Centaur Mining & Exploration Limited

CAWSE NICKEL PROJECT

Consultative Environmental

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Centaur Mining and Exploration Limited

CAWSE NICKEL PROJECT

CONSULTATIVE ENVIRONMENTAL REVIEW

Prepared for Centaur Mining and Exploration Limited by

Woodward-Clyde

Centaur Mining and Exploration
Cawse Nickel Project
Consultative Environmental Review

HOW TO MAKE PUBLIC SUBMISSIONS:
The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

Centaur Mining and Exploration Limited is proposing to establish a nickel mine and processing operation 50 km north-west of Kalgoorlie. In accordance with the *Environmental Protection Act, 1986* a CER has been prepared which describes this proposal and its likely effects on the environment. The CER is available for public review for a period of 4 weeks from Monday 25 March 1996 closing on Monday 22 April 1996.

Comments from Government agencies and the public will assist the EPA to prepare an assessment report in which it will make recommendations to Government.

Copies of the document may be obtained for the sum of $5.00 each from:

Centaur Mining & Exploration Limited
46 Kings Park Road
WEST PERTH WA 6005

Centaur Mining & Exploration Limited
P.O. Box 1594
WEST PERTH WA 6872

Why write a submission?
A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the *Freedom of Information Act*, and may be quoted in full or in part in each report.

Why not join a group?
If you prefer not to write your own comments, it may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how may people your submission represents.

Developing a submission
You may agree or disagree with, or comment on, the general issues discussed in the CER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific proposals in the CER:
- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

Points to keep in mind
By keeping the following points in mind, you will make it easier for your submission to be analysed.
- Attempt to list points so that the issues raised are clear. A summary of your submission is helpful.
- Refer each point to the appropriate section, chapter or recommendation in the CER.
- If you discuss different sections of the CER, keep them distinct and separate, so there is no confusion as to which section you are considering.
- Attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:
- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: **Monday 22 April 1996.**

Submissions should be addressed to:
Environmental Protection Authority
Westralia Square
141 St Georges Terrace
PERTH WA 6000
Attention: Mr Ian Harvey

Centaur Mining and Exploration Limited (Centaur) is proposing to establish a nickel mining and processing operation 50 kilometres north west of Kalgoorlie and 9 km east of Ora Banda.

The Project will involve open cut mining of a laterite nickel deposit at an initial rate of approximately 1 million tonnes per annum (Mtpa). The mined ore will be beneficiated to produce 500,000 tonnes per annum (tpa) of concentrate for processing. These mining and processing rates may be increased to 2 Mtpa and 1 Mtpa, respectively, as processing plant modifications are made and operational efficiencies are achieved. This proposal also includes provision for the proposed processing plant to be duplicated to an ultimate capacity 2 Mtpa. A coincident mining rate of 4 Mtpa would be required to sustain this processing rate. Processing of the concentrate will include high pressure acid leaching, purification and nickel/cobalt metal recovery.

Mining and processing are expected to be conducted over a period of at least 20 years which may vary depending on the rate of processing and extension of ore reserves.

Both the construction workforce and operational workforce will be accommodated at Kalgoorlie.

The most significant environmental implications arising from this proposed development will be temporary and permanent disturbance to the land surface through mining and long term storage of tailings. Environmental management strategies are being developed as an integral part of the overall project planning and feasibility studies to ensure the environmental impact of the Project is minimised.

Substantial operational efficiencies have been devised through integrated project planning. This approach has also produced several environmental benefits including:

- reduction in water requirements through re-use of various waste streams in the process;
- maximum water recovery from tailings storage facility to improve consolidation and reduce the potential for seepage;
- recovery of low grade reject material from beneficiation process for future processing;

- progressive infilling of mined out pits;
- location of out of pit dumps and infrastructure to avoid significant vegetation communities;
- negotiations with neighbouring gold mining operations to use high salinity waste water so that evaporation ponds are not required;
- contractual arrangements with the WMC Nickel Smelter to supply sulphuric acid rather than establishing an acid plant on-site and importing sulphur;
- location of service infrastructure e.g. gas pipeline within existing road easements to reduce disturbance to areas of native vegetation; and
- use of waste heat from electricity generation flue gas to produce steam.

This proposal is subject to formal assessment at the level of Consultative Environmental Review, pursuant to the provisions of Part IV of the *Environmental Protection Act*, 1986.

Key environmental topics addressed in the CER include:

- Environmental Management Programme;
- surface and groundwater hydrology;
- tailings storage;
- flora and fauna;
- rehabilitation of disturbed land areas;
- dust and noise;
- solid and liquid wastes;
- gaseous emissions; and
- decommissioning.

These and other environmental topics which were identified in the EPA's Guidelines for the proposal are also summarised in Table ES-1.

Environmental Management Programme

Centaur is committed to achieving a high standard of environmental management at Cawse Nickel Project and adhering to all environmental obligations relevant to its activities. This requires the integration of all monitoring and management programmes to refine and continuously improve environmental management of the operations.

Centaur will develop an Environmental Management Plan (EMP) to include all aspects of environmental management and monitoring programmes for both construction and operations at the Cawse Nickel Project. It is envisaged the EMP will be periodically reviewed and updated accordingly based on the results of monitoring and changing industry practice.

A programme of employee education will be practiced to ensure that all personnel are aware of Centaur's environmental responsibilities. This will be included in the overall workforce induction programme with specific emphasis placed on the individual's responsibilities to adhere to environmental rules, regulations and policies.

Surface and Groundwater Hydrology

Project facilities have been located to avoid disturbance to significant drainage lines. Some minor drainage lines may be interrupted by the following: mine pits, overburden storages, processing plant, tailings storage facility. access roads and haul roads. Minor drainage lines which are interrupted by the proposed development will be diverted around the facilities. The diverted water will be directed to re-enter the natural drainage system clear of the developed areas. Culverts will be located at significant drainage lines along the access road and all roads to avoid shadowing effects on vegetation.

It is expected that the open-cut mine, to a planned maximum depth of 60 m below ground level, will occur mainly above the water table which typically ranges between 40 to 50 m below ground level. The majority of the pits will be less than 40 metres deep and therefore the need for pit dewatering is expected to be minimal with minor seepage (if any) being controlled by the use of in-pit sumps. Future pits may intersect the water table later in the life of the Project. Where this occurs, water produced will be pumped from mine dewatering bores and piped to the processing plant.

Investigations to identify suitable borefields which meet the Project requirement of 4,700 kL per day at a processing rate of 500,000 tpa are in progress. This amount represents a maximum estimated requirement for early stages of the Project as it does not take into account return water from the tailings. Tailings return water may provide up to 30% of this requirement. A processing rate of 1 Mtpa would require approximately

6,000 kL/day of make-up water from the borefields. Expanded production, duplication of the processing plant to 2 Mtpa, would require up to 12,000 kL/day.

Potential water supplies are being investigated from paleochannels up to 30 km north of the project area. The expected water quality will contain between 30,000 and 60,000 mg/L TDS. Existing paleochannel borefields in this region are therefore used exclusively for mineral (gold) processing as the water is not suitable for other beneficial uses such as stock water.

Considerable emphasis was placed during the Project planning phase on means of reducing process water requirements. As an outcome, the recovery and re-use of various process and waste streams has resulted in a reduction of up to 50% of the original estimated water demand. This has produced significant cost savings and environmental benefits. Negotiations are also being conducted with neighbouring gold mining operations to use the excess high salinity water so that evaporation ponds are not required.

Tailings Storage

The tailings storage facility has been designed and will be constructed to minimise the potential for seepage of process water into the surrounding environment.

Geological information on the surrounding area indicates that the basement rock underlying the tailings storage facility is low permeability granite so it is therefore unlikely that there will be significant groundwater resources which would be affected by potential seepage. The granite is generally covered by a combination of both cemented and uncemented surficial sediments.

The salinity of the tailings solution will be similar to that of the process water which is expected to range between 30,000 and 60,000 ppm TDS. This range is typical of groundwater resources in the vicinity of the Project area and greatly exceeds maximum concentrations recommended for sheep, ie: 13,000 ppm TDS. The tailings material will not generate acid as the ore is totally oxidised.

Monitoring bores and piezometers will be installed around the tailings storage facility to detect any leakage that may occur. If leakage is detected which would adversely effect surrounding vegetation, remedial measures will be undertaken.

Flora and Fauna

A flora and vegetation survey undertaken for the Cawse project area identified two plant communities which were thought to be locally and regionally significant. A further three communities were identified as being locally significant but not of regional significance. Whilst the five plant communities are located in the overall project area, they are mostly located outside areas which may be disturbed through mining and processing related activities. About 10% of one locally significant plant community will be affected by mining.

No Declared Rare Flora were located in the project area. However, two Priority 3 flora species (*Acacia kalgoorliensis* and *Eremophila pustulata*) were identified within the project area (Mattiske Consulting Pty Ltd, 1995).

To ensure the protection of the Priority 3 species, disturbance to the communities in which they occur will be avoided wherever possible during the proposed operations. This has already been achieved as the location of significant plant communities was taken into account in early operations planning. Project aspects such as the out of pit waste storages, processing plant, tailings storage facility and access road were all located with reference to significant plant communities. In addition, management of vegetation disturbance will be closely supervised to assure the minimum area required for construction of the mine infrastructure is disturbed.

A survey of the project area identified six major fauna habitats, none of which were of regional significance. Three fauna habitats of local significance were identified. Based on information available for the region, four Schedule 1 and four Schedule 4 species are potentially present in the project area. To ensure that the impact of the Project on flora and fauna habitats is minimised, Centaur will develop and implement procedures as part of both the construction and operation stages of the Environmental Management Plan.

Rehabilitation

The development of mining, processing and infrastructure for the Cawse Project will involve disturbance to the landform, vegetation and flora, and fauna habitats. Centaur has made commitments to avoid unnecessary impacts on these aspects of the environment wherever practicable. However, land rehabilitation will be required in disturbed areas to minimise short term impacts such as dust generation and erosion, and produce a stable post-mining landform in the longer term.

The rehabilitation programme will be designed in the course of the operations taking into account site specific characteristics. The overall objective of the rehabilitation programme will be:

- in the short-term to reduce dust and to stabilise disturbed mine landforms; and
- in the long-term to establish a community of plants as stable, diverse and resilient as the pre-mining vegetation and which is compatible with the surrounding environment and land uses.

Rehabilitation requirements will be integrated with the operation of the mine.

A monitoring programme will also be established to assess the success of the rehabilitation programme.

Dust and Noise

Potential impacts associated with dust levels on site are mainly confined to the health and comfort of the workforce. Fugitive dust emissions are unlikely to be a problem with the Cawse Nickel Project as the nearest residents are located over 9 km from the project area.

The proposed development at Cawse Nickel Project will increase ambient noise levels within and immediately adjacent to the project area. The increased levels will be mainly attributable to the operation of mining plant and the ore processing plant. The impact of mine site noise on the human inhabitants of the region will be almost entirely restricted to the mine workforce and is not expected to have any impacts on the nearest residence which is located approximately 9 km to the west of the project area.

Noise from transport of acid, limestone and other reagents to the Project area is not expected to result in unacceptable impacts due to the relatively low number of truck movements in an area used predominantly for mining activities.

Solid and Liquid Wastes

The mining operation at Cawse will generate waste materials, including scrap metal, tyres, storage containers, wood, paper and domestic solid and liquid waste. While not hazardous, these materials could create an environmental impact if not disposed of or treated properly. The development and operation of the Project will also necessitate the use of a range of products termed 'hazardous materials'. These materials include fuels, process reagents lubricants, detergents, explosives and paints.

Centaur will develop and implement a comprehensive management programme for handling, storage and disposal of hazardous and other waste materials of the Cawse Nickel Project. All wastes which cannot be recycled will be disposed of in accordance with relevant State and local regulations.

Gaseous Emissions

No significant gaseous emissions will be produced from the high pressure leach, purification and nickel/cobalt recovery processes as these operate as closed circuits. Where steam may be vented from the high pressure acid leach circuit, wet scrubbing will be employed to remove any sulphuric acid that may be contained.

No gaseous emissions will be produced from the ammonia leach as it is a closed circuit with ammonia stripping and regeneration modules. No upset conditions are associated with these processes which could result in any significant gaseous emission. Some minor emissions of NO_x and SO_2 may be associated with the power station.

No sulphuric acid will be produced on site which would be a potential source of SO_2, NO_2 and CO emissions.

A hydrogen sulphide plant, if required, could also be a potential source of gaseous emissions. These would be primarily hydrogen sulphide and sulphur dioxide. Any excess hydrogen sulphide which may be produced would be flared rather than being released directly to the atmosphere. This could produce minor emissions of sulphur dioxide under infrequent upset conditions. No decision has been made on whether such a plant is required at this stage. This option will be considered in the detailed design phase.

Gaseous emissions from the processing plant and associated infrastructure are expected to be well below levels specified in the EPA Guideline objectives. However, monitoring will be conducted during commissioning of the processing plant and other infrastructure to measure actual emissions for licencing purposes.

Decommissioning

Operations at the Cawse Nickel Project are expected to continue for a period of at least 20 years as the identified ore body is progressively mined. Residual longer term impacts at the completion of mining operations will be mainly associated with the stabilisation of post-mining landforms.

At the completion of mining and processing all infrastructure will be removed. Rehabilitation activities will continue beyond the mine closure to enable final overburden storage areas, the tailings storage facility and other disturbed areas to be contoured and stabilised. Monitoring following decommissioning will consist of periodic site visits to assess the progress of revegetation. Environmental monitoring and ongoing research studies to be undertaken through the life of the Cawse Nickel Operations will assist in refining environmental management practices to minimise longer term impacts.

A decommissioning plan will be prepared at least 12 months prior to the completion of processing operations.

TABLE ES-1

SUMMARY OF THE TOPICS AND PROPOSED MANAGEMENT OF THE CAWSE NICKEL PROJECT

Environmental Topic	Assessment Objective	Existing Environment	Potential for Impact	Proposed Management	Predicted Outcomes
Leach Residue Disposal	Ensure the leach residue disposal area and evaporation pond are located and designed so as to minimise environmental impacts.	Tailings storage facility located on low permeability granite. No underlying groundwater with identified beneficial use. No evaporation pond required.	Seepage of saline process water may adversely affect adjacent vegetation.	Tailings storage facility to be designed and constructed to minimise the potential for seepage of process water into the surrounding environment. Install monitoring bores to detect any leakage. Apply remedial measures as appropriate if leakage detected. * Commitment 3	The operation will have no significant impact on groundwater or vegetation in the vicinity of the tailings storage facility.
Social Surroundings	Ensure the community is informed and has opportunity for input. Develop procedures in accordance with *Working with Communities, A Guide for Proponents*, November 1993, Department Commerce and Trade.	The nearest residence is located 9 km to the west of the Project. Other residences are located 13 km east of the Project. The Kalgoorlie township is approximately 50 km to the south east.	The activities of the construction and operation workforce may lead to demand on some existing infrastructure and services.	Workforce will be located in Kalgoorlie. CER public review will provide opportunity for wider community input. Opportunities to compete for contracts will be available to local communities.	Positive socio-economic impacts on nearby communities.
Rehabilitation	Develop process to identify post-mining land uses. Define appropriate rehabilitation criteria. Develop/design an integrated mining/rehabilitation procedure which includes continual progress towards an appropriate end landform and revegetation.	Topography consisting of low hills and broad valleys leading to salt lakes. The vegetation is characterised by Eucalypt - Casuarina-Mulga woodlands interspersed with *Acacia acuminata* spp. *burkittii* shrublands.	Changes to topography and disturbance to vegetation through mining, overburden storage, tailings storage, plant site and associated infrastructure. Modified local surface drainage regimes.	Minimise unnecessary disturbance to landform and vegetation. Post-mining landforms constructed to blend with surrounding landforms. Progressively develop and implement rehabilitation strategies which are consistent with defined post-mining land use objectives. Infilling of mined outpits to be maximised. * Commitments 2, 5, 6, 8	The post-mining landform will be structurally stable and compatible with surrounding land uses.
Risk	Implement project criteria in EPA Bulletin 611 and 627.	No current operations. Nearest residence is located 9 km to the west of the Project. Other residences are located approximately 13 km east of the Project.	Negligible risk to nearest residence due to distance.	Hazardous materials will be transported and stored in accordance with the relevant standards and regulations. Explosives will be stored in accordance with the relevant standards and regulations. The operation of the plant will be in accordance with the *Mines Safety and Inspection Act, 1995.* Hazop studies will be conducted as part of the detailed Project design.	No unacceptable risk to members of the public, property or the environment is expected.
Environmental Management Programme	Implement an approved and effective Environmental Management Programme.	No current operation.	NA	Prior to the commissioning of the Project, an EMP will be developed to address a range of environmental issues. The EMP will be reviewed and updated periodically throughout the life of the operations. * Commitment 1	All mining, processing and other activities associated with the Project will include environmental management procedures as an integral part of the operations.
NO_2 Emissions	The maximum one hour average of NO_2 should not exceed 320 $\mu g/m^3$ at the nearest residence. (World Health Organisation Standard).	No current operations producing NO_2 in the local area. The nearest residence is located 9 km to the west of the Project. Other residences are located 13 km east of the Project.	The only source of NO_2 from the Project is the power station. Estimated output of NO_2 is approximately 6g/kwhr. This equates to approximately 12g/s at a generating capacity of 6.5×10^7 kwhr/year.	Monitor gaseous emissions from potential sources during commissioning to ensure that levels are below EPA specified criteria. * Commitment 11	No significant impacts are likely.
SO_2 Emissions	The maximum one hour average of SO_2 should not exceed 350 $\mu g/m^3$ at the nearest residence. (World Health Organisation Standard).	Significant regional point sources include the Gidgee Gold Roaster and the Kalgoorlie Nickel Smelter. No significant point sources of SO_2 within 30 km of project area. The nearest residence is located 9 km to the west of the Project. Other residences are located 13 km east of the Project.	No significant quantities of SO_2 will be produced from the Project. No sulphuric acid plant required.	Monitor gaseous emissions during commissioning to ensure that levels are below EPA specified criteria. Purchase sulphuric acid from local supplier. * Commitment 11	No significant impacts are likely.

Environmental Topic	Assessment Objective	Existing Environment	Potential for Impact	Proposed Management	Predicted Outcomes
H_2S Emissions	There shall be no offensive odours from reduced sulphur compounds (including hydrogen sulphide) in areas beyond the boundary of the plant frequented by persons who are not employees of the plant. To achieve this objective, a 3-minute average design ground level concentration maximum of 1.0 $\mu g/m^3$ H_2S should be used, pending development of odour assessment methods applicable to specific industries.	No current operations producing H_2S in the local area. The nearest residence is located 9 km to the west of the Project. Other residences are located 13 km east of the Project.	The requirement for a Hydrogen Sulphide Plant has not been determined to date.	Monitor gaseous emissions during commissioning to ensure that levels are below EPA specified criteria. Commitment to include details of potential H_2S emissions and pollution control equipment in a Works Approval application if it is decided to establish a hydrogen sulphide plant. * Commitment 11	No significant impacts are likely.
CO Emissions	Maximum one hour average of CO should not exceed 30 mg/m^3 at nearest residence. Maximum 8 hour average of CO should not exceed 10 mg/m^3 at nearest residence (NHMRC standards).	No current operations producing CO in the local area. The nearest residence is located 9 km to the west of the Project. Other residences are located 13 km east of the Project.	The only potential source of CO from the Project is the power station. Estimated output CO is approximately 2.4 g/kwhr. This equates to approximately 5g/s at a generating capacity of 6.5×10^7 kwhr/year	Monitor gaseous emissions from potential sources during commissioning to ensure that levels are below EPA specified criteria. * Commitment 11	No significant impacts are likely.
Greenhouse gas emissions	Consistent with EPA requirements.	No current industrial sources of greenhouse gas emissions in local area.	Estimated output of 13,156 tonnes/year of CO and CO_2 from power generation equates to 0.05% of total estimated W.A. output in 1988.	Maintain inventory of greenhouse gas emissions. Ongoing investigations for improved energy efficiency.	No significant impact is likely.
Effects of gaseous emissions/dust on native vegetation	Protect native vegetation from effects of gaseous emissions and dust on advice from CALM and DEP.	No current operations producing gaseous emissions or significant quantities of dust in the local area. Dust produced from unsealed roads.	Gaseous emissions from the processing plant and infrastructure not sufficient to adversely affect vegetation. Dust generated from mining operations may impact on sensitive vegetation.	Monitor gaseous emissions from potential sources to ensure that they do not reach levels which would adversely affect vegetation. Dust levels to be controlled through the application of procedures to be included in the Environmental Management Plan.	No significant impacts are likely.
Fugitive Dust - storage, transport and handling of materials	Control fugitive dust to an acceptable standard as determined by DEP.	There are no current construction activities on-site. Dust is currently generated from areas of sparse vegetation during high winds and vehicles using unsealed roads.	Increase in ambient dust levels. Dust generation through mining and movement of large volumes of dry material. Unconsolidated surfaces may generate dust during windy conditions.	Ambient and occupational dust will be controlled by fitting dust suppression systems to equipment likely to generate dust. Water tankers will apply water to areas which are potential sources of dust. Rehabilitation of overburden storage and other disturbed areas.	No significant increase in ambient dust levels. Minor localised impacts may occur periodically.
Noise (project site)	Comply with statutory requirements.	No current construction, operation or blasting activities.	Increase in ambient noise levels.	A noise monitoring programme will be conducted. Workforce noise exposure will be managed in accordance with the requirements of the Mines Safety and Inspection Act. Blasting will be restricted to daylight hours.	Significant localised increases in noise is expected from construction, operation and blasting activities.
Noise (off-site eg: transport of materials)	Protect the amenity of neighbouring residents from unacceptable noise impacts.	Current heavy transport along proposed access routes associated with existing mining operations in the region.	Increased periodic noise from vehicles transporting materials to and from operations along access route.	A noise monitoring programme will be conducted.	Significant off-site noise impacts from vehicle transport is not expected due to the relatively low number of truck movements in an area predominantly used for mining.
Solid and Liquid Wastes	Implement best practice to avoid creating a contaminated site, ANZECC & NHMRC 1992 Guidelines.	No current operations.	Soil or water contamination could occur if waste materials are not disposed of properly.	Oily wastes will be collected and disposed of in accordance with conditions specified by the DEP. Disposal of hazardous wastes will be in accordance with relevant State and local regulations. Non-recyclable material will be disposed of in accordance with DEP guidelines.	No contaminated sites will be created as a result of the Project.

Environmental Topic	Assessment Objective	Existing Environment	Potential for Impact	Proposed Management	Predicted Outcomes
Surface Drainage	Ensure no adverse changes to existing drainage systems, vegetation/land systems and dependent fauna.	An ephemeral drainage line flows from south to north to the east of the site. The catchment area is relatively flat with numerous depressions which fill following rainfall events. The catchment only produces runoff following major rainfall events.	Minor drainage lines may be interrupted. Shadowing effect on vegetation downstream of interrupted surface drainage.	Drainage lines will be diverted around the mine and associated processing facilities to re-enter the drainage system downstream of the site. Disturbance to drainage lines will be avoided where possible. Monitor vegetation to assess and manage adverse impacts. * Commitment 2	There will be minor impacts on ephemeral drainage systems in the vicinity of the operation.
Powerlines, pipelines, other utilities.	Select route which avoids sensitive areas; rehabilitate to agreed landowner specifications.	No current services corridors for utilities. Existing public roads along proposed service corridor.	Potential impact on vegetation through construction and maintenance of service corridors.	The gas pipeline will be mainly located in the existing road easement to minimise the clearing of vegetation. Areas disturbed during the development of the pipeline will be rehabilitated, as appropriate. Powerlines are not required to be installed outside of the Project area. * Commitment 6	Minimal impact to the surrounding environment.
Protect Groundwater Resource from Pollution	Implement best practice to avoid contaminating the groundwater, EPA Bulletin 711.	Groundwater in the Project area is saline and ranges in depth from 40 - 50 m. Flows are related to topography and are towards the north-east. There is little recharge due to low rainfall and high evaporation.	Seepage of saline process water from tailings storage facility may affect underlying groundwater, where existent.	The use of groundwater will be minimised by the recirculation and recovery of water from the processing plant. Tailings storage facility located on low permeability granite. * Commitment 3	The operation will have a negligible impact on groundwater resources with beneficial uses other than industrial water supply.
Water Supply	Calculate water budget and ensure groundwater resource is not depleted.	Other mining operations in the area using established borefields. Groundwater in the Project area is not of sufficient quality for other beneficial uses such as stock watering. Deep rooted vegetation is not reliant on potential groundwater supply sources.	Groundwater levels may be lowered as a result of pumping.	The borefield will be located a sufficient distance from existing borefields to minimise any adverse impacts. Water levels in borefield will be regularly monitored. * Commitment 4	The operation will have a negligible impact on groundwater resources with beneficial uses other than industrial water supply.
Flora and Fauna	Protect Declared Rare and Priority flora and Reserve Listed fauna. Minimise the loss of locally and regionally significant vegetation associations and plant and animal habitats.	Flora: Vegetation is characterised by Eucalypt-Casuarina-Mulga woodlands interspersed with *Acacia* shrublands. No Declared Rare Flora were located in the Project area, although two Priority Three flora species were identified. Five plant communities thought to be locally and possibly regionally significant were located in the Project area: Fauna: Four Schedule 1 and four Schedule 4 species are potentially present in the Project area. Six major fauna habitats were identified, although none were of regional significance. Three fauna habitats of local significance were identified.	Flora: Loss or degradation to vegetation and flora through the destruction of habitat, introduction of weeds, pests and diseases, increased incidents of fire, land clearing for infrastructure and mining of the ore resource. Fauna: Local fauna species will be affected by the loss of habitats caused by land disturbance eg. land clearing, pit development and the construction of waste dumps, service corridors and haul roads.	Ensure that the minimum area of land is cleared for the mine infrastructure and unnecessary clearing is avoided. Plant communities supporting Priority species will be protected, where possible. Progressive rehabilitation will be undertaken using stockpiled topsoil and locally sourced seed. Adequate rubbish disposal procedures will be implemented to discourage scavenging animals. * Commitment 6, 7, 8	Protection of significant flora and vegetation. Minimal loss of one locally significant vegetation type. A degree of impact is predicted for five of the Schedule fauna species.
Heritage	Avoid disturbance to areas of heritage significance.	Two archaeological sites (FS1 and FS2) are located in the vicinity of the mine.	Two sites, FS1 and FS2, will be disturbed by the Project.	An application to disturb Aboriginal sites will be made in accordance with Section 18 of the *Aboriginal Heritage Act 1972-1980.* Where practicable, Aboriginal sites will be avoided. In accordance with the Act, additional sites located in the Project area will be recorded and reported. * Commitment 9	No significant sites are likely to be disturbed.

