5;

- Control noise levels in the project area in accordance with applicable acts and regulations and as detailed in Section 5.6;

- Utilise storage, transport and handling procedures for hazardous chemicals as detailed in Sections 4.2.3 and 5.4;

- Submit an annual report of environmental management and monitoring programmes to an agreed format and content with State Authorities; to exemption of these procedure from EPA

- Cap all boreholes and pipes, backfill costeans when no longer required as detailed in Section 5.9.2.2;

- Upon decommissioning remove all structures, equipment and rubbish and leave the site clean and tidy as detailed in Section 5.9.2.2;

7.3 Aboriginal Interests

- Submit an application to the W.A. Museum for Aboriginal artefact sites which are to be disturbed.

7.4 Public Safety

- Access to the mine site, and village will be prohibited to the public. Signs, fences and gates will be installed where necessary.

8.0 CONCLUSIONS

Based on the foregoing, it is concluded that the project can proceed with limited impacts on the environment provided the management practices as outlined in this document are implemented at the commencement of the project, and a regular system of monitoring is carried out to measure the effects of the project.

The proponents will keep abreast of the developments in environmental management and incorporate as appropriate those developments which are beneficial to the environment of the project area.

The project will generate significant benefits for Australia, the State of Western Australia and nearby communities such as Leinster as well as those communities from where concentrates will be shipped to overseas markets.

This project may also offer opportunities for downstream processing of concentrates within Australia.

9.0 CONTRIBUTORS TO THE PREPARATION OF CONSULTATIVE ENVIRONMENTAL REVIEW

This Consultative Environmental Review has been compiled by Soil and Rock Engineering Pty Ltd with contributions from:-

ORGANISATION	ACTIVITY
Dominion Mining Limited	Company details including ownership, location, history, geology of the ore body.
Minproc JR Joint Venture	Details of project processing, mining and processing operations, and infrastructure.
Ecologia (Ecological Consultants)	Fauna and flora surveys, assessment of impacts on flora and fauna and management of impacts and rehabilitation.
Rockwater Pty Ltd	Details of surface water and groundwater, assessment of environment impacts and management for groundwater, assessment of flooding.
Quartermaine Consultants	Aboriginal Site Surveys, archaeological work.
Rory O'Connor & Associates Pty Ltd	Aboriginal Site Surveys, ethnographic work.

In addition, discussions were held with officers of the following State Government Organisations:

- Department of Mines;
- Environmental Protection Authority (EPA);
- Department of Conservation and Land Management (CALM);
- Western Australian Government Railways (Westrail);
- Main Roads Department (MRD);
- State Electricity Commission of Western Australia (SECWA);
- Western Australian Water Authority (WAWA);
- Department of Resources and Development (DRD);
- Marine and Harbours Department - Port Authority Esperance and Port Authority Geraldton;

The following Shire Councils were contacted with regard to this project:

- Leonora;
- Esperance;
- Wiluna;
- Yalgoo;
- Cue;
- Mt. Magnet;
- Mullewa;
- Geraldton;

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