NA - Not applicable

* Summary of Commitments - refer to Table 6-1.

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1.0
INTRODUCTION

Centaur Mining and Exploration Limited (Centaur) is proposing to establish a nickel mining and processing operation 50 km north-west of Kalgoorlie 9 km east of Ora Banda, Western Australia. The Project is to be known as the Cawse Nickel Project (Figure 1).

The Project will involve open cut mining of a laterite nickel deposit at an initial rate of approximately 1 million tonnes per annum (Mtpa). The mined ore will be beneficiated to produce 500,000 tonnes per annum (tpa) of concentrate for processing. These mining and processing rates may be increased to 2 Mtpa and 1 Mtpa, respectively, as processing plant modifications are made and operational efficiencies are achieved. This proposal also includes provision for the proposed processing plant to be duplicated to an ultimate capacity 2 Mtpa. A coincident mining rate of 4 Mtpa would be required to sustain this processing rate. Processing of the concentrate will include high pressure acid leaching, purification and nickel/cobalt metal recovery.

This document describes the proposed mining and processing operations, evaluates potential environmental impacts and proposes management measures. Preliminary details of the Project were referred to the Environmental Protection Authority (EPA) which determined that the Project would be assessed as a Consultative Environmental Review (CER) under Part IV of the *Environmental Protection Act, 1986*. Guidelines issued by the EPA for the preparation of the CER are provided in Appendix A.

1.1 LOCATION AND TENURE

The site lies within a contiguous block of 220 tenements held by Centaur Mining and Exploration covering over 600 km^2 in the Mt Pleasant - Ora Banda area of the Eastern Goldfields region of Western Australia. Six Mining Lease applications have been lodged to cover the initial mining and processing areas. The overall Cawse Nickel Project area covers approximately 22 km of strike along the Siberia/Ora Banda Greenstone Belt (Figure 1).

1.2 PROPONENT

The proponent for the Cawse Nickel Project is:

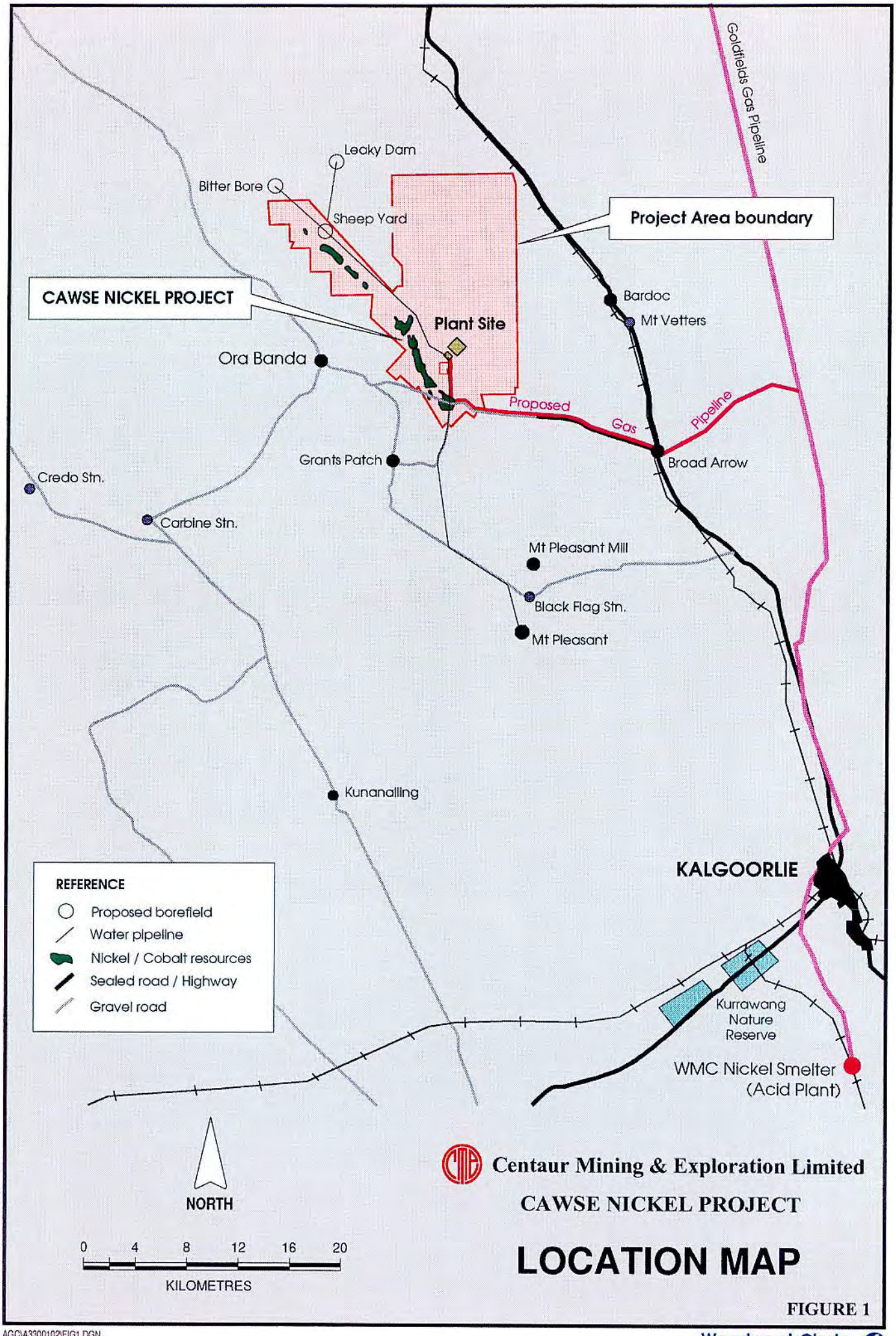
Centaur Mining & Exploration Limited
580 St Kilda Road
MELBOURNE VICTORIA 3004

Centaur Mining & Exploration Limited (Centaur) is listed on the Australian Stock Exchange and has operated the Lady Bountiful Extended Gold Mine 8 km to the south of Cawse since August 1989. Centaur has recently acquired the Mt Pleasant Gold Project which includes a 1.7 Mtpa Carbon in Leach gold processing plant and over 400 km^2 of exploration and mining tenements immediately to the south of Cawse.

1.3 GOVERNMENT LEGISLATIVE REQUIREMENTS AND PROCEDURES

This proposal is subject to formal assessment at the level of Consultative Environmental Review, pursuant to the provisions of Part IV of the *Environmental Protection Act*, 1986. Should approval for development be granted, the State Minister for the Environment will issue a Statement under Section 45 of the *Environmental Protection Act, 1986* stating the management and environmental protection conditions to be applied to the proposal. No other decision making authority may issue an approval to allow the proposal to proceed until this Ministerial Statement is issued. Subsequent to Ministerial approval, Works Approval and Licensing under Part V of the *Environmental Protection Act*, 1986 is also required.

Prior to the commencement of mining operations Centaur is also required to convert existing Prospecting and Exploration licences which cover the proposed Project area to Mining Leases. Six Mining Lease applications have been lodged to cover the areas of initial mining and processing. A standard condition is attached to all Mining Leases which requires written approval to proceed, with the development of Project, to be obtained from the State Mining Engineer. This requires assessment of the proposal by Department of Minerals and Energy officers which may occur simultaneously to the EPA assessment. Following this assessment, and providing the Project is deemed environmentally acceptable, written approval to proceed is issued by the State Mining Engineer.



ENVIRONMENTAL DRAFTING (09) 354 9052

A4 AGC\A3300102\FIG1.DGN

Woodward-Clyde

In addition to obtaining statutory approvals from the Minister for the Environment and the State Mining Engineer, the Proponent will also comply with relevant legislation and regulations administered by other State and Federal Government agencies including:

- *Environmental Protection Act, 1986 (Part V)*;
- *Wildlife Conservation Act, 1950*;
- *Conservation and Land Management Act, 1984*;
- *Agriculture and Related Resources Protection Act, 1976*;
- *Soil and Land Conservation Act, 1945*;
- *Rights in Water and Irrigation Act, 1914*;
- *Bush Fires Act, 1954*;
- *State Planning Commission Act, 1985*;
- *Land Act, 1933*;
- *Mines Safety and Inspection Act, 1995*;
- *Mining Act, 1978*;
- *Explosives and Dangerous Goods Act, 1961*;
- *Aboriginal Heritage Act, 1972-1980*;
- *Australian Heritage Commission Act, 1975*; and
- *Native Title Act, 1993.*

1.4 PROJECT JUSTIFICATION

Mining and processing of mineral resources is important to the State of Western Australia as such developments provide significant economic growth and employment opportunities. This also has flow-on effects as a significant amount of the materials and labour required during the construction and operational phases will be sourced, dependent on availability, in Western Australia. The Project is also integrated with both existing and newly established infrastructure in the area which provides the benefit of utilising such infrastructure more effectively. This includes the Goldfields Gas Transmission pipeline and the sulphuric acid plant at Western Mining Corporation's Kalgoorlie Nickel Smelter.

During the construction phase of 11 months, approximately 250-300 people will be employed. Approximately 170-200 persons will be directly employed on the Project when it is in full production. This may increase to 250 persons should the project be expanded. In addition to site personnel, specialist consultants and contractors will be employed during various stages of the Project to provide specialist input.

The Cawse Nickel Project will generate substantial income for the Kalgoorlie region and Western Australia in general. During the initial 3-5 years of the Project it could generate in excess of $200 million per annum, based on current prices.

Royalties from the Project will be used by the Western Australian Government for the benefit of the State. Additional benefits include improvements to Australia's balance of trade due to nickel export and associated taxes.

The Cawse Nickel Project has several features which provide it with a competitive advantage over other nickel laterite projects in Western Australia. These points are summarised as follows:

- the presence of higher grade zones;
- low MgO levels which lead to low operating costs;
- potential to significantly upgrade nickel and cobalt grades by screening;
- recoveries of at least 95% for nickel and cobalt, respectively; and
- proximity to Kalgoorlie, the Goldfields Gas Transmission pipeline and sources of sulphuric acid.

2.0
DESCRIPTION OF PROPOSAL

2.1 PROJECT OUTLINE AND TIMING

The Project will involve the development of a lateritic nickel cobalt mineralisation 50 km north-west of Kalgoorlie and 9 km east of Ora Banda (Figure 1). An overall potential resource of over 50 million tonnes (Mt) grading 1.0% nickel and 0.07% cobalt has been outlined by exploratory drilling to date covering 22 km of strike. However, the initial mining reserve (Cawse Central) covered by this proposal, will be in excess of 20 million tonnes grading approximately 1.1% nickel and 0.07% cobalt. This is expected to increase with additional delineation drilling within the 12 km length of the initial Cawse Central mining area (Figure 2).

A scoping study based on a 500,000 tpa processing was completed in November 1995. Optimisation studies are currently underway to produce a Bankable Feasibility Study which is scheduled to be completed in the June quarter of 1996. Final detailed design work will follow the Feasibility study to permit construction to commence in August 1996 and the Project to be in production by mid 1997. Mining and processing are expected to be conducted over a period of at least 20 years.

2.2 RESOURCES AND MINERALISATION STYLE

A resource of over 50 million tonnes grading 1.0% nickel and 0.07% cobalt has been outlined by drilling to date covering the 22 km of strike which includes Cawse Central and Cawse Extended. A large low grade nickel system also envelopes the resource. It is estimated that approximately 200 million tonnes grading around 0.7% nickel are located outside the existing resources. This low grade mineralisation is also amenable to upgrading and could potentially be treated after the high grade ore has been processed, thus potentially extending the Project for many years.

The nickel mineralisation typically occurs as a flat-lying sheet extending over a strike length of almost 30 kilometres and widths up to 500 metres. It lies over the deeply weathered basal portion of the ultramafic sequence adjacent to the sheared contact with the granite.

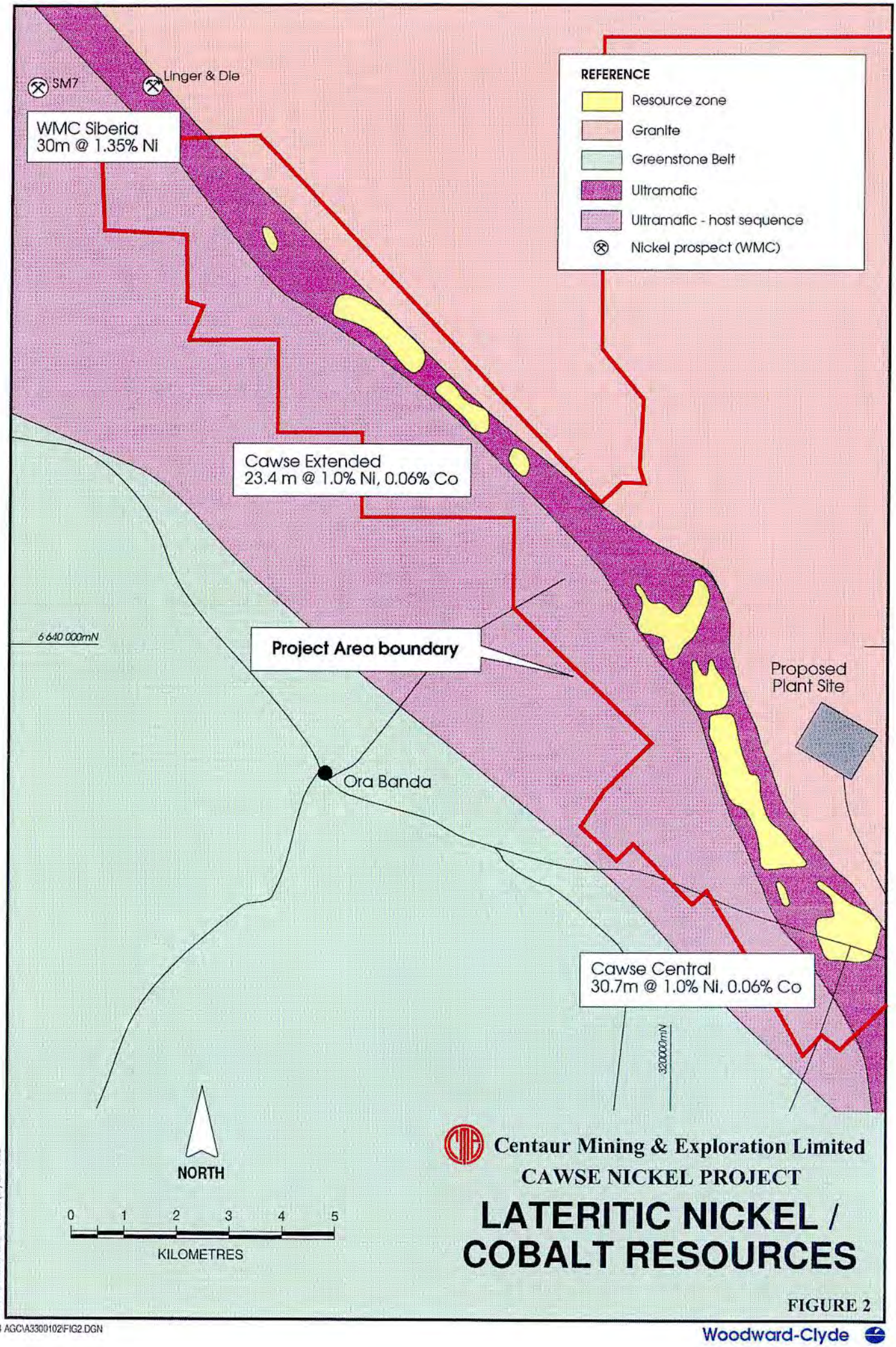
The mineralisation occurs at depths of 4-20 metres and averages 10-15 metres in thickness (Figure 3). Mineralised widths are commonly substantially greater, and the nickel grades higher, where bedrock structures such as north-south or east-north-east faults cut the ultramafic sequence. The latter may be intruded by late stage dolerite dykes.

Approximately 80% of the mineralisation occurs within limonite clays which form the upper 20-40 metres of weathering profile. These occur as sub-horizontal goethite rich clays with bands of nickel poor silica. Nickel grades are generally in the range of 0.5-1.5% nickel and are controlled by the silica content of the clays.

The limonite zones contain low magnesium levels averaging 1.5% magnesium oxide. In the upper portions of the limonite zone, generally within 8-10 metres of the surface, a 1-2 metre thick manganese rich layer is commonly developed. The horizon is rich in cobalt averaging 0.15-0.2% cobalt. In the area at Bunyip Dam this unit is 8 to 12 metres thick and contains up to 1.5% cobalt.

The remaining 20% of the ore occurs as talc mineralisation which is associated with bedrock structures and nontronitic clays which generally lie above the talc mineralisation. The nontronite and talc zones contain higher than average nickel grades but also generally occur deeper in the weathering profile and have higher magnesium levels (3-15% MgO).

The nickel grades and thickness of the limonite mineralisation also tend to increase adjacent to faults and the talc zones. These systems, therefore, represent the target zones for higher grade mineralisation with low stripping ratios. During the initial 3-5 years of the Project, high grade nickel and cobalt resources will be mined from the Bunyip Dam prospect to provide high grade feed for the processing plant.



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CAWSE NICKEL PROJECT

LATERITIC NICKEL / COBALT RESOURCES

FIGURE 2

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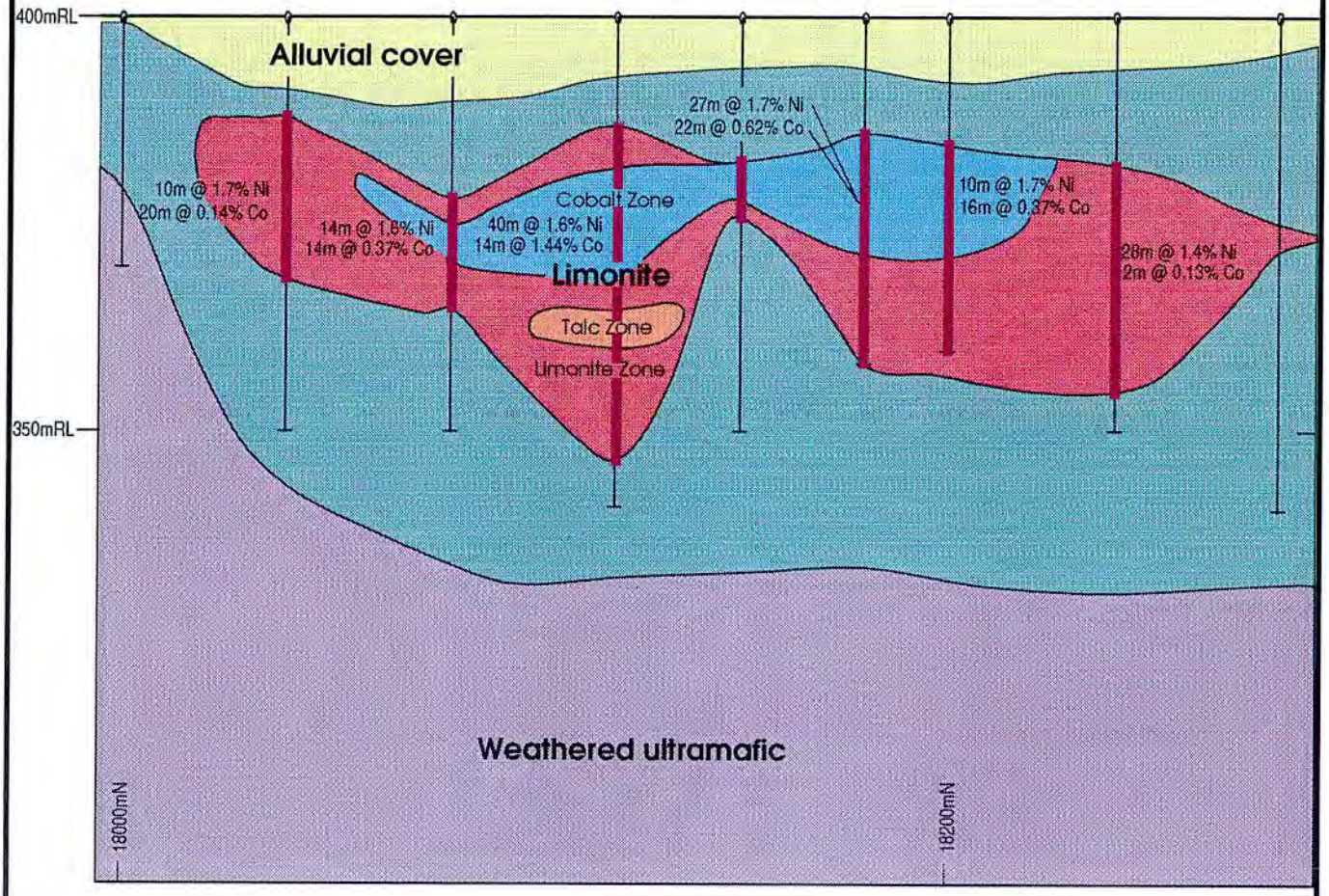
A4 AGC\A3300102\FIG2.DGN

CAWSE CENTRAL
LONG-SECTION 10 680mE



REFERENCE

Rock Types

- Soils / alluvials
- Limonite
- Ultramafic

Ore Types

- Limonite Zone
- Cobalt Zone
- Talc Zone

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CAWSE CENTRAL
LONG-SECTION 10 680mE

FIGURE 3

ENVIRONMENTAL DRAFTING (09) 354 9052

A4 AGC\A3300102\FIG3.DGN

Woodward-Clyde

2.3 MINING AND PROCESSING

The following sections describe various stages of mining and processing proposed for the Project. Table 2-1 summarises key aspects of the proposal.

TABLE 2-1

PROJECT SUMMARY TABLE

Project Aspect	Initial Mining and Process Rate	Potential Expansion Duplication
Mining Rate	1 -2 Mtpa	2 - 4 Mtpa
Average Stripping Ratio	1:1 - 6:1	1:1 - 6:1
Average Nickel Ore Grade	1.0 - 1.5%	1.0 - 1.5%
Beneficiation Throughput	1 -2 Mtpa	2 - 4 Mtpa
Beneficiated Concentrate	500,000 tpa - 1 Mtpa	1 - 2 Mtpa
Acid Leach Throughput	500,000 tpa - 1 Mtpa	1 - 2 Mtpa
Workforce	170 - 200	250
North Pit #1 (including dump)	100 ha *	100 ha*
North Pit #2	11 ha	11 ha
North Pit #3	17 ha	17 ha
Central Pit #1 (including dump)	188 ha *	188 ha*
Central Pit #2	100 ha	100 ha
Southern Pits (including dump)	101 ha *	101 ha*
Maximum Depth of Pits	60 m	60 m
Tailings Storage Facility (12 month starter embankment)	25 ha	25 ha
Final Tailings Storage	100 ha	100 ha
Water Requirement	4,700 - 6,000 kL/day	6,000 - 12,000 kL/day
Process Water Quality	30,000 - 60,000 ppm TDS	30,000 - 60,000 ppm TDS
Nickel Production	8,000 - 15,000 tpa	15,000 - 30,000 tpa
Cobalt Production	1,000 - 2,000 tpa	1,000 - 2,000 tpa

* Areas estimated for the North #1, Central #1 and Southern Pits include overburden storages associated with these pits. It is important to note, however, that these estimates are maximums based on no return of overburden to mined out pits. It is intended that a large proportion of this material will be infilled to the pits which will substantially reduce the estimated area of disturbance.

2.3.1 Mining

The Project will involve the mining and processing of a lateritic deposit. Mining will be by conventional open cut means at an initial rate of 1 Mtpa of 1.0-1.5% nickel ore to a maximum depth of 60 metres. A significant portion of low grade ore will be extracted during the mining operation as overburden. This material will be stockpiled for recovery and processing later in the life of the Project.

Waste rock and low grade ore will be separated and initially deposited in dumps adjacent to the mining area. Infilling of the mined out pits will commence once mining has progressed to a point where sufficient space is available and the areas beneath the open pits have been sterilised for deeper sulphide mineralisation. It is currently envisaged that infilling will commence by year 3 of the Project. Overburden material will then be returned directly to mined out sections of the pit and low grade ore will be placed on the surface for future recovery. This practice is preferred to the alternative of storing all the overburden and low grade ore outside the pit as it substantially reduces the area of the land disturbed. Stripping ratios are anticipated to be in the range of less than 1:1 to 6:1. Minor blasting is likely to be required in some areas to shatter silica rich layers prior to mining with an excavator.

The Run of Mine (ROM) ore will initially be beneficiated to produce approximately 500,000 tpa of concentrate for processing by pressure acid leaching. It is anticipated that the processing rate will increase up to 1 Mtpa as processing plant modifications are made and operational efficiencies are achieved. This would require the mining rate to be increased proportionally to 2 Mtpa as the processing rate increases. Further expansion/duplication of processing plant facilities may be considered in the future subject to market conditions. This would require further proportional increases in mining rates up to 4 Mtpa. However, the overall area of land disturbed by mining would not increase as it is confined to the limits of the Cawse Central orebodies (ie. up to 517 ha including overburden storage). Mining and processing is expected to be conducted over a period of at least 20 years and may be further extended as additional economic reserves are proven, and depending on market conditions.

2.3.2 Ore Handling

An initial plant capacity in the range of 500,000 tpa - 1 Mtpa is currently being considered. Of this total, approximately 70% will be limonitic, 10% talc, 5% a competent, siliceous cobalt ore and the remaining 15% nontronitic clay. During the initial 3-5 years of the Project, higher grade zones will be mined and treated. These zones typically contain greater quantities of the siliceous cobalt ores and the anticipated ore composition through this period will be 70% limonite, 15% siliceous cobalt , 5% talc and 10% nontronite mineralisation. It is proposed that these different ore types will be mined and stockpiled separately to permit both selective treatment and blending.

2.3.3 Beneficiation

Two distinct ore feeds will be processed by the plant. The Main Ore Blend (MOB) comprises 90-95% of the deposit and is predominantly limonitic mineralisation, with minor amounts of talc and nontronitic clay. It will be upgraded (beneficiated) by size separation which will be achieved by crushing followed by removal of the +212 micron fraction through wet screening, drum scrubbing, log washing, and cycloning. A grinding mill may also be added to this circuit if required.

The sub-grade portion of the coarse screen oversize will be disposed of with mine waste rock. The low grade material will be stockpiled for later grinding and processing depending on the grade. The cyclone oversize will be stockpiled for future processing in the early years of the Project when high grade ore is being treated. In the later years when lower grade material is being treated it will be co-disposed with overburden as infill to the mined out pits.

The remaining 5-10% of the deposit consists of a siliceous cobalt ore. This will be separated when mined by visual grade control, stockpiled on the ROM pad and crushed periodically under contract. The crushed ore will be milled and combined with the main ore slurry in a pre-leach thickener prior to the acid pressure leach circuit. During the initial 2 - 3 years of the Project the siliceous cobalt ore will comprise up to 40% of the leach feed. A process flowsheet is presented in Figure 4. A diagram of the proposed plant layout is provided in Figure 5.

2.3.4 Acid Pressure Leach

The upgraded ore in the form of a fine slurry, thickened to about 40% solids, will be preheated to 175°C by direct contact with flash steam in two stages ahead of the leach autoclaves. The steam will be recovered from flash tanks located at the discharge of the leach autoclaves. Slurry will be pumped continuously through these preheaters and, subsequently, through an acid injection pot into the 4.6 m diameter x 30 m long, autoclave. The autoclave will be a horizontal, six-compartment, titanium-clad vessel. Solids will be suspended by an agitator in each compartment. Positive displacement pumps will inject acid directly into the autoclave. High pressure steam will be injected to raise the slurry temperature to 250° and pressure to 4600 kPa.

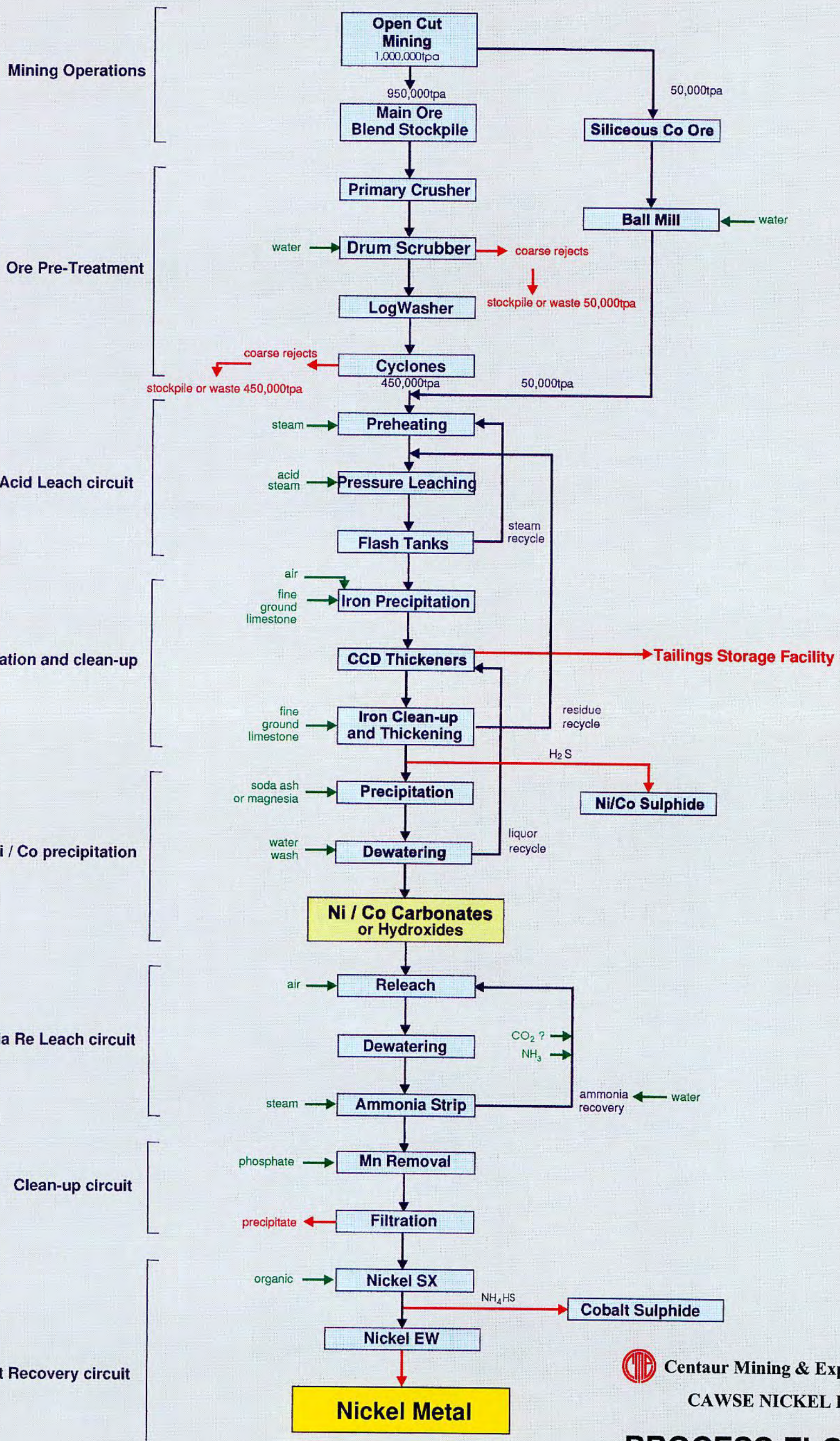
The discharge slurry stream pressure will be let down through ceramic chokes in two stages. Each choke will discharge into a flash tank from which the steam will be directed to the associated slurry preheat vessel. The final slurry will exit at atmospheric pressure, close to the boiling point, and will be mixed in the recycle leach tank with various recycle steams to redissolve nickel and cobalt contained therein.

2.3.5 Purification and Precipitation

As the slurry is depressurised after leaching, steam will flash off and the slurry will cool to 100°C. Limestone will be added to raise the pH and precipitate iron. The solids will then be separated from the pregnant liquor by counter current decantation (CCD). Overflow solution from the CCD circuit will pass to the following process stage and the solids will be discharged to a tailings impoundment.

The pregnant solution will be purified of residual iron by further limestone addition prior to the precipitation of nickel and cobalt carbonate by the addition of soda ash. There is an option to stop processing at this point and sell a nickel/cobalt sulphide precipitate to existing refineries. This would require the addition of hydrogen sulphide which would be produced on-site by a separate hydrogen sulphide plant, if required (see section 2.3.8).

Process Flowsheet



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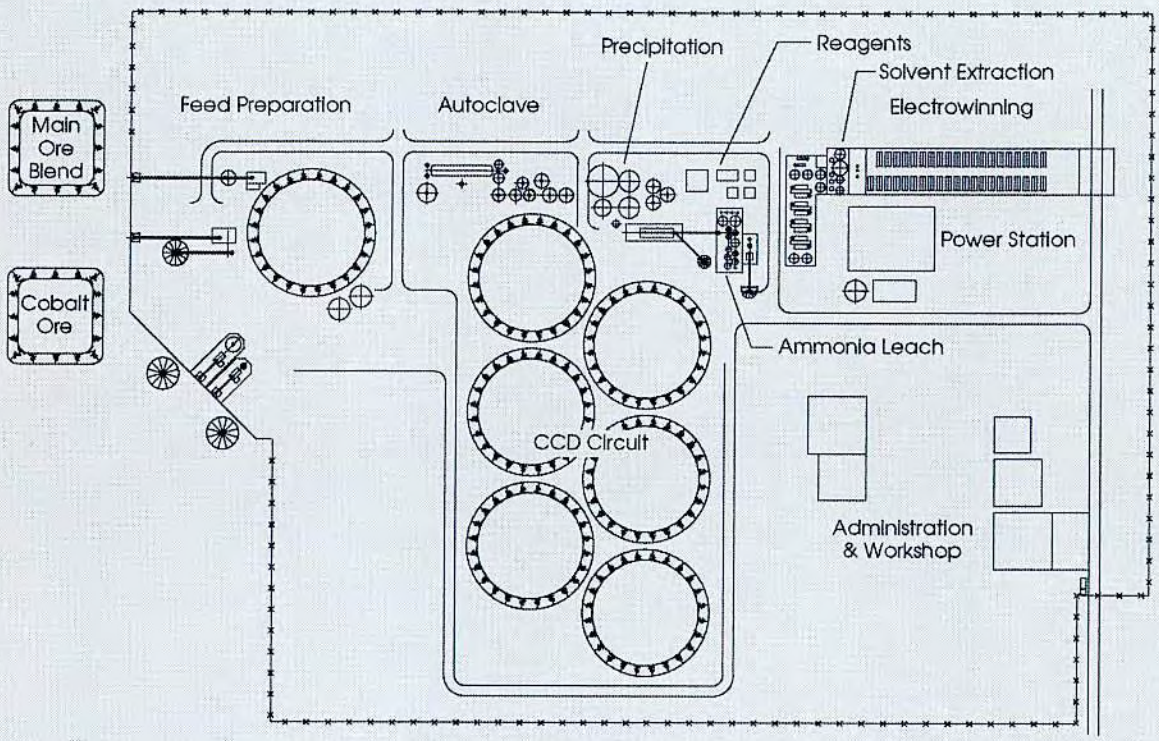
CAWSE NICKEL PROJECT

PROCESS FLOWCHART

FIGURE 4

Woodward-Clyde

ENVIRONMENTAL DRAFTING (09) 354 9052
A3 AGC\A3300102\FIG4.DGN



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CAWSE NICKEL PROJECT

PLANT LAYOUT

FIGURE 5

ENVIRONMENTAL DRAFTING (09) 354 9052

A4 AGC\A3300102\FIG5.DGN

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2.3.6 Ammonia Leach

The nickel/cobalt precipitate will be re-leached as ammonium salts. A partial strip of free ammonia may be required prior to the extraction, followed by the removal of traces of manganese by the addition of ammonium phosphate.

The ammonia will be recovered and recycled, with only minor make-up required.

2.3.7 Solvent Extraction and Electrowinning

2.3.7.1 Nickel

Nickel will be extracted from the pregnant ammoniacal solution using an organic solvent (LIX 84 I). The loaded organic will be scrubbed with acidified water to remove any co-extracted contaminants. The nickel will then be stripped from the organic using acidic spent electrolyte, thus producing a pure nickel electrolyte from which the nickel will be electrowon. The nickel will be deposited as "starter sheets", which will be returned to the cells for further nickel deposition to produce saleable cathodes. Provision has been made for the cathodes to be packed and strapped onto pallets, for shipment.

Entrained organic will be removed from aqueous solutions by flotation and filtration.

Initial production of nickel will be in the range of 8,000 - 15,000 tpa. A potential duplication of the processing plant could double this production to 30,000 tpa.

2.3.7.2 Copper

Provision has been made to strip copper which will co-extract with the nickel, by treating a slip stream of the organic solvent with strong acid. The copper will be precipitated from the aqueous solution using magnesia, filtered, dried and sold as an impure bi-product.

2.3.7.3 Cobalt

Cobalt will be recovered from the nickel extraction solution by the addition of ammonium hydrosulphide. The precipitate will be filtered, partially dried and sold. Zinc will also precipitate and be contained in this by-product.

The barren ammoniacal liquor will be recycled for re-use in the ammonia leach.

Initial cobalt production will be in the range of 1,000 - 2,000 tpa. A duplication of the processing plant would not substantially increase this production as lower grade cobalt ore zones will be encountered as mining progresses.

2.3.8 Hydrogen Sulphide Plant

The option to produce a nickel/cobalt sulphide precipitate, as an intermediate product, to sell to existing nickel refineries is raised in section 2.3.5. This would require the development of a hydrogen sulphide plant on site. Such a plant would be a modular unit with a capacity of approximately 10,000 tpa, based on the initial processing rate of 500,000 tpa. Incremental expansions would be required as the processing rate is increased.

Hydrogen sulphide (H_2S) is typically produced by reacting hydrogen gas with elemental sulphur. Approximately 10,000 tpa of sulphur would be required to produce 10,000 tpa of H_2S. Hydrogen would be produced on site from natural gas.

No specifications have been developed for a hydrogen sulphide plant, to date, as the option has not yet been decided.

2.3.9 Gaseous Emissions

No significant gaseous emissions will be produced from the high pressure leach, purification and nickel/cobalt recovery processes as these operate as closed circuits. Where steam may be vented from the high pressure acid leach circuit, wet scrubbing will be employed to remove any sulphuric acid that may be contained.

No gaseous emissions will be produced from the ammonia leach as it is a closed circuit with ammonia stripping and regeneration modules. No upset conditions are associated with these processes which could result in any significant gaseous emission.

No sulphuric acid will be produced on site which would be a potential source of SO_2, NO_2 and CO emissions.

Some minor emissions may be associated with the power station which is discussed in Section 2.5.2. Such emissions from high efficiency gas engines would be well below EPA specified limits. Typical gaseous emissions for duel fuel gas engines are provided in Table 2-2.

TABLE 2-2
GASEOUS EMISSIONS FOR POWER STATION
(6.5×10^7 kwhr/year @ 500,000 tpa)

Emission	g/kwhr
NO_x	6
CO	2.4
CO_2	200
SO_2	negligible
Total Hydrocarbon	0.7

Source: Detroit Engine and Turbine Co.

A hydrogen sulphide plant, if required, could be a potential source of gaseous emissions. These would be primarily hydrogen sulphide and sulphur dioxide. Any excess hydrogen sulphide which may be produced would be flared rather than being released directly to the atmosphere. This could produce minor emissions of sulphur dioxide under infrequent upset conditions. No decision has been made on whether such a plant is required at this stage. This option will be considered in the detailed design phase.

2.3.10 Tailings Storage Facility

Processing of the nickel cobalt ore will produce tailings from the leaching process in the form of a slurry containing approximately 40% solids by mass.

Table 2-3 indicates levels of various elements present in tailings material produced from pilot processing of the bulk sample.

TABLE 2-3

CHEMICAL COMPOSITION OF TAILINGS MATERIAL

Element	Concentration (ppm except as indicated)
Arsenic	12
Calcium	7.82%
Cobalt	232
Copper	122
Magnesium	5991
Aluminium	1.52%
Cadmium	<1
Chromium	6192
Iron	15.35%
Manganese	171
Sodium	1.25%
Lead	<5
Zinc	200
Sulphur (as sulphate)	10.56%

Indicative levels for tailings solution composition are presented in Table 2-4

TABLE 2-4

TAILINGS SOLUTION COMPOSITION

Element	Concentration (g/L)
Sodium	14.3
Chloride	25.2
Manganese	1.4
Cobalt	0.01
Zinc	0.001
Magnesium	21.9
Calcium	1.33
Iron	0.003
Nickel	0.08

It is estimated that the pH of the tailings solution will be approximately 5.0. Salinity will vary depending on process water quality which will be in the range of 30,000 to 60,000 ppm TDS.

The tailings will be deposited into an engineered storage impoundment which is designed and constructed to minimise the potential for seepage of process water into the surrounding environment. The tailings storage facility walls will be constructed using suitable selected low permeability waste material from the mining pits. Geotechnical testing of overburden materials is being conducted to determine characteristics and quantities of material available as part of the Feasibility Study.

A single impoundment cell measuring 500 m x 500 m will initially be constructed to contain tailings from the first 12 months of processing. During this time a second cell will be constructed as suitable overburden material is produced from mining operations. The operation of two cells will allow alternate discharge and drying of the tailings. Two additional cells will be constructed over the 20 year life of the Project covering a total area of approximately 100 ha based on the initial 20 Mt of proven ore reserves. Increasing the processing rate to 1 Mtpa or even 2 Mtpa would not require an increase in

the overall size of the proposed tailings storage facility. However, the rate of deposition would be increased.

Maximising water recovery from the tailings storage facility is a key factor in achieving significant water savings while improving the consolidation of the tailings material.

Preliminary design details of the tailings storage facility are provided in Appendix D. Detailed design of the tailings storage facility for construction and management will be undertaken as results of geotechnical and process test work are obtained.

2.3.11 Process Additives

2.3.11.1 Sulphuric Acid

Based on the estimated consumption at 375 kg/t leach feed, the annual sulphuric acid requirement will be approximately 200,000 tonnes. Centaur will purchase concentrated (98%) sulphuric acid from Western Mining Corporation's (WMC) Kalgoorlie Nickel Smelter. The sulphuric acid will be trucked to the Cawse Project by WMC in tankers which conform with the requirements of the Dangerous Goods Regulations.

The alternative of producing sulphuric acid on-site using imported elemental sulphur was considered, but was rejected for the following reasons:

- satisfactory agreement reached with WMC for reliable supply of sufficient quantities of acid;
- reduced up-front capital cost for project;
- environmental impacts associated with acid production i.e. SO_2 emissions; and
- problems associated with import of sulphur through Esperance.

2.3.11.2 Limestone and Magnesia

Approximately 100,000 tpa of limestone will be required at an ore processing rate of 500,000 tpa. Pebble limestone will be purchased from a local supplier and transported to

site by a combination of rail and road. The limestone will be crushed on-site and stored in silos.

Approximately 11,000 tpa of magnesia will be purchased in bulk from Queensland and transported to site by a combination of road and rail where it will be stored in silos.

2.3.11.3 Ammonia and Other Reagents

The ammonia will be purchased as a liquid in ISO containers, from which it will be drawn as required. The ammonia releach portion of the process has been designed as a closed circuit with ammonia stripping and regeneration modules. This means only minor make-up ammonia will be required during the operational phase. It is estimated that approximately 200 tpa of ammonia will be used in the process.

Kerosene used as a diluent for the active extraction solvents will be received in road tankers and stored in a 50,000 litre tank. It is estimated that approximately 320 kL of kerosene will be used in a year.

The organic solvents will be delivered and stored in 200 litre drums.

Flocculants will be received in bags. Mixing and hydration will be automated for continuous operation.

Caustic soda will be received in bulk by road tanker as a solution. It will be transferred into a stock tank from where it will be distributed as required.

Ammonium phosphate will be received in bulk bags and dissolved to 25% concentration for distribution.

Ammonia hydrosulphide is used for precipitating cobalt and will be received in bulk by road tanker as a solution and stored in tanks.

All bulk storages of ammonia and other reagents on site, will be bunded according to the requirements of the Dangerous Goods Regulations, 1992.

Table 2-5 provides a summary of annual requirements of various process additives.

TABLE 2-5
PROCESS ADDITIVES
(at a process rate of 500,000 tpa)

Additive	Consumption
Sulphuric Acid	200,000 tpa
Ammonia	200 tpa
Limestone	100,000 tpa
Magnesia	11,000 tpa
Ammonia Hydrosulphide	15,000 tpa
Caustic Soda	150 tpa
Kerosene	320 kLpa
Ammonia Phosphate	15 tpa
Organic Solvents	16 kLpa

2.4 CONSTRUCTION

Plant construction and infrastructure requirements include:

- ore stockpiling and crushing facilities;
- screening and grinding equipment;
- acid leach processing plant;
- hydrometallurgical circuit;
- solvent extraction and electrowinning plant;
- gas supply pipeline and gas power station;
- plant and equipment workshop;
- administration building;
- acid and reagent storage tanks;
- fuel storage tank;

- tailings storage facility and return water pond (100 ha);
- water supply pipelines and pipelines;
- mine access road (approximately 5 km); and
- haul roads (approximately 12 km).

A site plan showing the proposed mining, processing and infrastructure development requirements is presented in Figure 6.

Construction is proposed to commence in August 1996. The construction workforce will be about 250-300 people who will be accommodated in Kalgoorlie.

2.5 INFRASTRUCTURE REQUIREMENTS

2.5.1 Water Supply and Pipeline

Significant quantities of reasonable quality processing water (ie. < 40,000 ppm TDS) are present in fractured rock aquifers along the strike of the orebody within 15 km to the north-west of the plant site. Investigations to determine if these will fully meet the Project requirement of 4,700 kL per day at a processing rate of 500,000 tpa are in progress. This amount represents a maximum estimated requirement for early stages of the Project as it does not take into account return water from the tailings. Tailings return water may provide up to 30% of this requirement. A processing rate of 1 Mtpa would require approximately 6,000 kL/day of make-up water from the borefields. Expanded production, duplication of the processing plant to 2 Mtpa, would require up to 12,000 kL/day.

Additional water supplies are being investigated from paleochannels up to 30 km north of the project area. Potential borefields being investigated are in the vicinity of Bitter Bore, Sheepyard dam and Leaky Dam as shown in Figure 1. The studies are not yet completed. However, it is most likely that the process water will be a blend of supplies from these water resources.

The expected water quality will contain between 30,000 and 60,000 mg/L TDS. Existing paleochannel borefields in this region are therefore used exclusively for mineral (gold)

processing as the water is not suitable for other beneficial uses such as stock water. Saline groundwater is suitable for use in the process. It is, however, necessary for at least part of the water supply to have total dissolved solids (TDS) values less than 60,000 mg/L for desalination to produce potable water for steam.

A water supply pipeline is required to be constructed to link the borefields to the processing plant. As the borefields have not yet been proven, the final pipeline route is not known at this stage. It will, however, be properly engineered and constructed of high density polyethylene medium pressure pipe. The alignment will be planned to follow existing tracks, where practicable, and avoid areas of significant vegetation.

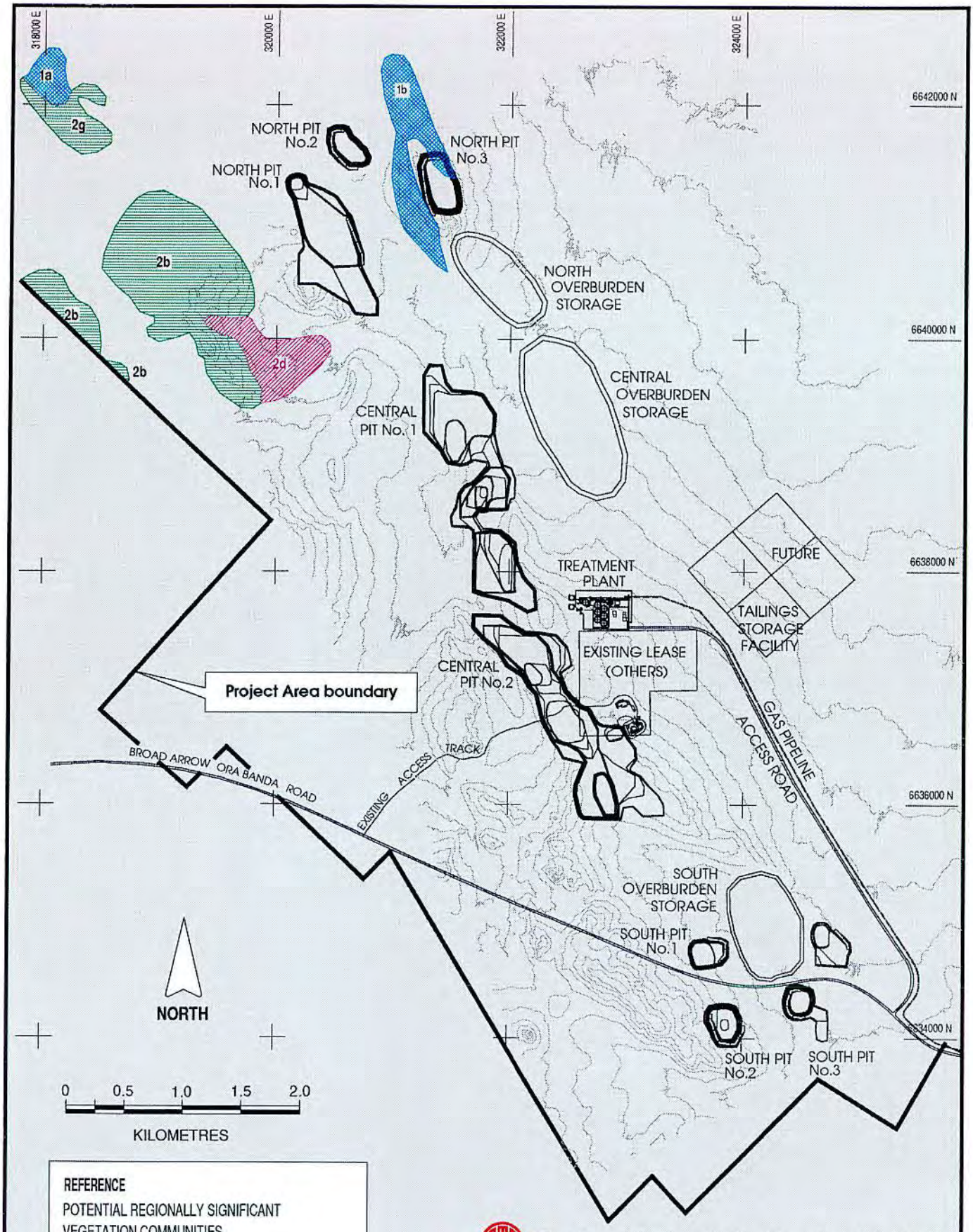
A desalinisation plant, consisting of a distillation unit utilising waste heat from the power station, will process a portion of the borewater to provide low TDS quality water for steam generation, the ammonia leach circuit and potable water. Negotiations are under way with neighbouring gold mining operations to use the excess high salinity water produced by the desalinisation plant so that evaporation ponds are not required.

Considerable emphasis was placed during the Project planning phase on means of reducing process water requirements. As an outcome, the recovery and re-use of various process and waste streams has resulted in a reduction of up to 50% of the original estimated water demand. This has produced significant cost savings and environmental benefits.

2.5.2 Electricity Supply

The preferred option for the Project is a power station with gas engines, and waste heat recovery boilers to meet the steam demand.

The proposed power station comprises six, 2.2 MW, 750/1,000 rpm, reciprocating gas engines generating at 11 kV. Five of the gas engines will be on duty, with one unit for standby. The gas engines run on a mixture of natural gas (95%) and diesel fuel (5%). The alternative of gas turbines was considered in the Project planning but reciprocating gas engines were found to be more fuel efficient.



Centaur Mining & Exploration Limited

CAWSE NICKEL PROJECT

PROJECT AREA AND SITE LAYOUT

FIGURE 6

ENVIRONMENTAL DRAFTING (09) 354 9052

A4 AGC\A3300102\FIG6.DGN

Woodward-Clyde

Existing Western Power power lines run within 10 km of the planned processing plant site. The option of providing an alternative or back-up supply from this grid is also being investigated.

2.5.3 Gas Supply

The Project lies within 30 km of the Goldfields Gas Transmission (GGT) pipeline. The gas supply for the power station and steam generation would be via an underground spur line connected to the GGT pipeline. The spur line will be located along the existing road easement and the mine access road to reduce disturbance to areas of native vegetation. Permission to use the road easement for a gas pipeline spur has been given by the Kalgoorlie-Boulder Shire Council.

2.5.4 Access Road

A new access road approximately 5 km in length is proposed to be constructed between the Ora Banda Road and Project area. The road will be located to the east of the orebody in an area underlain by granite. This will avoid interference with prospective mineral resources, such as gold, associated with the greenstone. It also avoids vegetation communities associated with the greenstone which have historically been subject to a high degree of disturbance throughout the region. The access road will be of a high standard gravel road construction.

2.5.5 Transportation

The Project will require the transport of personnel, process materials, fuel and equipment, and product to and from the site. Most of these movements will be concentrated from Kalgoorlie-Boulder north along the sealed Kalgoorlie-Meekatharra Road to Broad Arrow. From Broad Arrow access to the Project would be via the bitumen and gravel Broad Arrow-Ora Banda Road for a distance of approximately 13 km to the proposed mine access road. All transport would be in accordance with Main Roads Department and Department of Minerals and Energy regulations.

Estimated road transport requirements are summarised as follows:

Sulphuric Acid	-	550 tonnes per day = 16 road train movements per day
Limestone	-	275 tonnes per day = 8 road train movements per day
Other Process Additives	-	<100 tonnes per day = 10 truck movements per day
Fuel	-	2 truck movements per day
Personnel	-	3 shifts x 3 buses per shift = 18 bus movements per day
Nickel and Cobalt Product	-	200 tonnes per week = 20 truck movements per week

The above estimates assume the following:

- mining and processing operations would run 365 days per year, 24 hours per day;
- sulphuric acid would be delivered in loads of approximately 70 tonnes;
- limestone would be delivered in loads of approximately 70 tonnes;
- process additives would be delivered in loads averaging less than 20 tonnes;
- fuel loads would be 10-30 tonnes;
- product would be shipped in loads of approximately 20 tonnes; and
- approximately 50% of the overall vehicle movements would be classified as heavy vehicles.

On the basis of the above estimates the Project would result in an increase of approximately 55 truck movements per day.

2.5.6 Workforce, Accommodation and Housing

During the construction period (approximately 11 months) up to 350 persons will be on site with 170-200 persons directly employed on the Project when it is in full production. Both the construction and operations workforces will be bused daily to and from Kalgoorlie, via the Meekatharra and Ora Banda public roads.

3.1 REGIONAL SETTING

The proposed Cawse Nickel Project is located in the Goldfields Region of Western Australia, approximately 50 km north-west of Kalgoorlie and 9 km east of the Ora Banda townsite. The Project area is located on the Credo and Mt Vetters Pastoral Leases.

3.2 CLIMATE

The Project area has an arid climate, characterised by high temperatures, low and variable rainfall and high evaporation rates. Climatic summaries for Kalgoorlie, compiled by the Bureau of Meteorology statistics from 1939 to 1992, are presented in Table 3-1.

Mean maximum monthly air temperatures range from 16.5°C in July to 33.6°C in January, with an annual mean maximum of 25.1°C. The annual mean minimum air temperature is 11.5°C.

TABLE 3-1

MONTHLY CLIMATIC SUMMARY FOR KALGOORLIE

1939-1992

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean min. air temp. (°C)	18.1	17.7	16	12.4	8.4	6.2	4.8	5.4	7.8	10.9	13.9	16.5	11.5
Mean max. air temp. (°C)	33.6	32	29.6	25	20.4	17.4	16.5	18.3	22.1	25.6	28.8	32	25.1
Mean Rainfall (mm)	21.2	26.9	20.4	21.2	28.9	32.2	25.5	21.3	14.3	15.9	17.5	14.6	259.9
Mean no. raindays	4	4	4	5	7	9	9	7	5	4	4	3	65
Mean daily pan evaporation (mm)	12.7	11.2	8.8	5.9	3.6	2.6	2.7	3.7	5.7	8.3	10.2	12.2	-

(Source of Data: Bureau of Meteorology)

Rainfall is unpredictable, low and erratic. The mean monthly rainfall varies from 14.3 mm in September to 32.2 mm in June (Table 3-1). The annual mean rainfall is 259.9 mm, with an average of 65 raindays per annum, indicating an arid climate. Much of this rainfall, however, can occur in intense events. Average Storm Recurrence Intervals are presented in Table 3-2.

TABLE 3-2

AVERAGE STORM RECURRENCE INTERVALS

Return Intervals (years)	5	10	20	50	100
Duration (hours)	Rainfall Intensity (mm/hr)				
1	19.38	23.21	28.49	36.35	43.08
8	5.02	6.10	7.59	9.84	11.79
24	2.33	2.86	3.68	4.67	5.62
48	1.38	1.69	2.12	2.78	3.36

Source: Institution of Engineers, 1987

Mean daily pan evaporation rates range from a minimum of 2.6 mm in June to a maximum of 12.7 mm in January (Table 3-1). Average annual evaporation for Kalgoorlie is 2,644.5 mm.

Wind data collected by the Bureau of Meteorology at Kalgoorlie-Boulder indicate the dominance of easterly winds in the morning (with an average wind speed between 11 to 20 km/hr) between the months of January and April. Wind direction tends towards the north, north-westerly direction in the later afternoon with similar wind speeds. Between the months of May and September, wind direction is predominantly north to north-west at an average wind speed between 11 and 20 km/hr. Between the months of October and December, the wind direction tends towards the easterly direction with an average wind speed between 11 and 20 km/hr.

3.3 GEOLOGY AND SOILS

3.3.1 Geology

3.3.1.1 Regional Geology

The Project area lies within the Coolgardie Plateau of the Coolgardie Region physiographic unit (Beard, 1981). This area is dominated by an extensive greenstone belt, consisting of an area of low hills and broad valleys leading to salt lakes. Drainage is in a north-easterly direction terminating in an extensive series of salt lakes (Mattiske Consulting Pty Ltd, 1995).

3.3.1.2 Deposit Geology

Exploration by Centaur has identified lateritic nickel cobalt mineralisation in a series of sub-horizontal layers within at least six zones extending over approximately 30 km of strike with widths up to 500 m. The mineralisation occurs as nickel and cobalt bearing limonite clays extending from surface to a maximum depth of 50 m. These clays are formed by the intense weathering of underlying nickel bearing ultramafic rocks which occur at depths of 50 to 70 m.

Four distinct types of lateritic nickel/cobalt mineralisation are present at the Project site:

- limonite represents 61% of the resource;
- talc-phlogopite comprises 13% of the ore;
- nontronite clays being 20%; and
- siliceous cobalt totalling 6% of the resource.

Mineralisation widths are commonly substantially greater where bedrock structures such as north-south or east-north-east faults cut the ultramafic sequence. The latter may be intruded by late stage dolerite dykes.

The limonite zones contain low magnesium levels. In the upper portions of the limonite zone, generally within 8-10 m of surface a 1-2 m thick manganese rich layer is commonly developed. The horizon is also rich in cobalt containing 0.15 - 0.2% cobalt.

Plastic nontronitic clays lie within and below the limonite zone and occur sporadically throughout the deposit. The talc mineralisation is associated with bedrock structures and, hence, often occur as steeply dipping rather than horizontal zones. The talc zones contain higher than average nickel grades and also generally occur deeper in the weathering profile than the limonite ores.

The nickel grades and thickness of the limonite mineralisation also tend to increase adjacent to faults and talc zones. These systems comprise the initial mining area as they contain higher grade mineralisation with low stripping ratios.

3.3.2 Soils

The Project area lies within a gently undulating terrain of low relief dominated by neutral red earths on the plains, calcareous loams and brown calcareous earths on the elevated hilly portions and saline soils on and near the playa lakes (Mattiske Consulting Pty Ltd, 1995). These soils are typical of the Coolgardie Plateau.

3.4 HYDROLOGY AND GROUNDWATER

3.4.1 Surface Hydrology

The surface drainage regime in the vicinity of the project area is typified by gently undulating ridges with well defined channels which outwash on to a broad valley (Figure 7). The valley is relatively flat with numerous depressions. An ephemeral drainage line, flowing from south to north, is located approximately 2 km to the north-east of the proposed processing plant site. This drainage continues in a north-easterly direction and ultimately terminates in an extensive series of salt lakes.

The minor drainage lines along the ridges will flow intermittently following significant rainfall events. Sheet flow over the broad valley also occurs during significant rainfall events. This occurs as rainfall runoff progressively fills the series of depressions until all storages are inter-connected. Once these storages have been filled, major runoff could occur from relatively small rainfall events. The total catchment will only produce noticeable runoff following a major rainfall event or series of smaller events.

Centaur Mining & Exploration Limited

CAWSE NICKEL PROJECT

DRAINAGE REGIME

REFERENCE

- Watercourse
- Sealed road
- Gravel road / track

Project Area boundary

Catchment Area boundary

CATCHMENT AREA

SHEET FLOW

SHEET FLOW

CHANNEL FLOW

Leaky Dam

Telegraph Dam

Bitter Bore

White Well

New Sheep Yard Dam

Sheep Yard Dam

Pumping Well Dam

Vetters Dam

Vetters Sand Hill

VETTERSBURG

Cosgrove Dam

Bull Ant Dam

Blue Dam

BARDOC

North Pits

Round Dam

Middle Bunyip Dam

Overburden Storage

Plant Site

Government Dam

ORA BANDA

MOUNT GARNAGE

Tailings

Mine

Mining Piles

CASHMANS

Central Pits

Bunyip Dam

Tailings Storage Facility

GIMLET SOUTH MINE

STEWART MINING CENTRE

CAWSE FIND

Cawse Tank

Forty Five Mile Tank

LADY EVELYN

BLACK RANGE

Mining Area

Overburden Storage

Southern Pits

Windanya Dam

Tank

Mining Area

Gnamma Hole (P.D.)

WELLINGTON GROUP

DARK HORSE

GRANTS PATCH

BROAD ARROW

NORTH

0 1 2 3 4

KILOMETRES

FIGURE 7

ENVIRONMENTAL DRAFTING (09) 354 9052

A3 AGC\A3300102\FIG7.DGN

Woodward-Clyde

Most of the Project area including the mine, processing plant and tailings storage facility is located at higher points in the landscape where natural drainage lines are well defined.

3.4.2 Groundwater

The Project area lies within the Yilgarn Goldfields fractured-rock groundwater province where the general occurrence of groundwater is associated with weathered and fractured Archaean bedrock, widespread alluvium and lake deposits and localised palaeochannel deposits.

In the area of the mineral deposit, groundwater occurrence is associated with mafic and ultramafic rocks which form part of a north-westerly trending greenstone belt. The depth to water ranges from about 40 to 50 m below ground level and the groundwater is saline with a typical total dissolved solids concentration in excess of 25,000 mg/L. Groundwater flow, which is related to topography, is towards the north-east. Groundwater recharge is only a very small proportion of rainfall and leakage flows may occur between the main aquifer zone and overlying alluvium and/or between the main aquifer zone and adjacent lower-permeability rocks.

Where sufficiently well fractured, useful yields of saline groundwater can be obtained from the mafic and ultramafic rocks at depths of up to about 120m below ground level. Yields of between 360 and 600 kL/d have been obtained from a borefield located several kilometres along strike from the proposed mining area.

3.5 VEGETATION AND FLORA

A flora and vegetation survey was undertaken for the Cawse Project area in November 1995 by Mattiske Consulting to define and describe the botanical values of the area. The survey was conducted during a favourable season for identifying much of the regional flora. The Project area lies near the northern boundary of the Swan Natural Region, within the Southwestern Interzone Botanical Provinces defined by Beard (1981). The Southwestern Interzone Botanical Province is characterised by plants predominantly from the families Mimosacaeae (Wattles), Myrtaceae (Eucalypts) Myoporaceae (Poverty Bushes), Chenopodiaceae (Samphires, Bluebushes), Asteraceae (Daisies) and Poaceae (Grasses) (Mattiske Consulting Pty Ltd, 1995).

The vegetation of the Project area lies near the northern boundary of the Coolgardie Botanical District. It is heavily influenced by the Eremaean Botanical District which lies to the north-east. The vegetation in the area of this region is predominantly open sclerophyll woodlands dominated by *Eucalyptus clelandii*, *Eucalyptus salmonophloia* and *Eucalyptus transcontinentalis* (Beard, 1972). These areas are interspersed by Mulga (*Acacia aneura)* and *Casuarina* low woodlands on the plains and dense thickets on the ironstone ridges (Beard, 1990; Mattiske Consulting Pty Ltd, 1995).

The nearest conservation reserve to the Project area is Kurrawang Nature Reserve, located 54 km to the south and about 10 km south west of Kalgoorlie.

3.5.1 Vegetation

The vegetation of the Project area is characterised by Eucalypt-Casuarina-Mulga woodlands interspersed with *Acacia acuminata* spp. *burkittii* Shrublands. A total of 17 plant communities were defined and mapped by Mattiske Consulting Pty Ltd in October and November 1995 (Figure 8). This mapping was conducted over the entire Cawse lease area and therefore covers a much larger area than the orebodies which are the subject of this CER.

The plant communities identified are described in the following Sections.

WOODLANDS

1a Open Woodland of *Eucalyptus ebanoensis* and Casuarina over Acacia and Senna over an open herb layer of mixed Asteraceae species on stony rises

1b Woodland of *Eucalyptus clelandii* over midstorey of Eremophila over understorey of Eremophila, Acacia Frankenia and Atriplex on slopes

1c Woodland of *Eucalyptus ebanoensis* and *E. laxophleba* over a midstorey of Acacia and Allocasuarina over understorey of Scaevola, Dodonaea, Eriostemon and Grevillea on ridges

1d Open Woodland of *Casuarina eristata* over low shrubs of Atriplex and Acacia over dense herbs of Rhodanthe, Schoenia and introduced thistle Centaurea on drainage lines

1e Very Open Woodland of *Eucalyptus transcontinentalis* and *E. salubris* over midstorey of Eremophila over a herb layer dominated by Stipa and mixed Asteraceae species on broad valleys

1f Woodland of *Eucalyptus salmonophloia* and *E. transcontinentalis* over *E. clelandii* and Casuarina over midstorey of Eremophila and Acacia and understorey of Maireana and Atriplex on broad valleys

1g Open Woodland of *Eucalyptus salmonophloia* and Casuarina over Acacia, Senna and Ptilotus over dense herb layer of Rhodanthe and grasses such as Stipa and Eragrostis on broad valleys

SHRUBLANDS

2a Open Shrubland of *Acacia quadrimarginea* and *A. kalgoorliensis* over Scaevola and Mirbelia on granite ridges

2b Shrubland of *Acacia acuminata* and *A. kalgoorliensis* and Allocasuarina with emergent mallee Eucalyptus over understorey of Triodia on ridges

2c Shrubland of Acacia species over midstorey of Scaevola, Dodonaea, Senna and Eremophila with understorey of Ptilotus, interspersed with Woodland of Eucalyptus and Casuarina over midstorey of Eremophila and Acacia over understorey of Acacia, Scaevola and Dodonaea on undulating low stony rises

2d Shrubland of *Acacia acuminata* and *A. prainii* with emergent Eucalyptus over herb layer of Stipa and Asteraceae species on undulating rises

2e Shrubland of Acacia species over understorey of Dodonaea, Eremophila and Allocasuarina over low shrubs of Prostanthera and Dodonaea occasionally with Triodia interspersed with Woodland of Eucalyptus and Casuarina on undulating rises

2f Shrubland of *Acacia acuminata* Eremophila and Senna with emergent Eucalyptus over mixed low shrubs on undulating stony rises

2g Shrubland of *Acacia acuminata* and *A. kalgoorliensis* and Allocasuarina with emergent Eucalyptus over understorey of Scaevola, Dodonaea and Mirbelia on undulating stony rises

2h Open Low Shrubland of *Senna artemisioides*, Atriplex, Acacia over dense herb layer of Rhoadanthe and the grass Stipa on drainage lines

2i Shrubland consisting of *Acacia acuminata* with occasional *Eucalyptus eremicola* and Casuarina over Senna and Acacia on drainage lines

2j Shrubland of *Acacia stowardii* and *A. ramulosa* with emergent Casuarina and Eucalyptus spp. over dense Asteraceae species on plains

6 650 000mN
6 645 000mN
6 640 000mN
6 635 000mN
310 000mE
315 000mE
320 000mE
325 000mE
330 000mE

New Sheep Yard Dam
Sheep Yard Dam
Horrys Bore
Coegrove Dam
Paddy Knob Bore (P.D.)
Mine
E.W.s
Government Dam
QRA BANDA
MOUNT CARNAGE
Ov
Mine
Piles
Mining
CASHMANS
STEWART MINING CENTRE
Tailings
LADY EVELYN
Mine
Round Dam
Middle Bellyna Dam
Bunyip Dam
CAWSE FIND Mine
Cawse Tank
Windarrya Dam
Mining Area
M24/539
M24/517
M24/518
E24/7

NORTH

0 0.5 1.0 1.5 2.0
KILOMETRES

REFERENCE
Watercourse
Gravel road / track

ENVIRONMENTAL DRAFTING (09) 354 9052
A3 AGC\A3300102\FIG8.DGN

Centaur Mining & Exploration Limited

CAWSE NICKEL PROJECT

VEGETATION MAP

FIGURE 8

Woodward-Clyde

3.5.1.1 Woodlands

Community Type 1a Open Woodland of *Eucalyptus ebbanoensis* and *Casuarina cristata* ssp. *pauper* over *Acacia acuminata* ssp *burkittii* and *Senna artemisioides* ssp. *filifolia* over an open herb layer of mixed Asteraceae species on stony rises.

This community is located outside the immediate ore body area and is considered to be locally significant. As the community has not been described by McKenzie and Hall (1992) or Beard (1981), it may, therefore, be regionally significant.

Community Type 1b Woodland of *Eucalyptus clelandii* over mid-storey of *Eremophila scoparia* and *Eremophila interstans* over understorey of *Eremophila parvifolia* ssp. *auricampa*, *Acacia erinacea*, *Frankenia aff. magnifica*, *Atriplex cinerea* and *Atriplex nummularia* ssp. *spathulata* on slopes.

This community is located outside the immediate ore body area and is considered to be locally significant. As the community has not been described by McKenzie and Hall (1992) or Beard (1981), it may, therefore, be regionally significant.

Community Type 1c Woodland of *Eucalyptus ebbanoensis* and *Eucalyptus loxophleba* over a mid-storey of *Acacia acuminata* ssp. *burkittii* and *Allocasuarina eriochlamys* ssp. *eriochlamys* over understorey of *Scaevola spinescens, Dodonaea lobulata, Eriostemon brucei ssp. brucei* and *Grevillea oligomera* on ridges.

This community was relatively well represented within the Project area.

Community Type 1d Open woodland of *Casuarina cristata* ssp. *pauper* over low shrubs *of Atriplex cinerea* and *Acacia hemiteles* over dense herbs of *Rhodanthe charsleyae*, *Schoenia cassiniana* and introduced thistle *Centaurea melitensis* on drainage lines.

This community is typical of broad drainage lines within the region.

Community Type 1e Very open woodland of *Eucalyptus transcontinentalis* and *Eucalyptus salubris* var. *glauca* over mid-storey of *Eremophila interstans* over a herb layer dominated by *Stipa scabra* and mixed Asteraceae species on broad valleys.

This community is widespread locally within the Project area and regionally throughout the Coolgardie Plateau (Beard, 1981).

Community Type 1f Woodland of *Eucalyptus salmonophloia* and *Eucalyptus transcontinentalis* over *Eucalyptus clelandii* and *Casuarina cristata* ssp. *pauper* over mid-storey of *Eremophila scoparia* and *Acacia oswaldii* and understorey of *Maireana sedifolia* and *Atriplex nummularia* ssp. *spathulata* on broad valleys.

This community is very widespread both locally and regionally (Beard, 1981).

Community Type 1g Open Woodland of *Eucalyptus salmonophloia*, *Eucalyptus transcontinentalis* and *Casuarina cristata* ssp. *pauper* over *Acacia acuminata* ssp. *burkittii*, *Acacia erinacea*, *Senna artemisioides* ssp. *filifolia*, *Ptilotus obovatus* over dense herb layer of *Rodanthe floribunda* and grasses such as *Stipa scabra* and *Eragrostis dielsii* on broad valleys.

This community is relatively widespread within the Project area and the region.

3.5.1.2 Shrublands

Community Type 2a Open Shrubland of *Acacia quadrimarginea* and *Acacia kalgoorliensis* (Priority 3 species) over *Scaevola spinescens*, *Mirbelia depressa* and *Eremophila* aff. *incisa* on granite ridges.

This community was not well represented within the Project area and is considered to be locally significant. However, it is widespread throughout the region (McKenzie and Hall, 1992).

Community Type 2b Shrubland of *Acacia acuminata* ssp. *burkittii*, *Acacia kalgoorliensis*, *Allocasuarina helmsii* and *Allocasuarina eriochlamys* ssp. *eriochlamys* with emergent mallee *Eucalyptus ebbanoensis* over understorey of *Triodia irritans* on ridges.

This community, although widespread throughout the region (McKenzie and Hall, 1992), was not well represented within the Project area and is therefore considered to be locally significant. Two Priority species were recorded in this community (see Section 3.5.2).

Community Type 2c Shrubland of *Acacia ramulosa*, *Acacia acuminata* ssp. *burkittii*, *Acacia aneura* var. *aneura* and *Acacia stowardii* over mid-storey of *Scaevola spinescens*, *Dodonea lobulata*, *Senna artemisioides* ssp. *filifolia* and *Eremophila decipiens* with understorey of *Ptilotus obovatus*, interspersed with Woodland *of Eucalyptus transcontinentalis*, *Casuarina cristata* ssp. *pauper*, *Eucalyptus clelandii*, *Eucalyptus loxophleba* and *Eucalyptus calycogona* over mid-storey of *Eremophila interstans*, *Eremophila oppositifolia* and *Acacia acuminata* ssp. *burkittii*, over understorey of *Acacia*

erinacea, *Scaevola spinescens* and *Dodonea lobulata* on undulating stony rises.

This community was widespread throughout the Project area and is typical of the region.

Community Type 2d — Shrubland of *Acacia acuminata* ssp. *burkittii* and *Acacia prainii* var. *linearis* with emergent *Eucalyptus griffithsii* over herb layer of *Stipa scabra* and Asteraceae species on undulating rises.

This community, located outside the immediate ore body, was recorded at one location within the Project area and is considered locally significant. It appears to be a variation of Community 2b and was located outside the immediate ore body. *Acacia kalgoorliensis* (Priority 3 species) was recorded in this community.

Community Type 2e — Shrubland of *Acacia stowardii*, *Acacia acuminata* ssp. *burkittii* and *Acacia ramulosa* over understorey of *Dodonea rigida*, *Eremophila granitica* and *Allocasuarina eriochlamys* ssp. *eriochlamys* over low shrubs of *Prostanthera wilkieana* and *Dodonaea microzyga* var. *acrolobata*, occasionally with *Triodia irritans* interspersed with Woodland of *Eucalyptus clelandii*, *Eucalyptus eremicola*, *Eucalyptus grifithsii* and *Eucalyptus transcontinentalis* and *Casuarina cristata* ssp. *pauper* on undulating rises.

This community was widespread throughout the Project area and is typical of the region.

Community Type 2f — Shrubland of *Acacia acuminata* ssp. *burkittii*, *Eremophila interstans* and *Senna artemisiodes* ssp. *filifolia*, with emergent

Eucalyptus clelandii and *Eucalyptus griffithsii* over mixed low shrubs on undulating stony rises.

This community was not well represented within the Project area and appears to be a local variant of *Acacia acuminata* ssp. *burkittii* shrublands.

Community Type 2g — Shrubland of *Acacia acuminata* ssp. *burkittii*, *Acacia kalgoorliensis* (Priority 3 species) and *Allocasuarina eriochlamys* ssp. *eriochlamys* with emergent *Eucalyptus ewartiana* and *Eucalyptus griffithsii* over understorey of *Scaevola spinecens*, *Dodonaea microzyga* var. *acrolobata* and *Mirbelia depressa* on undulating stony ridges.

This community was well represented in the Project area and is typical of the shrublands of this region. One of the species within this community is listed as Priority Three with the Department of Conservation and Land Management.

Community Type 2h — Open low shrubland of *Senna artemisioides* ssp. *filifolia*, *Atriplex cinerea*, *Acacia hemiteles* and *Atriplex nummularia* ssp. *spathulata* over dense herb layer of *Rhodanthe floribunda* and the grass *Stipa scabra* on drainage lines.

This community was widespread throughout the Project area and is typical of the region.

Community Type 2i — Shrubland consisting of *Acacia acuminata* ssp. *burkittii*, with occasional *Eucalyptus eremicola* and *Casuarina cristata* ssp. *pauper* over *Senna glutinosa* ssp. *chatelainiana*, *Senna artemisioides* ssp. *filifolia* and *Acacia hemiteles* on drainage lines.

This community was recorded at one location within the Project area, however, it is typical of the region.

Community Type 2j — Shrubland of *Acacia stowardii* and *Acacia ramulosa* with emergent *Casuarina cristata* ssp. *pauper, Eucalyptus loxophleba, Eucalyptus lucasii* and *Eucalyptus eremicola*, over dense Asteraceae species on plains.

This community was quite widespread within the Project area and is typical of the region.

3.5.1.3 Significant Vegetation Communities

Of the 17 vegetation communities identified in the survey, two community types were considered to be locally significant, and may possibly be regionally significant. These vegetation communities are:

Community Type 1a — Open Woodland of *Eucalyptus ebbanoensis* and *Casuarina cristata* ssp. *pauper* over *Acacia acuminata* ssp *burkittii* and *Senna artemisioides* ssp. *filifolia* over an open herb layer of mixed Asteraceae species on stony rises.

Community Type 1b — Woodland of *Eucalyptus clelandii* over mid-storey of *Eremophila scoparia* and *Eremophila interstans* over understorey of *Eremophila parvifolia* ssp. *auricampa, Acacia erinacea, Frankenia aff. magnifica, Atriplex cinerea* and *Atriplex nummularia* ssp. *spathulata* on slopes.

Another three communities are widespread throughout the region but are not well represented within the Project area, and are therefore considered to be locally significant.

Community Type 2a Open Shrubland of *Acacia quadrimarginea* and *Acacia kalgoorliensis* over *Scaevola spinescens*, *Mirbelia depressa* and *Eremophila* aff. *incisa* on granite ridges.

Community Type 2b Shrubland of *Acacia acuminata* ssp. *burkittii*, *Acacia kalgoorliensis*, *Allocasuarina helmsii* and *Allocasuarina eriochlamys* ssp. *eriochlamys* with emergent mallee *Eucalyptus ebbanoensis* over understorey of *Triodia irritans* on ridges.

Community Type 2d Shrubland of *Acacia acuminata* ssp. *burkittii* and *Acacia prainii* var. *linearis* with emergent *Eucalyptus griffithsii* over herb layer of *Stipa scabra* and Asteraceae species on undulating rises.

None of these five community types is represented in the nearest Reserve, Kurrawang Nature Reserve (Chapman *et al.*, 1991). However, most of the significant vegetation types identified in the area occur outside the immediate orebody being considered in this CER and areas set aside for overburden storage, stockpiling and mine facilities. The location of the Project infrastructure and stockpiles has been designed to ensure that disturbance to these plant communities will be minimised. However, the North Pit #3 does impinge on community type 1b which was identified within the Project area. It is estimated that less than 10% of this community type will be affected by the pit development. (Figure 6).

3.5.2 Flora

A total of 131 vascular plant species from 65 genera and 34 families were recorded by Mattiske Consulting Pty Ltd. for the Project area (Appendix B). This total included two introduced species. The dominant families were Asteraceae (17 species), Myoporaceae (16 species), Myrtaceae (14 species), Mimosaceae (10 species) and Chenopodiaceae (9 species).

These five groups contributed to 50% of the flora collected in the area and the representation is typical of the contribution of these families to the flora of the Coolgardie Botanical District.

During the field surveys conducted in October 1995 by Mattiske Consulting Pty Ltd., no Declared Rare Flora which are listed in the Wildlife Conservation (Rare Flora) Notice July 1995, gazetted pursuant to subsection (2) of Section 23F of the *Wildlife Conservation Act, 1950-1980* were located within the Project area.

Two flora species, *Acacia kalgoorliensis* and *Eremophila pustulata*, listed as Priority Three - Poorly Known Taxa by the Department of Conservation and Land Management (1995), were located within the survey area by Mattiske Consultants in October 1995. Priority Three species are "Taxa which are known from several populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey" (Department of Conservation and Land Management, 1995).

Both species occurred in Plant Community 2b while *Acacia kalgoorliensis* also occurs in Communities 2a, 2d and 2g. All these communities occur within the leases of the Project area, but are outside the currently identified ore body and area of plant infrastructure and hence will not be subject to disturbance during the mining, plant and infrastructure construction work being considered in this CER.

3.6 FAUNA

A survey of vertebrate fauna was undertaken for the Cawse Project area in November 1995 by Ninox Wildlife Consulting to identify fauna and habitats, and describe the conservation status of vertebrate fauna found within the area.

The proposed Project area is located on the "Mulga-Eucalypt Line" which marks the south-eastern limit of species adapted to the cooler, wetter south-west and the south-western limit of arid-adapted species. No habitats of regional significance occur within

the Project area although its position on the "Mulga-Eucalypt Line" is of scientific interest.

A total of six major fauna habitats were recognised during field investigations in November 1995 (Ninox Wildlife Consulting, 1995). Fauna habitat descriptions were based on the flora and vegetation survey work conducted concurrently by Mattiske Consulting Pty Ltd. These habitats include:

Habitat 1 — *Stony ridges, rises and slopes* supporting Woodlands and Open Woodlands with understoreys of mixed shrubs and on occasions an open herb layer.

Habitat 2 — *Stony ridges and rises* supporting Shrublands and Open Shrublands. The mid-storeys and understoreys consist of a large range of mixed species.

Habitat 3 — *Ridges and undulating rises* supporting Shrublands and Open Shrublands interspersed with Woodland over Spinifex.

Habitat 4 — *Broad, loamy valleys* supporting Woodlands, Open Woodlands, Very Open Woodlands over a mixed shrublayer and a dense herb/grass layer.

Habitat 5 — *Broad valley/seasonal floodplain* supporting a Shrubland with occasional emergents over dense Asteraceae species.

Habitat 6 — *Drainage lines* supporting Open Woodlands, Shrublands and Open Low Shrublands over a dense herb layer.

Some of the habitat types are an amalgam of several vegetation communities described by Mattiske Consulting and have been grouped because most highly mobile and opportunistic fauna would perceive them as a continuum rather than discrete habitat types.

The single most important feature which influences both vertebrate and invertebrate fauna of the arid zone is rainfall, its frequency, duration and amount of runoff. Habitats that either retain water for some time (claypans and dams), channel water to specific locations (ephemeral watercourses and their environs) or low lying sites where water tends to saturate the soil over a broad area (floodplains) are particularly important to fauna. Greater concentrations of vertebrates and invertebrates per unit area are found in these habitats, several of which occur in the Project area.

Also significant are the spinifex communities that tend to support a large range of reptiles, some of which are habitat-specific.

No habitats of regional significance were recognised during field investigations, however, three habitats are of some local significance. In descending order of significance these include:

Habitat 3 — *Ridges and undulating rises* - these spinifex habitats are poorly represented within the Project area, vulnerable to fire and support a range of habitat specific and specialised fauna;

Habitat 5 — *Broad valleys/seasonal floodplains* - the periodic inundation, silty soils and relatively dense vegetation in this habitat result in it being attractive to fauna; and

Habitat 6 — *Drainage lines* - the existing dams on these drainage lines are also significant as they provide a reliable long-term source of water and seasonally support a range of waterbirds.

The proposed Project area is a complex mosaic of woodlands and shrublands and is topographically variable, it is, therefore, likely to have a diverse range of fauna. All habitats, however, are represented in nature reserves or surrounding uncleared country.

Thirty-five species of bird, one species of native mammal, three species of introduced mammal and no frogs or no reptiles were recorded during the field assessment. Given

intensive survey effort spread over a range of seasonal conditions, a total of 99 species of bird, 21 native mammals (including bats), six introduced or feral animals, four frogs and 66 reptiles may occur.

No rare animals were recorded during the field survey, however, eight species potentially occur in the area based on distribution patterns and records of the Western Australian Museum (Ninox Wildlife Consulting, 1995). Two of these species, if present, would be occasional visitors or nomads and the remaining six would be residents.

Schedule 1 species are described as 'fauna that is rare or likely to become extinct'. Among other criteria these can represent:

- animals which have not been seen in Western Australia for many years;
- others which are known to be rare because specific searches have shown this to be so;
- species whose distribution has contracted markedly since European settlement;
- animals with a limited distribution; and
- fauna about which relatively little is known but are presumed to be under threat.

Schedule 4 species are described as 'other specially protected fauna' and mainly include:

- uncommon birds with a cosmopolitan distribution;
- species whose breeding areas are threatened; or
- previously exploited reptiles.

The following Schedule 1 species potentially occur at the proposed Project site:

- Grey Falcon (*Falco hypoleucos*) - a non-resident rare visitor. Its probability of occurrence is moderate to low. This species occurs in low numbers, thereby contributing to its classification as a rare species.

- Scarlet chested Parrot (*Neophema splendida*) - a casual visitor in good seasons. Its probability of occurrence is high. This is a nomadic parrot that is considered to have

been particularly common, although, numbers in the wild fluctuate dramatically (Hoser, 1991).

- Malleefowl (*Leipoa ocellata*) - a resident. Its probability of occurrence is low. Hunting and predation of nests by foxes are the major reason for the decline of this species.

- Crested Shrike-Tit (*Falcumculus frontatus*) - a resident. Its probability of occurrence is moderate. Few sightings have been made in the Kalgoorlie district. This is a very quiet, secretive species and is difficult to observe in tree canopies despite its distinctive colouration.

The following Schedule 4 species potentially occur at the proposed Project site:

- Peregrine Falcon (*Falco peregrinus*) - a resident. Its probability of occurrence is very high. This species occurs in low numbers which contributes to its perceived rarity. This species could be expected to occur throughout the Project area, particularly near dams where it preys on waterbirds.

- Pink or Major Mitchell's Cockatoo (*Cacatua leadbeateri*) - a resident. Its probability of occurrence is moderate. This species is protected in Western Australia. It is expected to occur in locations where fresh surface water is seasonally present and tree hollows are available for nesting.

- Carpet Python (*Morelia spilota imbricata*) - a resident. Its probability of occurrence is moderate. This species occurs in low numbers which contributes to its rarity. This species is expected to occur in most vegetation types, but has a preference for rockier country.

- Woma (*Aspidites ramsayi*) - a resident. Its probability of occurrence is high. This species is a harmless, nocturnal, terrestrial python which was formerly common.

A review of vertebrate fauna lists from various surveys conducted in the Kalgoorlie area indicates that only the Malleefowl has been recorded in these surveys.

In summary, no impact is predicted for three of the above rare or endangered species (Peregrine Falcon, Grey Falcon, Scarlet-chested Parrot). A small degree of impact is predicted for the remaining five species, if present. Management and monitoring strategies for limiting impact on these species are outlined in Section 4.0.

3.7 ABORIGINAL HERITAGE

Archaeological and anthropological site surveys were conducted over the Cawse Project area to identify any sites of significance to Aboriginal people. The following sections provide details of the surveys' findings.

3.7.1 Archaeological Survey

In the desert region of Western Australia the few dated sequences of Aboriginal occupation are generally less than 5,000 B.P. years (Before Present years). In the eastern goldfields a date of around 2,000 B.P. years was obtained in the Agnew region from a rockshelter site (Liberman, Maynard and Novak, 1977 in Quartermaine Consultants, 1995).

Previous research and surveys have established a pattern of sparse Aboriginal occupation in the Eastern Goldfields. Based on this preliminary research Quartermaine consultants were able to generalise on the range of site types and patterns of site locations. The following range of site types and their locational attributes may occur in the survey region:

- small artefact scatters near ephemeral water sources such as claypans and drainage lines;
- quarry sites at suitable rock outcrops such as chert, quartz and silcrete;
- stone arrangements in the vicinity of water sources; and
- painting and engraving sites, although rare, may be associated with other site types such as rockshelters with artefact scatters.

In arid areas such as the Eastern Goldfields, water was the major factor in site location and the size of campsites is roughly proportional to the size and permanency of water sources. Within the Project area, there is one major ephemeral drainage indentation and several small ephemeral creeklets. Other resources present that may indicate Aboriginal occupation are the lithics strewn over the landscape, however, no major outcrop was located during the field survey undertaken in November 1995.

Research work undertaken by Quartermaine Consultants indicates that no previously recorded sites have been registered in the Project area. Within a radius of 20 km two archaeological sites have been recorded. These sites comprise of a quarry site and an artefact scatter and both are located on the margin of salt pans. Both assemblages were considered to be examples of small task specific sites (O'Connor & Mattner, 1991).

Two archaeological sites, FS1 and FS2, as defined by the *Aboriginal Heritage Act,* 1972-1980 were recorded and were located during field surveys conducted by Quartermaine Consultants. In addition, nine isolated finds (IF1-IF5) were located, indicating evidence of past Aboriginal occasional hunting and gathering forays within the Project area. Seven of these isolated artefacts were located alongside a minor creekline in the southwestern sector of the Project area and the remaining two were located around Bunyip Dam. Isolated artefacts are, however, of limited scientific significance and do not constitute a site (Quartermaine Consultants, 1995).

Sites FS1 and FS2 are described as follows:

Field Site 1 (FS1)

This site comprises a small artefact scatter of some 150 artefacts around a clay depression (gilgai) within an open plain. The site encompasses an area of 30 m north-south and 60 m east-west. The artefacts recorded consist of flakes, flaked pieces and cores. The attributes of 20 artefacts within a 20 x 20 m sample were recorded by Quartermaine Consultants.

This site suggests a short term habitation camp as indicated by:

- the lack of cortex on 85% of the artefacts which implies curation;
- the number of implements noted, but not included in the recorded sample; and
- the variety of lithologies represented.

The lithologies were predominantly chalcedony and fine grained siliceous sediment with a few examples of chert and silcrete.

This site is located in the vicinity of the proposed processing plant and will be disturbed through the development. An application will be made under Section 18 of the *Aboriginal Heritage Act*, 1972-1980 to disturb the site.

Field Site 2

This site comprises around 200 artefacts associated with scattered rocks eroding from the ground. It is located on a slight rise of an alluvial plain some 100 m west of a wide abraided creek. The location is subject to flooding as evidenced by debris indicating the high water mark beyond the site. Field investigations indicated that all the artefacts appear to have originated from the surface rock. The site covers an area of 50 m north-south and 30 m east-west, which includes the outcropping rock and scattering of artefacts that surround the exposed rocks.

This site is an example of a small task specific site as indicated by:

- the amount of cortex remaining on 50% of the artefact described;
- the nature of the assemblage with 80% of the artefacts being flakes; and
- the homogeneity of the lithology.

Fifteen artefacts were recorded from a 10 x 10 m sample area. The lithology of all artefacts and the host rock consisted of differing brownish shades and varied grades of quartzite. The assemblage contained mostly flakes with a single core, a flake fragment and a flaked piece.

This site will eventually be disturbed by mining of identified nickel deposits. An application will be made under Section 18 of the *Aboriginal Heritage Act 1972-1980* to disturb the site.

The significance of both sites is low as similar examples of discrete stone procurement and small habitation areas are frequently located near ephemeral water sources in the Goldfields (Quartermaine Consultants, 1995).

The results of the field investigation are consistent with the general model for Aboriginal occupation in the Eastern Goldfields concerning site distribution in arid areas, i.e. that sites are likely to be found in areas where natural resources such as significant water sources and knappable stone occur.

3.7.2 Anthropological Survey

An anthropological survey was conducted for the Project by R O'Connor & Associates in December 1995. The survey included archival research and consultation with recognised Aboriginal custodians for the area, the Gubrun and Maduwongga groups. The consultations did not result in any significant anthropological sites being identified.

3.7.3 Native Title

The Project site is also located on land which is currently subject to two native title claims:

- Gubrun (WC95/27); and
- Maduwongga (WC94/3).

These native title land claims are subject to an independent assessment by the Native Title Tribunal and it is, therefore, understood that assessment of this issue is beyond the scope of the environmental assessment and the provisions of the *Environmental Protection Act, 1986.* Negotiations are underway with both parties. Ongoing consultation will continue throughout the life of the Project.

3.8 EUROPEAN HERITAGE

European habitation of the goldfields region began in 1892 with the discovery of gold in Coolgardie by Bayley and Ford. A year later Flannigan, Hannan and O'Shea were to make their historic discovery at Mt Charlotte. On the strength of this discovery, the townsite of Hannan was developed which was later re-named Kalgoorlie (Goldfields Esperance Development Commission, 1994).

The early history of the region is dominated by the goldrush and the ensuing personal tragedy, hardship, droughts, disease, fire and theft which swept through makeshift towns. By the turn of the century, the population had swollen to 50,000. Rail transport was introduced in 1896 and the supply of permanent water via the Goldfields Water Pipeline was available in 1903 (ibid).

In recent years, the total value of gold production in the region was approximately $1.3 billion, representing over 50% of the State's total. The economic base has broadened to include other minerals, such as nickel, and development in the service, tourism, retailing and manufacturing industries has been considerable (ibid). Nickel production from the region during 1994 was worth over $630 million.

Previous gold mining activities were carried out at Cawse Find which is part of the overall Project area. An abandoned open pit and a small rehabilitated overburden storage remain.

3.9 SOCIO-ECONOMIC SETTING

The development of mining in the Kalgoorlie-Boulder region since the late 1800's has contributed significantly to both the regional economy and population growth of the area. The economy of the Goldfields region is dominated by the recovery and processing of minerals particularly the production of gold and nickel. Pastoralism represents the most extensive land use in the Goldfields region.

The population of the Goldfields was estimated at 38, 619 at the 1991 census. This value is likely to be lower than the real population number due to the transient nature of the workforce resulting from the type of industries established in the region. With continued mining activity, infrastructure upgrades and residential land releases in the Kalgoorlie-

Boulder region, the Goldfields region is likely to experience population increases in the future (ibid).

The nearest settlements to the Project Area are:

- Ora Banda which is located approximately 9 km to the west and has 23 permanent residents;
- Broad Arrow, 13 km to the south-east, has 9 permanent residents; and
- Mount Vetters Homestead, 14 km to the north-east.

This section discusses potential environmental impacts associated with the proposed mining operations and the environmental management measures aimed at minimising and avoiding adverse impacts. Specific commitments are also made which relate to identified impacts.

4.1 ENVIRONMENTAL MANAGEMENT PLAN

Centaur Mining and Exploration is committed to achieving a high standard of environmental management at Cawse Nickel Project and adhering to all environmental obligations relevant to its activities. This requires the integration of all monitoring and management programmes to refine and continuously improve environmental management of the operations.

4.1.1 Management

Centaur Mining and Exploration intends to develop an Environmental Management Plan (EMP) to include all aspects of environmental management and monitoring programmes for the operations at Cawse Nickel Project. It is envisaged the EMP will be periodically reviewed and updated accordingly based on the results of monitoring and changing industry practice.

The Environmental Management Plan (EMP) will be developed in the context of the following:

- Environmental Protection Act Ministerial Conditions;
- Mining Lease Conditions;
- Commitments outlined in this CER;
- Environmental Protection Authority Licence Conditions; and
- Water and Rivers Commission Groundwater Well Licence Conditions.

To reduce any potential impacts and to reinforce the company's commitment to, and responsibility for, environmental concerns, the following policies will also be adopted.

- Centaur will ensure all subcontracting teams undergo a site induction programme where they will be adequately briefed and made aware of the environmental constraints imposed on the Project and themselves.

- Centaur will ensure regular spot checks for breaches of sound environmental practices are undertaken by delegated individuals to anticipate and/or rectify problems at an early stage.

- Centaur will prepare a brief handout on sound environmental practices which will be distributed to and signed by all members of the subcontracting teams and permanent employees during site induction.

An on-site person will have designated responsibility to oversee the implementation and management of the EMP. Responsibilities will include:

- ensuring compliance with all relevant environmental obligations and statutory requirements;

- ensuring that the management aims and monitoring responsibilities of the Environmental Management Plan are upheld;

- maintaining routine contact with the operation manager to ensure the integration of environmental objectives with the mining and processing operations;

- reporting, as required, on environmental issues;

- providing information/training to employees and contractors regarding their environmental obligations; and

- to liaise with the contractor and government agencies as required.

A programme of employee education will be practiced to ensure that all personnel are aware of Centaur's environmental responsibilities. This will be included in the overall workforce induction programme with specific emphasis placed on the individual's responsibilities to adhere to environmental rules, regulations and policies.

4.1.2 Commitment

Commitment 1 - The Proponent will prepare and implement an Environmental Management Plan (EMP) for the Cawse Nickel Project to the satisfaction of the EPA on advice from the Department of Environmental Protection and the Department of Minerals and Energy.

The EMP will be developed in two separate stages as follows:

I. Project Construction EMP - To be submitted to the EPA prior to commencement of construction.

II. Project Operation EMP - To be submitted to the EPA prior to commissioning.

The EMP will be developed in accordance with statutory conditions applied to the approved operations. The EMP will be reviewed and updated as required.

4.2 SURFACE HYDROLOGY

4.2.1 Impacts

Most of the Project area including the mine, processing plant and tailings storage facility is located at higher points in the landscape where natural drainage lines are well defined. These minor drainage lines flow intermittently following significant rainfall events. Major rainfall events produce more consistent flow which outwashes on to the broad valley to the east of the project area.

Minor drainage lines on the ridges and sheet surface flows may be interrupted by the following:

- mine pits;
- overburden storages;
- processing plant;
- tailings storage facility;
- access roads; and
- haul roads.

This may result in the 'shadowing' of some vegetation immediately downstream of these developments which could rely on intermittent flows. During construction and operations, unconsolidated surfaces such as overburden storages, stockpiles and unsealed roads may contribute to sediment loads in runoff water. Sediment transport following significant rainfall events may lead to some silting in drainage structures.

4.2.2 Management

Project facilities have been located to avoid disturbance to significant drainage lines, where possible. Drainage lines which are interrupted by the proposed development will be diverted around the facilities. The diverted water will be directed to re-enter the natural drainage system clear of the developed areas. This will be done by establishing a system of bunds and diversion channels which are designed to withstand a one in fifty year rainfall event. The bunds and channels will be stabilised to avoid erosion and sediment traps will be constructed at the discharge points. Where runoff to the mine pit is unavoidable and water collects, it will be pumped from the pit and used as process water. Culverts will be located at significant drainage lines along the access road and haul roads to avoid shadowing effects on vegetation.

A seepage/sediment collection trench will also be constructed around the perimeter of the tailings storage facility to collect runoff from the embankment. The trench will outfall into sediment traps located to the east of the facility.

Natural drainage channels will be intercepted to the west and south of the tailings storage by a shallow excavated channel and flood protection bund. Runoff will be diverted to the east and north of the facility, outfalling to the sediment traps to allow water to return to the natural drainage lines and to minimise any drainage "shadow" to the east of the facility.

The tailings storage embankments will be constructed with a 2% crossfall to the inside of the storage to minimise erosion of the upstream batter.

4.2.3 Commitment

Commitment 2 - The Proponent will avoid disturbance to natural drainage lines, where possible. Where this is not possible, the Proponent will develop and implement a site drainage plan and monitoring programme, as part of both construction and operational stages of the Environmental Management Plan, to manage and assess the impacts of modified drainage on vegetation. This will be to the satisfaction of the EPA.

4.3 GROUNDWATER

4.3.1 Impacts

4.3.1.1 Borefield

The water supply borefields for the Project have not been confirmed to date. However, potential paleochannel borefields in the vicinity of Bitter bore, Sheepyard Dam and Leaky Dam are being investigated (Figure 1). Groundwater levels at these borefields may be lowered as a result of water supply pumping. However, adverse ecological impacts through lowering of the groundwater only occur where vegetation is reliant on freshwater aquifers. In the circumstance of the potential paleochannel borefields, water is typically >30 m deep with a salinity in excess of 30,000 ppm TDS which is usually too saline for deep rooted vegetation. Water is not of sufficient quality for other beneficial uses such as stock watering.

4.3.1.2 Mine and Tailings Storage Facility

The potential for any significant impacts on groundwater from mining and/or water supply activities associated with the Project is negligible. No pit dewatering is envisaged in early stages of the operation due to the shallow pit depths (ie <40 m). However, some minor pit dewatering may be necessary later in the life of the Project as deeper ore zones (40 - 60 m) are encountered. This water would be used in the processing plant.

Indicative levels of a range of elements present in the tailings material are presented in Table 2-3 of this report. Indicative levels for elements in the tailings solution are presented in Table 2-4. These preliminary results do not indicate high levels of potentially toxic contaminants which could leach into the groundwater. The pH of the process water is estimated to be approximately 5.0. The tailings material will not generate acid as the ore is totally oxidised. Total sulphur present in the tailings material is mainly in the form of sulphate, not sulphide.

The salinity of the tailings solution will be similar to that of the process water which is expected to range between 30,000 and 60,000 ppm TDS. This range is typical of groundwater resources in the vicinity of the Project area and greatly exceeds maximum concentrations recommended for sheep, ie: 13,000 ppm TDS (Environmental Protection Authority, 1993).

Geological information on the surrounding area indicates that the basement rock underlying the tailings storage facility is low permeability granite so it is therefore unlikely that there will be significant groundwater resources which would be affected by potential seepage. The granite is generally covered by a combination of both cemented and uncemented surficial sediments. Lateral seepage of high salinity process/tailings water has the potential to adversely affect vegetation adjacent to the tailings storage facility.

4.3.2 Management

It is expected that the open-cut mine, to a planned maximum depth of 60 m below ground level, will occur mainly above the water table which typically ranges between 40 to 50 m below ground level. The majority of the pits will be less than 40 metres deep and therefore the need for pit dewatering is expected to be minimal with minor seepage (if any) being controlled by the use of in-pit sumps. Future pits may intersect the water table later in the life of the Project. Where this occurs, water produced will be pumped from mine dewatering bores and piped to the processing plant.

Although the source is yet to be fully proven, it is probable that a component of the process water supply will be obtained from a borefield in the vicinity of Sheepyard Dam, located between about 8 and 10 km along strike from the proposed mining area (Figure 1). Water use will be minimised by utilising recirculation and recovery techniques in the processing plant which will result in lower levels of abstraction. Water levels will be monitored to provide data for the assessment of aquifer behaviour and the revision of operational activities, as necessary.

No saline groundwater will be discharged to the surface environment. The discharge of process water will be controlled under the plant and tailings management plans. Negotiations are also being conducted with neighbouring gold mining operations to use the excess high salinity water produced by the desalinisation plant so that evaporation ponds are not required.

The tailings storage facility has been designed and will be constructed to minimise the potential for seepage of process water into the surrounding environment (see Appendix D). Monitoring bores and piezometers will be installed around the tailings storage facility to detect any leakage that may occur. If leakage is detected which would adversely effect surrounding vegetation, remedial measures will be undertaken.

4.3.3 Commitment

Commitment 3 - Prior to the discharge of tailings, the Proponent will install a series of monitoring bores adjacent to the tailings storage facility which will be monitored on a regular basis to detect any potential leakage of process water from the facility. If leakage is detected, remedial work will be undertaken to the satisfaction of the Department of Environmental Protection and the State Mining Engineer. Details of the tailings storage facility management and monitoring programmes will be included in the operational stage of the Environmental Management Plan.

4.4 WATER PIPELINE

4.4.1 Impact

Process water for the operation will be derived from a blend of reasonable quality and saline groundwater. The saline water will be piped from several borefields of up to 25 km from the mine site. Pipeline leakage or failure can result in saline water being discharged to the ground surface. This would have the potential to adversely effect sensitive vegetation over areas flooded by the saline water.

4.4.2 Management

A number of standard management strategies will be implemented to minimise the potential adverse impacts of pumping saline groundwater to the mine site. These include:

- pipeline construction;
- pressure testing of pipelines;
- isolation of pipeline sections;
- containment of potential leakage;
- location of the pipeline; and
- preparation of a management plan.

4.4.2.1 Pipeline Construction

The pipelines will be properly engineered and constructed of high density polyethylene medium pressure pipe. The pipelines will be laid above the ground and adjacent to a maintained track to allow for regular inspection.

4.4.2.2 Pressure testing of pipeline

The pipelines will be pressure tested to well above their expected operating pressures. Once installed, the pipe and joiners should remain competent for the duration of the Project.

4.4.2.3 Isolation of pipeline sections and containment

The pipeline sections will have a series of shut off valves along the length to enable sections of the pipeline to be isolated and drained for maintenance, or in the case of a leakage. The pipeline will be able to be drained to sumps constructed along the pipeline. Where sumps are unable to be constructed, provision will be made for saline water to be collected from the pipeline and transported to the Project site for disposal.

4.4.2.4 Pipeline Location

The pipeline will be located mostly above the ground along existing tracks to reduce the need for further clearing and to allow access for pipe inspections and maintenance. Although the pipeline routes have not yet been determined, they will be located to avoid areas of significant vegetation. Vegetation mapping will be undertaken where pipelines are located outside of the initially surveyed area.

4.4.2.5 Management plan

A plan will be developed for the pipeline route selection and prevention and control of spills. This plan will outline potential impacts, management procedures and a monitoring programme for the pipeline throughout the operations. In the event of a spill:

- the extent of the spill will be restricted;
- relevant authorities will be notified a soon as possible;
- the full extent of the spill will be recorded;
- the cause of the spill will be investigated and measures instigated to prevent similar events occurring in the future; and
- the affected area will be rehabilitated.

The plan will present rehabilitation strategies for the immediate rehabilitation of areas affected by a spill of saline.

4.4.3 Commitment

Commitment 4 - The Proponent will develop and implement management and monitoring procedures, as part of both construction and operational stages of the Environmental Management Plan, to avoid potential impacts associated with the process water supply. These will include details of the water source, pipeline construction and management of potential leakage.

4.5 LANDFORMS

4.5.1 Impacts

Changes to the landform will result from the following developments:

- mine pit;
- initial overburden storage area;
- ore stockpiles;

- borrow pits;
- access road and service corridors;
- process plant infrastructure;
- tailings storage facility;
- mine site buildings; and
- drainage control and flood protection.

Mining of the nickel laterite resource will result in open pit mining to a maximum depth of 60 m below ground level.

Table 4-1 provides an estimate of areas which may be affected during mining and related activity.

TABLE 4-1

AREA OF LAND DISTURBANCE

Location	Estimated Area of Disturbance
North Pit # 1 -	100 ha (inclusive of dump) *
North Pit # 2 -	11 ha
North Pit # 3 -	17 ha
Central Pit # 1 -	188 ha (inclusive of dump) *
Central Pit # 2 -	100 ha
Southern Pits -	101 ha (inclusive of dump) *
Tailings Storage Facility -	100 ha (final tailings storage)
Processing Plan and Associated Infrastructure	20 ha

* Areas estimated for the North #1, Central #1 and Southern Pits include overburden storages associated with these pits. It is important to note, however, that these estimates are maximums based on no return of overburden to mined out pits. It is intended that a large proportion of this material will be infilled to the pits which will substantially reduce the estimated area of disturbance.

4.5.2 Management

The following measures will be adopted to ensure that impacts are as a result of land disturbances are minimised.

- The minimum amount of overburden will be placed outside the pit area. Overburden will be progressively infilled into mined areas as a priority once the area below the pit has been sterilised.

- The overburden storage area outside the pit will be constructed to blend with the surrounding landforms. Final surfaces will be formed as early as possible and battered to slopes of 20^{o} or less and rehabilitated.

A condition will be included in all contractor agreements which prohibits unauthorised clearing. Monitoring of the rehabilitated areas will continue until the vegetation is seen to be progressing towards a stable condition.

4.5.3 Commitment

Commitment 5 - The Proponent will develop and implement procedures, as part of both construction and operational stages of the Environmental Management Plan, to avoid unnecessary disturbance to areas which are not required for mining, processing or infrastructure development.

4.6 VEGETATION AND FLORA

4.6.1 Impacts

Two plant communities were identified which are thought to be locally and regionally significant. A further three communities were identified as being locally significant but not of regional significance. Whilst the five plant communities are located in the overall Project area, they are mostly located outside areas which may be disturbed through

mining and processing related activities (Figure 6). However, the North Pit #3 does impinge on community type 1b which was identified within the Project area. It is estimated that less than 10% of this community type will be affected by the pit development. (Figure 6).

No Declared Rare Flora were located in the Project area. However, two Priority 3 flora species (*Acacia kalgoorliensis* and *Eremophila pustulata*) were identified within the Project area (Mattiske Consulting Pty Ltd, 1995).

Potential impacts on the vegetation and flora include:

- direct loss and degradation through land clearance and landform modification;
- introduction of weeds, pests and diseases via vehicles and heavy machinery, especially where land disturbance has occurred. Weed invasion, in particular, could threaten the conservation value of the project area; and
- increased incidence of fire associated with increased human activity.

4.6.2 Management

To ensure the protection of the Priority 3 species, disturbance to the communities in which they occur will be avoided wherever possible during the proposed operations. This has already been achieved as the location of significant plant communities was taken into account in early operations planning. Project aspects such as the out of pit waste storages, processing plant, tailings storage facility and access road were all located with reference to significant plant communities. In addition, management of vegetation disturbance will be closely supervised to assure the minimum area required for construction of the mine infrastructure is disturbed. Contractors will not be permitted to vacate the site until any such disturbance is rehabilitated.

4.6.3 Commitment

Commitment 6 - The Proponent will develop and implement procedures, as part of both construction and operational stages of the Environmental Management Plan, to avoid unnecessary disturbance to vegetation, especially significant associations, and flora.

4.7 FAUNA

4.7.1 Impacts

Whilst the Project area has no exceptional regional or local qualities or unusually distinctive suites of fauna, all habitats have some importance to a range of species. The impact of mining on fauna can be described as primary or secondary (Ninox Wildlife Consulting, 1995). The primary impact of mining on fauna is the physical and permanent destruction of particular habitats through the removal of underlying ore bodies. Secondary impacts relate to activities with varying degrees of impact beyond the immediate point where mining is taking place i.e. haul roads, service corridors, laydown areas and workshops.

The effect of primary impacts on vertebrates is described below.

Territorial birds will be impacted to some extent due to the total area and range of habitats which will be cleared. Although birds are highly mobile, forced movement of territorial species to adjacent territories may cause some local conflict beyond the initial area of impact. Species may be exposed to a higher level of predation, competition for food resources, shelter and breeding sites.

Larger mammals are able to move away from the areas of primary impact. This movement may cause increased competition in adjacent areas. Small territorial mammals, such as marsupial carnivores and native rodents, are not as mobile. This results in the elimination of a proportion of local populations occurring in the area of primary impact.

Larger reptiles, such as monitor lizards, are capable of moving large distances away from disturbance or adapting to changed conditions, but most small reptile and amphibian populations within the area of primary impact will be lost.

The tailings storage facilities and return process water ponds may attract waterbirds and other fauna which can result in entrapment in mud.

The presence of mine site personnel can also have some impact upon fauna, particularly through the increased potential for fires and road casualties.

4.7.2 Management

To ensure the impact of mining operations on the fauna of the area is minimised, the following impact reduction strategies will be implemented.

- The stockpiling of topsoil and plant debris for later use in rehabilitation. Debris such as logs, branches and leaf litter provides micro habitats for vertebrate and invertebrate species, allowing early recolonisation by fauna.

- The unnecessary clearing of vegetation will be avoided.

- The rehabilitation of cleared areas which are no longer required will be undertaken as soon as possible to encourage fauna by providing micro-relief and vegetation cover.

- The use of saline water for dust suppression will be carefully controlled, as this can cause vegetation die-off adjacent to tracks resulting in a subsequent loss of downslope fauna habitats.

- Disused tracks and gridlines will be blocked, and if compacted, deep ripped to encourage plant regrowth and the subsequent rehabilitation of fauna habitats.

- Increased run-off from mining areas and access roads will be channelled and restricted to minimise erosion within fauna habitats.

- Off road vehicles will be restricted to access roads.

- Methods for discouraging fauna from using tailings storage facilities will be investigated.

- The integrity of all exploration drill hole caps will be periodically checked.

- Firearms and pets will be excluded from the Project area unless a nominated individual is given the responsibility for feral animal control.

- Strict speed limits will be applied to all roads to minimise fauna deaths.

- Adequate rubbish disposal procedures will be followed to discourage scavenging by ravens, introduced foxes and feral cats.

4.7.3 Commitment

Commitment 7 - The Proponent will develop and implement procedures, as part of both construction and operational stages of the Environmental Management Plan, to avoid unnecessary disturbance to fauna species and habitats.

4.8 REHABILITATION

4.8.1 Background

The development of mining, processing and infrastructure for the Cawse Project will involve disturbance to the landform, vegetation and flora, and fauna habitats as described in previous sections. Centaur has made commitments to avoid unnecessary impacts on these aspects of the environment wherever practicable. However, land rehabilitation will be required in disturbed areas to minimise short term impacts such as dust generation and erosion, and produce a stable post-mining landform in the longer term.

4.8.2 Strategy

A rehabilitation programme will be designed in the course of the operations taking into account site specific characteristics. The overall objective of the rehabilitation programme will be:

- in the short-term to reduce dust and to stabilise disturbed mine landforms, i.e. to reduce erosion; and

- in the long-term to establish a community of plants as stable, diverse and resilient as the pre-mining vegetation and which is compatible with the surrounding environment and land uses.

Rehabilitation requirements will be integrated with the operation of the mine. During the construction phase of mine development, topsoil will be stripped and stored in low stockpiles for use in later rehabilitation. In arid areas, topsoil is important to the success of rehabilitation programmes as it contains the local seed stock, organic matter and microorganisms.

Following construction, all areas no longer required, such as borrow pits, temporary access roads and hardstand areas, will be contoured, as required, to blend with the surrounding environment. Stored topsoil will be spread and the area ripped to reduce compaction and to promote infiltration. Where required, local species will be seeded.

Where practicable, waste material will be returned to the pit. This will be overlain by sub-grade material which is not presently economically viable to process. The returned material will be stabilised and contoured to reduce erosion as an interim measure until it becomes viable for the sub-grade material to be processed or the pit area is rehabilitated.

Where out of pit waste dumps are required, they will be designed and constructed to ensure that the final landform blends with the surrounding topography. Final slopes will be constructed to have a maximum slope of 20° or less.

The waste dumps will be built progressively with berms 4-5m in width constructed every 7-10 m in height. Final height is estimated to be around 20 m. The berms will:

- provide access for machinery spreading stored topsoil;
- act as catchment drains;
- channel runoff from the dump to vertical drains; and
- be constructed with a bund on the outer edge to reduce runoff overflow over the edge of the waste dumps.

Sediment traps will be established on the vertical drains to reduce the energy of runoff and, hence, reduce erosion. The drains and sediment traps will be designed to be maintenance free and long lasting to ensure failures do not occur once vegetation has been established.

The faces of the waste dumps will be topsoiled with the stockpiled material, where practicable, to a depth of approximately 300 mm. The availability of suitable topsoil may, however, be limited as there is a very thin cover in some areas. In these circumstances the use of other materials will be investigated to minimise erosion and provide a growth medium. After topsoil has been spread, the faces will be ripped on the contour. Ripping will be deep enough to break through the topsoil and into the underlying waste material. This will reduce compaction, create catchment areas and promote infiltration.

Waste dumps will be seeded with seed stock collected from local species which are adapted to local conditions. Where practicable, a belt of native vegetation will be left around the dump to facilitate natural colonisation of species and to screen the operation.

To minimise the spread of weeds, pests and diseases, access will be restricted from undisturbed areas.

A monitoring programme will be established to assess the success of the rehabilitation programme. The frequency of the programme will be timed to satisfy the agreed performance objectives.

4.8.3 Commitment

Commitment 8 - The Proponent will develop a rehabilitation programme, as part of the operational stage of the Environmental Management Plan. The rehabilitation programme will be implemented in the course of the operations and will be consistent with defined post-mining land use objectives.

4.9 ABORIGINAL HERITAGE

4.9.1 Impacts

Site FS1 (section 3.7.1) is located in the vicinity of the proposed processing plant and is likely to be disturbed. FS2 lies within the area of the proposed northern pits and is also likely to be disturbed. Applications to disturb the sites will be made in accordance with the *Aboriginal Heritage Act (1972-1980)*.

Some potential for further archaeological sites may exist in the extreme north-west corner of the extended Project area on the raised west bank of the creek. Should development be considered in this locality, further and more intensive survey work would be required.

If additional archaeological evidence is revealed at any stage throughout the construction or operation stages of the mine, these findings will be reported to the Department of Aboriginal Affairs.

4.9.2 Management

Wherever possible, Aboriginal sites will be avoided. Interference with/to Aboriginal sites is an offence, unless authorised under the Act, as outlined in Section 17 of the *Aboriginal Heritage Act, 1972-1980*. To minimise damage to Aboriginal sites, all employees and contractors will undergo a compulsory induction including an Aboriginal cultural awareness programme. They will be advised of their obligation, as outlined under Section 15 of the *Aboriginal Heritage Act, 1972*-1980, to report any archaeological material encountered during ground disturbance. Centaur will also require that all employees and contractors promptly report any potential sites discovered in the vicinity of the operations to the environmental officer or the designated responsible person on-site.

Ongoing education of personnel will take place throughout construction and operation of the mine.

4.9.3 Commitment

Commitment 9 - The Proponent will comply with the provisions of the Aboriginal Heritage Act, 1972-1980.

4.10 DUST

4.10.1 Impacts

Open cut ore mining involves the movement of large volumes of materials which are usually dry. Activities which have the potential for dust emission include:

- drilling and blasting;
- overburden stripping;
- loading operations;
- ore and overburden hauling;
- truck unloading (tipping); and
- primary crushing.

Potential impacts associated with dust levels on site are mainly confined to the health and comfort of the workforce. These will be monitored and controlled in accordance with the requirements of the *Mines Safety and Inspection Act,* 1995.

High dust levels also have potential to affect sensitive vegetation where it is constantly blanketed with dust. This is usually a localised impact near the source of the dust (ie. road sides, unloading areas etc) as the heavy particulates settle over a relatively short distance. Watering for dust suppression can also affect vegetation where saline water is used.

Fugitive dust emissions can be a nuisance to nearby residents where the lighter particulates are carried by wind over some distances. However, this is unlikely to be a problem with the Cawse Nickel Project as the nearest residents are located over 9 km from the project area.

Other potential sources, unrelated to the Project, which may contribute to background dust levels in the area include; unsealed roads, areas of sparse vegetation and other mining activities.

4.10.2 Management

Occupational and ambient dust levels will be controlled, at source, by fitting suppression systems throughout the processing plant, as required.

Water tankers will be used to apply water to areas which have the potential to be a source of dust within the operations area, particularly along unsealed roads, haul roads and construction areas. The use of saline water for dust suppression will be controlled to limit the accumulation of salt in areas to be revegetated. Sprays will also be controlled to avoid overspray which may affect vegetation.

Housekeeping practices will be employed to ensure that there is no accumulation of waste materials in or around the premises which may lead to the generation of airborne dust. Routine maintenance of equipment designed to reduce dust levels will be undertaken to ensure their effective use.

All employees and contractors will be informed of the importance of reducing ambient dust levels.

Procedures for dust control will be included in the Environmental Management Plan.

4.11 NOISE

4.11.1 Impact

The proposed development at Cawse Nickel Project will increase ambient noise levels within and immediately adjacent to the project area. The increased levels will be mainly attributable to the operation of mining plant and the ore processing plant. Noise from these sources will be a factor within the immediate vicinity of the mine site and may cause temporary and localised disruption to wildlife movements.

The impact of mine site noise on the human inhabitants of the region will be almost entirely restricted to the mine workforce. The nearest residence is at Ora Banda which is located approximately 9 km to the west of the project area. The other nearest residences are at Broad Arrow (13 km) and Mount Vetters (14 km). Under certain still climatic conditions the operations may be heard by residents at these distances. However, it would be difficult to distinguish between the Cawse Nickel Project or other nearby gold mining projects which have been in operation for many years.

Kalgoorlie township lies some 50 kilometres to the south east. These residences are all sufficiently distant from the Project to be unaffected by noise generated at the mine site.

Noise from transport of acid, limestone and other reagents to the Project area is not expected to result in unacceptable impacts due to the relatively low number of truck movements in an area used predominantly for mining activities.

4.11.2 Management

Centaur will ensure the contractors' vehicles meet appropriate standards which minimise the potential for unacceptable noise.

4.12 BLASTING

4.12.1 Impacts

Given the nature of the Cawse Nickel orebody it will be necessary to undertake minor blasting in some areas to shatter silica rich layers prior to excavation. All blasting activities will be conducted below ground level apart from blasting required to remove the surficial caprock which is present throughout much of the Project area. The nearest residence is Ora Banda which is located approximately 9 km to the west of the Project area. The other nearest residences are at Broad Arrow (13 km) and Mount Vetters (14 km). Kalgoorlie-Boulder is located some 50 km to the south east. These residences are all sufficiently distant and will not be affected by blasting noise.

4.12.2 Management

To minimise the noise impact, blasting activities will be undertaken during daytime only.

4.13 WASTE PRODUCTS AND HAZARDOUS MATERIALS

4.13.1 Impacts

The mining operation at Cawse will generate waste materials, including scrap metal, tyres, storage containers, wood, paper and domestic solid and liquid waste. While not hazardous, these materials could create an environmental impact if not disposed of or treated properly.

The development and operation of the Project will also necessitate the use of a range of products termed 'hazardous materials'. These materials include fuels, process reagents (refer to Table 2-2), lubricants, detergents, explosives and paints. If allowed to escape, these materials have the potential to cause atmospheric, soil or water contamination and could potentially pose risks to human health and the environment.

4.13.1.1 Management of Hydrocarbons and Oily Wastes

Hydrocarbons include oils, greases, fuels (petrol and diesel), de-greaser, emulsified oils, kerosene and oily waste water. The correct management of these products requires five integrated steps:

- appropriate storage and handling procedures;
- minimal generation of waste and associated contaminants;
- segregation of hydrocarbon waste from stormwater and other water;
- clean-up procedures for spills; and
- environmentally acceptable disposal of captured waste.

Hydrocarbons will be managed in order to minimise the potential risk of spills and the area of contamination should spillage occur. Management practices will include, but not be limited to:

- installation of appropriate bunding around all 200 L drum storage areas;
- drums in use being placed on spill capturing platforms;
- effective maintenance of all valves and piping systems; and
- use of oil capturing systems in heavy and light vehicle service areas.

All fuels and oils will be stored in accordance with the Australian Standard for *The Storage and Handling of Flammable and Combustible Liquids* (AS 1940-1993). All hydrocarbon storage facilities shall conform to DEP Licence requirements.

Potential spillage will be contained and appropriately addressed by techniques including the placement of absorbent material and the excavation and removal of contaminated soil.

Oily wastes generated at site will be collected and disposed of in accordance with conditions specified by the DEP Division of Waste Management.

4.13.1.2 Management of Hazardous Materials

To ensure the safe handling of all hazardous materials used on site, Centaur will adopt a formal Hazardous Materials Management Programme (HMMP) which will incorporate the following elements:

- adoption of a formal policy statement;
- designation of responsibility for all elements of the programme;
- employee participation;
- training of personnel;
- dissemination of information;
- establishment of purchasing and inventory controls; and
- environmental monitoring.

The storage, handling and disposal of these materials will comply with all local and State regulations. Bulk fuel will be stored in above-ground tanks located in impermeable, bunded enclosures in accordance with Department of Minerals and Energy requirements. Explosives will be stored in a magazine remote from workshops and the mine site.

4.13.1.3 Commitment

Commitment 10 - The Proponent will develop and implement a Hazardous Materials Management Programme in accordance with requirements, and to the satisfaction, of the Department of Minerals and Energy.

4.13.1.4 Management of Other Waste Products

Wherever practicable, materials (e.g. batteries, 205 L drums, scrap metal) will be recycled. All non-recyclable solid waste will be disposed of in accordance with the DEP *Code of Practice for Country Landfill Management.*

Operation of the sanitary landfill site will include:

- diversion of surface water around the landfill site;
- regularly (weekly) cover of the landfill face to a depth of 230 mm; and
- a litter fence around the landfill perimeter.

4.14 ROAD TRANSPORT

4.14.1 Impacts

Recent estimates of vehicle movements on the Kalgoorlie-Meekatharra road between Kalgoorlie and Menzies during 1995 indicate an average of approximately 12,000 vehicle movements per day (1996 *pers comm* Main Roads Department). It was further estimated that heavy vehicle movements, eg. semi-trailers and road trains, comprise 24% of the total vehicle movements. It should be noted, however, that these figures are highly variable at different points along the route and over time as much of the traffic is associated with regional mining activities.

It is estimated that the Cawse Nickel Project would result in an increase of approximately 55 truck movements per day. On the basis of the above estimates the proportional increase of total vehicle movements along this transport route as a result of the Cawse Project would be less than 5%. Assuming that 40% of the vehicle movements associated with the Cawse Project are heavy vehicles the proportional increase of heavy vehicle movements would be about 24%.

4.14.2 Management

Centaur will ensure that contractors' vehicles meet appropriate noise and safety standards.

4.15 RISK

4.15.1 Impacts

A qualitative risk assessment has not been conducted at this stage in the Project planning as significant off-site hazards have not been identified. The Project is situated in an isolated area where the nearest residences are located at Ora Banda, 9 km to the west, and Broad Arrow, 13 km to the south east. The Mount Vetters Station homestead is located at a distance of 14 km to the north-east.

Public risk criteria outlined in EPA Bulletin 627, *Criteria for assessment of risk from industry - expanded discussion,* May 1992 are not relevant to on-site impacts as these areas are adequately covered by the occupational health and safety provisions of the *Mines Safety and Inspection Act, 1995.*

Public safety is a concern where there is public access to the site.

4.15.2 Management

On-site hazards to the workforce will be managed in accordance with the occupational health and safety provisions of the *Mines Safety and Inspection Act, 1995.* Similarly all hazardous materials will be transported, stored and handled in accordance with the *Dangerous Goods Regulations, 1992.*

The detailed design of the tailings storage will be in accordance with the Department of Minerals and Energy's *Guidelines on the Safe Design and Operating Standards for Tailings Storages* which includes a hazard rating system.

Design and management of the Project in accordance with the following statutory requirements and guidelines will minimise both on and off-site risks:

- *Mines Safety and Inspection Act and Regulations, 1995*
- *Dangerous Goods Regulations, 1992*
- *Guidelines on the Safe Design and Operating Standards for Tailings Storages*

The public will be excluded from processing and mining areas, and public roads will be realigned, as necessary, to avoid mine workings.

Hazop studies will be conducted as part of the detailed design and construction phases of the Project. Details of these studies will be included in applications for Works Approval and Licencing.

4.16 GASEOUS EMISSIONS

4.16.1 Impacts

Gaseous emissions from the processing plant and associated infrastructure have been characterised in section 2.3.9.

The high pressure leach process does not produce significant gaseous emissions as it is mainly a closed system where steam is recycled. Where high pressure steam is vented there is some potential for small amounts of sulphuric acid to be contained in the steam.

Another source of gaseous emission is the power station which will consist of reciprocating gas engines. These engines run on a mixture of natural gas (95%) and diesel (5%) fuel. Emissions from the power station would be consistent with similar stations using these high efficiency gas engines. Considering the distance of the Project area to the nearest residences in Ora Banda and Broad Arrow (9 and 13 km respectively) it is unlikely that gaseous emissions from the power station will be significant.

Another potential source of gaseous emissions would be a hydrogen sulphide plant, if this option is adopted. Hydrogen sulphide at low concentrations (ie. >1.0 $\mu g/m^3$) can have an offensive odour. Flaring hydrogen sulphide can produce minor emissions of sulphur dioxide.

Waste heat from the power station will be used to generate steam for the high pressure acid leach process. Carbon dioxide will also be produced from the flue gas.

4.16.2 Management

Gaseous emissions from the processing plant and associated infrastructure are expected to be well below levels specified in the EPA Guideline objectives. However, monitoring

will be conducted during commissioning of the processing plant and other infrastructure to measure actual emissions for licencing purposes. Where steam is vented from the high pressure acid leach circuit, wet scrubbing will be employed to remove any sulphuric acid.

No gaseous emissions will be produced from the ammonia leach process as it is a closed circuit with ammonia stripping and regeneration modules. Some ammonia will be lost through evaporation. No upset conditions are associated with this process which could result in any significant gaseous emission.

If the option to establish a hydrogen sulphide plant is adopted, details of potential emissions and pollution control equipment will be provided in the application for Works Approval. Any excess hydrogen sulphide which may be produced would be flared. Potential SO2 emissions would be monitored to ensure that levels are below EPA specified criteria (ie 350 $\mu g/m^3$ at the nearest residence).

4.16.3 Commitment

Commitment 11 - The Proponent will monitor gaseous emissions from potential sources during commissioning of the processing plant and associated infrastructure to ensure that levels are below EPA specified criteria to the satisfaction of the Department of Environmental Protection.

Commitment 12 - The Proponent will include details of potential emissions and pollution control equipment in a Works Approval application to the Department of Environmental Protection, if a decision is made to establish a hydrogen sulphide plant.

4.17 GREENHOUSE GAS EMISSIONS

4.17.1 Impacts

The Cawse Nickel Project does not involve any processes which would be considered significant sources of greenhouse gas emissions.

Annual emissions of CO_2 and CO from the power station gas engines are estimated on the basis of the following:

- annual power consumption = 6.5 x 107 kwhr/year
- CO_2 emission = 200 g/kwhr
- CO emission = 2.4 g/kwhr

It is therefore estimated that a combined total of 13,156 tonnes per year of CO_2 and CO would be produced. By comparison, it was estimated that carbon dioxide emissions from energy use in Western Australia during 1988 amounted to 24.7 million tonnes (Government of Western Australia, 1992). The Cawse total equates to 0.05% of this estimated 1988 Western Australian output. Minor CO_2 emissions will also be associated with exhaust from mining equipment and other vehicles used for the Project.

4.17.2 Management

An inventory of greenhouse gas emissions will be developed as part of the Environmental Management Plan. Means of improving energy efficiency will continue to be investigated throughout the life of the Project which would result in significant cost savings in addition to reducing greenhouse gas emissions.

4.18 DECOMMISSIONING

4.18.1 Background

Operations at the Cawse Nickel Project are expected to continue for a period of at least 20 years as the identified ore body is progressively mined. Residual longer term impacts at the completion of mining operations will be mainly associated with the stabilisation of post-mining landforms. As discussed in previous sections of this CER.

4.18.2 Strategy

At the completion of mining all infrastructure will be removed. Concrete footings will be excavated and/or buried. Remaining surfaces of borrow pits or overburden storage areas that have not been previously rehabilitated will be battered to an angle of 20° or less. Top soil removed and stored prior to commencement of mining will be spread, stabilisation techniques will be applied to exposed surfaces and locally sourced seed applied where necessary.

Safety bund walls will be constructed around the decommissioned pits and their design will comply the Department of Minerals and Energy, *Guidelines on Safety Bund Walls Around Abandoned Open Pits.*

All compacted surfaces resulting from the operation of the mine will be ripped to promote water penetration and the catchment of wind blown seed. Where necessary, seeding will occur using species from previously identified plant communities.

To ensure the site is left in a condition which minimises the impacts caused by erosion in ensuing years, revegetation will continue beyond the mine closure to enable final overburden storage areas to be contoured and stabilised. Monitoring following decommissioning will consist of periodic site visits to assess the progress of revegetation.

Environmental monitoring and ongoing research studies to be undertaken throughout the life of the mining operation at the Cawse Nickel Project will assist in refining the environmental management practices to minimise longer term impacts.

4.18.3 Commitment

Commitment 13 - The Proponent will prepare a management plan for decommissioning at least 12 months prior to the completion of processing operations to the satisfaction of the Department of Environmental Protection and the Department of Minerals and Energy.

5.0
PUBLIC CONSULTATION

This proposal to establish a mining operation at the Cawse Nickel Project is being assessed as a CER which is designed to provide information to the public and EPA about the environmental aspects of the proposal and their management. The CER is subject to a four week public review period during which interested persons and organisations are encouraged to make submissions to the EPA regarding the proposal. This assists the EPA in assessing the proposal and providing advice to the Minister for the Environment. A guide to the preparation of submissions is included as a preface to the CER.

In addition to the requirement for the public review of the CER, Cawse is undertaking a consultation programme to inform interested parties of the proposal and seek feedback from Government authorities and the community.

The consultation programme has included the following organisations and authorities:

- DEP - Environmental Assessment Division;
- DEP - Kalgoorlie Office;
- DEP - Pollution Prevention Division;
- DME - Environment and Rehabilitation Division;
- DME - Kalgoorlie Inspectorate;
- DME - Occupational and Radiation Health Division;
- The Chamber of Mines and Energy of Western Australia - Aboriginal Affairs;
- City of Kalgoorlie-Boulder;
- Local Pastoralists; and
- Aborigines who speak for the area.

The following table summarises issues raised at meetings held with various bodies between October and November 1995 for this project.

TABLE 5-1
SUMMARY OF ISSUES RAISED DURING THE COMMUNITY CONSULTATION PROGRAMME

Department or Local Government Authority	Issues	CER Section
Department of Environmental Protection (Perth) - Environmental Assessment Division	• Material handling and waste classification	2.3.1, 4.5
	• Impacts on surface drainage patterns	4.2, 3.4
	• Impacts on water supply for other users, transport to site, bunding and water holding dams/tanks	2.5.1, 4.3, 3.4.2
	• Impact of dewatering on vegetation	4.3.1
	• Supply of acid from alternative sources	2.3.10.1
	• Address present and future options for acid, power and transport	2.3.10.1, 2.5.2, 2.5.3, 2.5.5
	• Close proximity of site to nature reserves with regional conservation significance	3.5.1.3
	• Need for early consultation with relevant interested parties	5.0
	• Documentation of commitments as future environmental management programmes inclusive of monitoring	4.1
Department of Minerals and Energy - Environment and Rehabilitation Division	• Consultation with the Land Access Unit	
	• Rehabilitation	3.5.1.3, 4.5, 4.6, 4.7, 4.8
	• Tailings disposal and seepage	2.3.9, 4.2.2, 4.3.2
City of Kalgoorlie-Boulder	• Transport issues (particularly sulphuric acid supply)	2.5.5
	• Gas pipeline extension	2.5.3
	• Employment	3.9, 1.4
	• Supply of Limestone (particularly road transport)	2.3, 10.2
	• Disposal of saline water	4.3.2

Department of Environmental Protection - Kalgoorlie Office	• Community awareness of new technology and new issues • Leach residue • Sources of sulphuric acid • Disposal of saline water • Commitment to revegetate stockpiles	 2.3.10, 4.3 2.3.10.1 4.3.2 3.5.1.3
Department of Minerals and Energy - Kalgoorlie Inspectorate	• Waste disposal • Operational characteristics of mining (particularly type of machinery to be used etc) • Commitments with respect to revegetation • Cumulative impacts (such as mine life, water requirements etc) • Tailings composition and management • Infrastructure layout	2.3.1, 2.3.9 NA 4.8.3 2.5.1, 4.3 4.3.1, 2.3.9, 4.3.2 2.4, 2.5
Department of Minerals and Energy - Occupational and Radiation Health Division	• Compliance with Australian Standards with respect to storage and handling of chemicals • Storage, handling and transport of chemicals • Address the following issues: – site layout (including location of storage facilities for dangerous goods) – bunding for each tank – separation between various types of chemicals – emergency response plant, MSDS, contingency plans – pipework from supply points – delivery details, vehicle containment location, alarm systems for ammonia – security information – gas cylinder siting and storage – personal protective equipment	4.13 2.3.10, 2.5.5, 4.13, 4.14 4.13, 4.14
Department of Environmental Protection - Pollution Prevention Division	• Atmospheric Emissions • Works Approval and Licence • Preferred options with alternatives • Possible plant shut downs, emissions of hydrogen sulphide and ammonia • Tailings Management	2.3.8, 4.15, 4.16 1.3 2.3.8, 4.15 4.3, 2.3.10

6.0
SUMMARY OF COMMITMENTS

The proposal to establish the Cawse Nickel Project, as described in this CER, will involve the mining and processing of a lateritic nickel deposit 50 km north-west of Kalgoorlie. The operation will generate substantial income for the Kalgoorlie region and Western Australia in general.

Centaur has taken into account the results of environmental studies in the planning and design of the Project and is committed to achieving a high standard of environmental management. This requires the integration of all monitoring and management programmes to refine and continuously improve environmental management of the operations.

The commitments listed in this CER have been formulated with the intention of including specific environmental management measures in an Environmental Management Plan which will be periodically revised by Centaur and submitted for review by the DEP. This will facilitate a more effective environmental management system as practices can be modified in response to monitoring programmes and any operational change.

The commitments made by Centaur, as the Proponent for the Cawse Nickel Project, are summarised in Table 6-1 as follows:

TABLE 6-1

SUMMARY OF PROPONENT'S COMMITMENTS

Issue	Assessment Objective	Commitment	Timing (Phase)	Regulatory Agency	Specification (Performance Indicator where applicable)
Environmental Management Plan	Implement an approved and effective Environmental Management Plan.	Commitment 1 The Proponent will prepare and implement an Environmental Management Plan (EMP) for the Cawse Nickel Project to the satisfaction of the EPA on advice from the Department of Environmental Protection and the Department of Minerals and Energy. The EMP will be developed in two separate stages as follows: I. Project Construction EMP - To be submitted to the EPA prior to commencement of construction. II. Project Operation EMP - To be submitted to the EPA prior to commissioning. The EMP will be developed in accordance with statutory conditions applied to the approved operations. The EMP will be reviewed and updated as required.	Develop prior to commissioning. Implement from Project commissioning. Periodically review and update throughout the life of the Project.	Develop in consultation with the DEP. Approval by EPA and DME.	To be agreed with the DEP and DME. EMP to be implemented to the requirements of DEP and DME.
Surface Drainage	Ensure no adverse changes to existing drainage systems, vegetation/land systems, and dependent flora and fauna.	Commitment 2 The Proponent will avoid disturbance to natural drainage lines, where possible. Where this is not possible, the Proponent will develop and implement a site drainage plan and monitoring programme, as part of both construction and operational stages of the Environmental Management Plan to manage and assess the impacts of modified drainage on vegetation. This will be to the satisfaction of the EPA.	Ongoing	EPA, DME	Criteria to be agreed with the DEP and DME.
Groundwater	Implement best practice to avoid contaminating the groundwater.	Commitment 3 Prior to the discharge of tailings, the Proponent will install a series of monitoring bores adjacent to the tailings storage facility which will be monitored on a regular basis to detect any potential leakage of process water from the facility. If leakage is detected, remedial work will be undertaken to the satisfaction of the Department of Environmental Protection and the State Mining Engineer. Details of the tailings storage facility management and monitoring programmes will be included in the operational stage of the Environmental Management Plan.	Ongoing	DEP, DME, Water and Rivers Commission.	EPA Bulletin 711 Guidelines on the Safe Design and Operating Standards for Tailings Storages, DME.
Water Supply	Calculate water budget and ensure groundwater resource is not depleted.	Commitment 4 The Proponent will develop and implement management and monitoring procedures, as part of both construction and operational stages of the Environmental Management Plan, to avoid potential impacts associated with the process water supply. These will include details of the water source, pipeline construction and management of potential leakage.	Ongoing	DEP, DME and Water and Rivers Commission.	Criteria to be agreed with the DEP and DME.
Landform	Minimise disturbance to areas which are not required for Project. Develop/design an integrated mining/rehabilitation procedure which includes progress towards an appropriate end landform and rehabilitation.	Commitment 5 The Proponent will develop and implement procedures, as part of both construction and operational stages of the Environmental Management Plan, to avoid unnecessary disturbance to areas which are not required for mining, processing or infrastructure development.	Ongoing	DEP and DME	Post-mining land use and rehabilitation criteria to be agreed with the DEP and DME.

Issue	Assessment Objective	Commitment	Timing (Phase)	Regulatory Agency	Specification (Performance Indicator where applicable)
Flora and Fauna	Protect Declared Rare and Priority flora and Reserve Listed fauna.	Commitment 6 The Proponent will develop and implement procedures, as part of both construction and operational stages of the Environmental Management Plan, to avoid unnecessary disturbance to vegetation, especially significant associations, and flora Commitment 7 The Proponent will develop and implement procedures, as part of both construction and operational stages of the Environmental Management Plan, to avoid unnecessary disturbance to fauna species and habitats.	Develop prior to commencement of construction. Ongoing Develop prior to commencement of construction. Ongoing	CALM, DEP.	Compliance with the *Wildlife Conservation Act* 1950.
Rehabilitation	Develop process to identify post-mining land uses. Define appropriate rehabilitation criteria. Develop/design an integrated mining/rehabilitation procedure which includes continual progress towards an appropriate end landform and revegetation.	Commitment 8 The Proponent will develop a rehabilitation programme, as part of the operational stage of the Environmental Management Plan. The rehabilitation programme will be implemented in the course of the operations and will be consistent with defined post-mining land use objectives.	Develop prior to commissioning. Periodically review and update throughout the life of the Project.	Develop in consultation with the DEP and DME.	Post-mining land uses and rehabilitation criteria to be agreed with the DEP and DME. Programme to be implemented to the requirements of DEP and DME.
Heritage	Avoid disturbance to sites of significance to Aboriginal people.	Commitment 9 The Proponent will comply with the provisions of the Aboriginal Heritage Act, 1972-1980.	Ongoing	Department of Aboriginal Affairs.	Compliance with the *Aboriginal Heritage Act* 1972-1980.
Waste Products and Hazardous Materials	Ensure safe handling, storage and disposal of all hazardous materials.	Commitment 10 The Proponent will develop and implement a Hazardous Materials Management Programme in accordance with requirements, and to the satisfaction, of the Department of Minerals and Energy.	Ongoing	DME	Mines Safety and Inspection Act, 1995. Dangerous Goods Regulations, 1992.
Gaseous Emissions	Limit various gaseous emissions to the atmosphere to within appropriate standards specified by the EPA and DEP.	Commitment 11 The Proponent will monitor gaseous emissions from potential sources during commissioning of the processing plant and associated infrastructure to ensure that levels are below EPA specified criteria to the satisfaction of the Department of Environmental Protection.	During commissioning. Prior to construction.	EPA DEP	Appropriate EPA specified standards for relevant emissions.
Decommissioning	Ensure that the decommissioning of the Project is in accordance to best practice.	Commitment 12 The Proponent will include details of potential emissions and pollution control equipment in a Works Approval application to the Department of Environmental Protection, if a decision is made to establish a hydrogen sulphide plant.	12 months prior to completion of processing operations.	EPA and DME	Criteria agreed to by DEP and DME.

7.0
ABBREVIATIONS

AS	Australian Standard
CALM	Department of Conservation and Land Management
CCD	counter current decantation
CER	Consultative Environmental Review
DME	Department of Minerals and Energy
DEP	Department of Environmental Protection
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
g/s	grams per second
ha	hectares
HDPE	High Density Polyethylene
HMMP	Hazardous Materials Management Programme
kg/t	kilograms per tonne
km	kilometre
km^2	square kilometre
km/hr	kilometres per hour
kL	kilolitre
kLpa	kilolitre per annum
kw	kilowatt
kwhr	kilowatt hour
L	litre
m	metre
mg/L	milligrams per litre
µg/ms	microgram per cubic metre
ML	Mining Lease
mm	millimetre
MOB	main ore blend
Mt	million tonnes
Mtpa	million tonnes per annum

NATA	National Association of Testing Authorities
°C	degrees Celsius
PL	Prospecting Lease
ppm	parts per million
ROM	run-of-mine
TDS	total dissolved solids
tpa	tonnes per annum
WMC	Western Mining Corporation
WRC	Water and Rivers Commission

8.0
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ENVIRONMENTAL PROTECTION AUTHORITY GUIDELINES

Appendix A

CAWSE NICKEL PROJECT, 50KM NORTH WEST OF KALGOORLIE

CONSULTATIVE ENVIRONMENTAL REVIEW GUIDELINES

Overview

All environmental reviews have the objective of protecting the environment, and environmental impact assessment is deliberately a public process in order to obtain broad ranging advice. The review requires the proponent to describe the proposal, receiving environment, potential environmental impacts and the management of the issues arising from the environmental impacts, so that the environment is protected to an acceptable level.

Throughout the assessment, the Department of Environmental Protection (DEP) aims to assist the proponent to improve the proposal so that environmental impacts are minimised. The DEP also co-ordinates advice from relevant government agencies and the public about environmental matters during the assessment of the Consultative Environmental Review (CER).

Objectives of the CER

- To communicate clearly with the public and government agencies, so that the EPA can obtain informed comment to assist in providing advice to government.
- To describe all aspects of the proposal adequately, so that the Minister for the Environment can consider approval of a well-defined project.
- To provide the basis for the environmental management programme, which should demonstrate that the environmental issues resulting from the proposal can be acceptably managed.

The contents of the CER should reflect these objectives.

Contents of the CER

The text of the CER should be simple, concise, and referenced. This document would form the legal basis of the Minister for the Environment's approval of the proposal and should include a description of all the components of the proposal.

The environmental management programme for the proposal should be developed in conjunction with the engineering and economic programs of the proposal. That is, the CER should be designed to be immediately useful at the start of the proposal, and the DEP recommends that an environmental management and audit programme be incorporated as a concluding part of the CER.

The textual content of the CER should include:

- introduction to the proponent, the project and location;
- the legal framework, decision making authorities and involved agencies;
- description of the components of the proposal and identification of the potential environmental impacts;
- description of the receiving environment which may be affected;
- discussion of the key environmental topics (shown in the next section), including an assessment of their significance in comparison to relevant objectives, policies or standards;
- discussion of the objectives for management of the issues, including commitments to appropriate action; and
- a summary of the environmental management programme, including the key commitments, monitoring work and the auditing of the programme.

The EPA considers that the proponent should approach environmental management in terms of best practice, which includes:

- development of an environmental policy;
- agreed environmental objectives;
- management practices to achieve the objectives;
- involve the public as appropriate;
- audit environmental performance against agreed indicators;
- regular reporting to the EPA (or nominated agency);
- commitment to a quality assured management system and continuous improvement; and
- periodic review in conjunction with the EPA (or nominated agency).

Additional content requirements for the CER are included in the next section.

Key environmental topics

The key topics can be determined from a consideration, called scoping, of the potential impacts of the proposal on the environment. The receiving environment includes social surroundings.

The CER should focus on the key topics for the proposal as agreed in consultation with the DEP and relevant government agencies. A description of the project component and the receiving environment should be directly included with, or referenced to, the discussion of the topic. The technical basis for measuring the impact and any specifications or standards for assessing and managing the topic should be provided.

The key topics identified at this stage and the assessment objectives include:

Environmental topic	Assessment objective
Leach residue disposal area and evaporation pond	Ensure the leach residue disposal area and evaporation pond are located and designed so as to minimise environmental impacts.
Social surroundings	Develop procedures in accordance with: Working with Communities, A Guide for Proponents, November 1993, Dept. Commerce and Trade
Rehabilitation	• Develop process to identify post-mining land uses. • Define appropriate rehabilitation criteria. • Develop/design an integrated mining/rehabilitation procedure which includes continual progress towards an appropriate end landform and revegetation.
Risk	Implement project to comply with criteria in EPA Bulletins 611 and 627
Environmental Management Programme	Implement an approved and effective EMP
NO_2 emissions	The maximum one hour average of NO_2 should not exceed 320 $\mu g/m^3$ at the nearest residence (World Health Organisation Standard).
SO_2 emissions	The maximum one hour average of SO_2 should not exceed 350 $\mu g/m^3$ at the nearest residence (World Health Organisation Standard).

Environmental topic	Assessment objective
H_2S emissions	There shall be no offensive odours from reduced sulphur compounds (including hydrogen sulphide) in areas beyond the boundary of the plant frequented by persons who are not employees of the plant. To achieve this objective, a 3-minute average design ground level concentration maximum of 1.0 $\mu g/m^3$ H_2S should be used, pending development of odour assessment methods applicable to specific industries.
CO emissions	Maximum one hour average of CO should not exceed 30 mg/m^3 at nearest residence. Maximum 8 hour average of CO should not exceed 10 mg/m^3 at nearest residence (NHMRC standards).
Greenhouse gas emissions	Consistent with EPA requirements.
Effects of gaseous emissions / dust on native vegetation.	Protect native vegetation from effects of gaseous emissions / dust on advice from CALM and DEP.
Fugitive dust - storage, transport and handling of materials	Control fugitive dust to an acceptable standard as determined by DEP.
Noise (project site)	Comply with statutory requirements.
Noise (off-site eg: transport of materials)	Protect the amenity of neighbouring residents from unacceptable noise impacts.
Solid and liquid wastes	Implement best practice to avoid creating a contaminated site; refer to ANZECC & NHMRC 1992 Guidelines
Surface drainage	Ensure no adverse changes to existing drainage systems, vegetation/land systems, and dependent flora and fauna.
Powerlines, pipelines, other utilities	Select route which avoids sensitive areas; rehabilitate to agreed landowner specifications.
Protect groundwater resource from pollution	Implement best practice to avoid contaminating the groundwater, refer to EPA Bulletin 711.
Water supply	Calculate water budget and ensure groundwater resource is not depleted.
Flora and fauna	Protect Declared Rare and Priority flora and Reserve Listed fauna. Minimise the loss of locally and regionally significant vegetation associations and plant and animal habitats.

Commonwealth requirements (if applicable)

Environmental topic	objective
National Estate Areas	Protect National Estate areas
Endangered species	Protect species listed in Schedule 1 of the Endangered Species Protection Act

Further key topics may be raised during the preparation of the CER, and on-going consultation with the DEP and relevant agencies is recommended. Minor issues which can be readily managed as part of normal operations may be briefly described. Information used to reach conclusions should be properly referenced, including personal communications. Assessments of the significance of an impact should be soundly based rather than unsubstantiated opinions, and the assessment should lead to a discussion of the management of the issue.

In discussing the key topics identified in the table above, the CER should contain:

- the results of recent, comprehensive, fauna, flora and vegetation surveys;
- procedures with regard to any Declared Rare and/or Priority flora and Reserve Listed fauna;
- an assessment of the regional significance of the vegetation associations likely to be affected by this proposal, including discussion of the representation of these associations in secure conservation areas;
- the probable pond water budget for the pond area remaining once mining is complete;
- the physical and chemical characteristics of leach residue should be specified;
- evidence of an adequate Environmental Management System (EMS) and demonstrated proponent commitment to environmental performance;
- a table summarising the key characteristics of the proposal. For example, clearing rates, mining rate, separation & processing rates, and trucking rate. This will facilitate the assessment of any future changes to the operation;
- pollution source flow sheet which quantifies point source emissions;
- two base maps and an overlay of the proposed project layout. The base maps should show the existing physical and social environment, which when displayed with the overlay illustrate the physical disturbance likely, and the impacts on residents and residential centres. Latitude and Longitude should be clearly marked;
- a table summarising the environmental impacts of the proposal and describing:
  - the present state of the environment;
  - potential impacts of the proposal on the environment;
  - environmental management objectives for those aspects which require management;
  - environmental management proposed to manage impacts to meet those objectives; &
  - envisaged resultant state of the environment.

  These topics should be presented under the major headings used in the table above ie, biophysical environment, pollution potential, and social surroundings.

Public consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent in preparing the CER. It should describe the activities undertaken, the dates, the groups/individuals involved and the objectives of the activities. Cross reference should be made with the description of environmental management of the issues which should clearly indicate how community concerns have been addressed. Those concerns which are dealt with outside the EPA process can be noted and referenced.

Environmental management commitments

The method of implementation of the proposal and all commitments made by the proponent in the CER become legally enforceable under the conditions of environmental approval issued by the Minister for the Environment. Commitments which address key environmental topics form a schedule to the Minister's environmental conditions and will be audited by the DEP. The commitments have the form of: the proponent (who) will prepare a plan or take action (what) to meet an objective, to the timing for its achievement (when), and to which agencies will be consulted or to whose requirements, if not the DEP, the action/plan will be prepared.

Other commitments show that the proponent is dedicated to good environmental management of the project, and the DEP expects that the proponent will audit these commitments by internal processes under an Environmental Management System. Though not subject to routine audit, the DEP may request that compliance with, or the in-house audit of, these commitments be demonstrated, so as to verify satisfactory environmental performance. The commitments define the goals/objectives for the environmental management programme and procedures (the details of how the commitment will be met), which should be described in as much detail as possible. The DEP acknowledges that,

with the implementation of best practice and continuous improvement for the project, the procedures may need to be modified, or added to, in regular updates to the environmental management programme. An example of a typical commitment is:

Issue	Objective	Commitment	Timing (Phase)	Whose requirements	Specification (Performance Indicator)
EMP	Implement effective EMP	Develop and implement an effective EMP	Pre-construction and on-going	DEP	EMP developed and implemented to requirements of DEP.

FLORA SPECIES LIST AND DISTRIBUTION

(Source: Matiske Consulting Pty Ltd, 1995)

Appendix B

APPENDIX : VASCULAR PLANT SPECIES LIST FOR THE CAWSE FIND PROJECT AREA, OCTOBER 1995 (* denotes introduced species)

FAMILY	GENUS	SPECIES
POACEAE	*Amphipogon*	*strictus*
	Aristida	*contorta*
	Eragrostis	*dielsii*
	Eragrostis	*eriopoda*
	Stipa	*elegantissima*
	Stipa	*platychaeta*
	Stipa	*scabra*
	Triodia	*irritans*
ANTHERICACEAE	*Thysanotus*	*manglesianus*
CASUARINACEAE	*Allocasuarina*	*campestris*
	Allocasuarina	*eriochlamys ssp. eriochlamys*
	Allocasuarina	*helmsii*
	Casuarina	*cristata ssp. pauper*
PROTEACEAE	*Grevillea*	*acuaria*
	Grevillea	*nematophylla*
	Grevillea	*oligomera*
	Hakea	*preissii*
	Hakea	*recurva*
SANTALACEAE	*Exocarpos*	*aphyllus*
	Santalum	*acuminatum*
	Santalum	*spicatum*
CHENOPODIACEAE	*Atriplex*	*cinerea*
	Atriplex	*nummularia ssp. spathulata*
	Enchylaena	*tomentosa*
	Maireana	*georgei*
	Maireana	*sedifolia*
	Maireana	*trichoptera*
	Rhagodia	*drummondii*
	Rhagodia	*preissii ssp. preissii*
	Sclerolaena	*drummondii*
AMARANTHACEAE	*Ptilotus*	*axillaris*
	Ptilotus	*chamaecladus*
	Ptilotus	*exaltatus*
	Ptilotus	*helipteroides*
	Ptilotus	*obovatus*
BRASSICACEAE	*Stenopetalum*	*anfractum*

APPENDIX : VASCULAR PLANT SPECIES LIST FOR THE CAWSE FIND PROJECT AREA, OCTOBER 1995 (* denotes introduced species)

FAMILY	GENUS	SPECIES	
PITTOSPORACEAE	*Pittosporum*	*phylliraeoides*	
MIMOSACEAE	*Acacia*	*acuminata ssp. burkittii*	
	Acacia	*aneura var. aneura/intermedia (intergrade)*	
	Acacia	*erinacea*	
	Acacia	*hemiteles*	
	Acacia	*kalgoorliensis*	*Priority 3*
	Acacia	*oswaldii*	
	Acacia	*prainii var. linearis*	
	Acacia	*quadrimarginea*	
	Acacia	*ramulosa*	
	Acacia	*stowardii*	
	Acacia	*tetragonophylla*	
CAESALPINIACEAE	*Senna*	*artemisioides ssp. filifolia*	
	Senna	*glutinosa ssp. chatelainiana*	
PAPILIONACEAE	*Mirbelia*	*depressa*	
	Psoralea	*cinerea*	
ZYGOPHYLLACEAE	*Zygophyllum*	*fruticulosum*	
	Zygophyllum	*iodocarpum*	
RUTACEAE	*Eriostemon*	*brucei ssp. brucei*	
STACKHOUSIACEAE	*Stackhousia*	*muricata*	
SAPINDACEAE	*Alectryon*	*oleifolius ssp. macrocalyx*	
	Dodonaea	*lobulata*	
	Dodonaea	*microzyga var. acrolobata*	
	Dodonaea	*rigida*	
	Dodonaea	*stenozyga*	
RHAMNACEAE	*Cryptandra*	*leucopogon*	
	Trymalium	*myrtillus*	
MALVACEAE	*Alyogyne*	*hakeifolia*	
STERCULIACEAE	*Brachychiton*	*gregorii*	
FRANKENIACEAE	*Frankenia*	*aff. magnifica*	

APPENDIX : VASCULAR PLANT SPECIES LIST FOR THE CAWSE FIND PROJECT AREA, OCTOBER 1995 (* denotes introduced species)

FAMILY	GENUS	SPECIES
VIOLACEAE	*Hybanthus*	*floribundus ssp. curvifolius*
THYMELAEACEAE	*Pimelea*	*microcephala*
MYRTACEAE	*Eucalyptus*	*calycogona*
	Eucalyptus	*celastroides ssp. celastroides*
	Eucalyptus	*clelandii*
	Eucalyptus	*ebbanoensis*
	Eucalyptus	*eremicola*
	Eucalyptus	*ewartiana*
	Eucalyptus	*griffithsii*
	Eucalyptus	*loxophleba (ssp."smooth bark")*
	Eucalyptus	*lucasii*
	Eucalyptus	*salmonophloia*
	Eucalyptus	*salubris var. glauca*
	Eucalyptus	*transcontinentalis*
	Eucalyptus	*trivalvis*
	Melaleuca	*uncinata*
HALORAGACEAE	*Haloragis*	*gossei*
	Haloragis	*trigonocarpa*
APOCYNACEAE	*Alyxia*	*buxifolia*
CONVOLVULACEAE	*Porana*	*sericea*
BORAGINACEAE	*Halgania*	*cyanea*
CHLOANTHACEAE	*Newcastelia*	*viscida*
LAMIACEAE	*Prostanthera*	*althoferi ssp. althoferi*
	Prostanthera	*grylloana*
	Prostanthera	*wilkieana*
	Prostanthera	sp. (RJ Cranfield & PS Spencer 7723)
	Westringia	*rigida var. brachyphylla*
SOLANACEAE	*Solanum*	*lasiophyllum*

APPENDIX : VASCULAR PLANT SPECIES LIST FOR THE CAWSE FIND PROJECT AREA, OCTOBER 1995 (* denotes introduced species)

FAMILY	GENUS	SPECIES	
MYOPORACEAE	*Eremophila*	*alternifolia*	
	Eremophila	*decipiens*	
	Eremophila	*georgei*	
	Eremophila	*glabra*	
	Eremophila	*granitica*	
	Eremophila	*aff. incisa*	
	Eremophila	*interstans*	
	Eremophila	*ionantha*	
	Eremophila	*latrobei*	
	Eremophila	*longifolia*	
	Eremophila	*maculata ssp. brevifolia*	
	Eremophila	*oldfieldii*	
	Eremophila	*oppositifolia ssp. angustifolia*	
	Eremophila	*parvifolia ssp. auricampa*	
	Eremophila	*pustulata*	*Priority 3*
	Eremophila	*scoparia*	
PLANTAGINACEAE	*Plantago*	*varia*	
GOODENIACEAE	*Brunonia*	*australis*	
	Goodenia	*havilandii*	
	Goodenia	*pinnatifida*	
	Scaevola	*spinescens*	
	Velleia	*rosea*	
ASTERACEAE	*Angianthus*	*tomentosus*	
	Calocephalus	*multiflorus*	
	* *Centaurea*	*melitensis*	
	Cephalipterum	*drummondii*	
	Cratystylis	*subspinescens*	
	* *Hypochaeris*	*glabra*	
	Leucochrysum	*fitzgibbonii*	
	Olearia	*muelleri*	
	Olearia	*pimeleoides*	
	Podolepis	*capillaris*	
	Podolepis	*kendallii*	
	Rhodanthe	*charsleyae*	
	Rhodanthe	*floribunda*	
	Rhodanthe	*uniflorum*	
	Schoenia	*cassiniana*	
	Streptoglossa	*cylindriceps*	
	Waitzia	*acuminata*	

APPENDIX B : DISTRIBUTION OF SPECIES BY PLANT COMMUNITIES FOR THE CAWSE FIND PROJECT AREA, OCTOBER 1995 (* denotes introduced species)

	Woodlands							Shrublands									
	1A	1B	1C	1D	1E	1F	1G	2A	2B	2C	2D	2E	2F	2G	2H	2I	2J
Acacia acuminata ssp. burkittii	+		+		+	+	+		+	+	+	+	+	+		+	+
Acacia aneura var. aneura/intermedia (intergrade)										+		+					
Acacia erinacea	+	+				+	+			+			+				
Acacia hemiteles	+			+	+	+	+			+		+	+	+	+	+	+
Acacia kalgoorliensis								+	+		+			+			
Acacia oswaldii						+											
Acacia prainii var. linearis					+				+		+						
Acacia quadrimarginea								+									
Acacia ramulosa										+		+					+
Acacia stowardii										+		+					+
Acacia tetragonophylla	+		+		+			+		+		+					+
Alectryon oleifolius ssp. macrocalyx						+				+		+			+		
Allocasuarina campestris									+								
Allocasuarina eriochlamys ssp. eriochlamys			+									+		+			
Allocasuarina helmsii									+								
Alyogyne hakeifolia			+														
Alyxia buxifolia	+									+		+					
Amphipogon strictus			+									+					
Angianthus tomentosus															+		+
Aristida contorta	+		+							+		+					
Atriplex cinerea		+		+		+									+		+
Atriplex nummularia ssp. spathulata		+				+									+		
Brachychiton gregorii										+		+					+
Brunonia australis										+		+					+
Calocephalus multiflorus												+	+				
Casuarina cristata ssp. pauper	+	+	+	+		+	+			+		+				+	+

APPENDIX B : DISTRIBUTION OF SPECIES BY PLANT COMMUNITIES FOR THE CAWSE FIND PROJECT AREA, OCTOBER 1995 (* denotes introduced species)

	Woodlands							Shrublands									
	1A	1B	1C	1D	1E	1F	1G	2A	2B	2C	2D	2E	2F	2G	2H	2I	2J
**Centaurea melitensis*				+	+										+		
Cephalipterum drummondii					+		+										
Cratystylis subspinescens						+											
Cryptandra leucopogon									+					+			+
Dodonaea lobulata			+			+				+		+	+	+			
Dodonaea microzyga var. acrolobata	+		+		+					+		+		+			
Dodonaea rigida										+		+					+
Dodonaea stenozyga		+															
Enchylaena tomentosa							+										
Eragrostis dielsii						+	+								+		
Eragrostis eriopoda															+		
Eremophila alternifolia			+														+
Eremophila decipiens									+	+		+					+
Eremophila georgei			+									+					
Eremophila glabra						+											
Eremophila granitica								+		+		+				+	+
Eremophila aff. incisa								+									
Eremophila interstans		+			+					+	+	+	+	+			
Eremophila ionantha												+					
Eremophila latrobei												+					
Eremophila longifolia															+		+
Eremophila maculata ssp. brevifolia															+		
Eremophila oldfieldii	+									+		+					+
Eremophila oppositifolia			+			+	+			+		+	+				
Eremophila oppositifolia ssp. angustifolia										+							
Eremophila parvifolia ssp. auricampa		+															

APPENDIX B : DISTRIBUTION OF SPECIES BY PLANT COMMUNITIES FOR THE CAWSE FIND PROJECT AREA, OCTOBER 1995 (* denotes introduced species)

	Woodlands							Shrublands									
	1A	1B	1C	1D	1E	1F	1G	2A	2B	2C	2D	2E	2F	2G	2H	2I	2J
Eremophila pustulata									+								
Eremophila scoparia		+				+	+								+		
Eriostemon brucei ssp. brucei			+							+		+					
Eucalyptus calycogona			+							+							
Eucalyptus celastroides ssp. celastroides										+							
Eucalyptus clelandii		+				+				+		+	+				
Eucalyptus ebbanoensis	+		+						+								
Eucalyptus eremicola			+							+		+				+	+
Eucalyptus ewartiana														+			
Eucalyptus griffithsii					+					+	+	+	+	+			+
Eucalyptus loxophleba (ssp. "smooth bark")			+							+							+
Eucalyptus lucasii																	+
Eucalyptus salmonophloia						+	+			+							
Eucalyptus salubris var. glauca					+	+											
Eucalyptus transcontinentalis					+	+	+			+		+					
Eucalyptus trivalvis							+					+					
Exocarpos aphyllus						+	+			+							+
Frankenia aff. magnifica		+															
Goodenia havilandii					+				+						+		
Goodenia pinnatifida	+				+	+				+		+					+
Grevillea acuaria			+				+										
Grevillea nematophylla										+		+		+			+
Grevillea oligomera			+									+		+			
Hakea preisii															+		
Halgania cyanea									+								
Haloragis gossei					+							+					

APPENDIX B : DISTRIBUTION OF SPECIES BY PLANT COMMUNITIES FOR THE CAWSE FIND PROJECT AREA, OCTOBER 1995 (* denotes introduced species)

	Woodlands							Shrublands									
	1A	1B	1C	1D	1E	1F	1G	2A	2B	2C	2D	2E	2F	2G	2H	2I	2J
Haloragis trigonocarpa													+				
Hybanthus floribundus ssp. curvifolius			+									+					
Leucochrysum fitzgibbonii	+									+		+		+			+
Maireana georgei		+			+	+	+			+							+
Maireana sedifolia						+	+										
Maireana trichoptera		+			+	+	+								+		
Melaleuca uncinata			+							+		+		+			
Mirbelia depressa								+						+			
Newcastelia viscida												+					
Olearia muelleri	+	+	+			+				+		+					+
Olearia pimeleoides			+														
Pimelea microcephala			+														
Pittosporum phylliraeoides						+				+							
Plantago varia															+		
Podolepis capillaris																	+
Podolepis kendallii												+					
Porana sericea															+		
Prostanthera althoferi ssp. althoferi												+					
Prostanthera grylloana			+														
Prostanthera wilkieana			+							+		+					
Prostanthera sp. (RJ Cranfield & PS Spencer 7723)	+													+			
Psoralea cinerea															+		
Ptilotus axillaris												+					
Ptilotus chamaecladus					+		+	+		+					+		+
Ptilotus exaltatus		+			+	+	+			+					+	+	+
Ptilotus helipteroides												+					

APPENDIX B : DISTRIBUTION OF SPECIES BY PLANT COMMUNITIES FOR THE CAWSE FIND PROJECT AREA, OCTOBER 1995 (* denotes introduced species)

	Woodlands							Shrublands									
	1A	1B	1C	1D	1E	1F	1G	2A	2B	2C	2D	2E	2F	2G	2H	2I	2J
Ptilotus obovatus	+	+			+	+	+			+	+	+		+		+	+
Rhagodia preissii ssp. preissii																	+
Rhodanthe charsleyae				+													
Rhodanthe floribunda						+	+	+						+	+	+	
Santalum acuminatum	+		+		+	+				+	+	+	+				+
Santalum spicatum			+					+				+	+				
Scaevola spinescens	+	+	+			+		+	+	+	+	+	+	+			+
Schoenia cassiniana				+													
Sclerolaena drummondii					+	+	+								+		
Senna artemisioides ssp. filifolia	+		+	+		+	+			+	+	+	+	+	+	+	+
Senna glutinosa ssp. chatelainiana							+									+	
Solanum lasiophyllum								+		+							
Stackhousia muricata	+								+					+			
Stenopetalum anfractum	+																+
Stipa elegantissima												+					
Stipa platychaeta							+										
Stipa scabra					+	+	+			+	+	+	+		+		+
Streptoglossa cylindriceps				+	+	+	+								+		
Thysanotus manglesianus									+								+
Triodia irritans			+						+			+					
Trymalium myrtillus			+						+								
Velleia rosea												+					+
Waitzia acuminata			+							+		+					+
Westringia rigida var. brachyphylla	+								+				+				
Zygophyllum fruticulosum						+						+					+
Zygophyllum iodocarpum						+					+						

FAUNA SPECIES LIST

(Source: Ninox Wildlife Consulting, 1995)

Appendix C

Appendix C ***List of vertebrate species recorded from various biological surveys conducted in the Kalgoorlie area. Species recorded and predicted to occur at Cawse Find are shown.***

KEY

♠ = Gazetted as rare or in need of special protection
? = Taxonomic status unconfirmed
S = Signs such as scats, tracks etc.
P = Predicted to occur
X = Present

LOCALITIES

CF = Cawse Nickel Project area
BF = Black Flag
KNS = Kalgoorlie Nickel Smelter
KHC = Kangaroo Hills/Calooli Timber Reserves
KW = Kurrawang Nature Reserve

	SITES	CF	BF	KNS	KHC	KW
	NUMBER OF SURVEYS	-	3	3	3	1
BIRD SPECIES						
DROMAIIDAE						
Dromaius novaehollandiae	Emu	X	X	X	X	X
ACCIPITRIDAE						
Lophoictinia isura	Square-tailed Kite	X		X	X	X
Haliastur sphenurus	Whistling Kite	P				
Accipiter fasciatus	Brown Goshawk	P		X	X	
A. cirrhocephalus	Collared Sparrowhawk	P		X		
Aquila audax	Wedge-tailed Eagle	P	X	X	X	
Hieraaetus morphnoides	Little Eagle	P	X	X		
Circus assimilis	Spotted Harrier	P		X		
FALCONIDAE						
Falco peregrinus ♠	Peregrine Falcon	P				
F. longipennis	Australian Hobby	P	X	X		
F. hypoleucos ♠	Grey Falcon	P				
F. berigora	Brown Falcon	P	X	X	X	
F. cenchroides	Australian Kestrel	X		X		X
MEGAPODIIDAE						
Leipoa ocellata ♠	Malleefowl	P		X	X	
TURNICIDAE						
Turnix velox	Little Button-quail	X		X		
OTIDIDAE						
Ardeotis australis	Australian Bustard	P				
COLUMBIDAE						
Phaps chalcoptera	Common Bronzewing	X	X	X	X	
Ocyphaps lophotes	Crested Pigeon	X	X	X	X	X
CACATUIDAE						
Calyptorhynchus magnificus	Red-tailed Black-Cockatoo	P				
Cacatua roseicapilla	Galah	X	X	X	X	X
C. leadbeateri ♠	Pink Cockatoo	P				
LORIIDAE						
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	P	X	X	X	

	SITES	CF	BF	KNS	KHC	KW
	NUMBER OF SURVEYS	-	3	3	3	1
POLYTELITIDAE						
Polytelis anthopeplus	Regent Parrot	P		X	X	
Nymphicus hollandicus	Cockatiel	P	X			
PLATYCERCIDAE						
Melopsittacus undulatus	Budgerigar	X		X		
Platycercus icterotis	Western Rosella	P				
Barnardius zonarius	Port Lincoln Ringneck	X	X	X	X	X
Psephotus varius	Mulga Parrot	P		X	X	X
Neophema splendida ♠	Scarlet-chested Parrot	P				
CUCULIDAE						
Cuculus pallidus	Pallid Cuckoo	P	X	X	X	
C. pyrrhophanus	Fan-tailed Cuckoo	P		X		
Chrysococcyx osculans	Black-eared Cuckoo	X		X	X	
C. basalis	Horsfield's Bronze-Cuckoo	P	X	X	X	
STRIGIDAE						
Ninox novaeseelandiae	Southern Boobook	P	X		X	
PODARGIDAE						
Podargus strigoides	Tawny Frogmouth	P	X	X	X	X
AEGOTHELIDAE						
Aegotheles cristatus	Australian Owlet-nightjar	P		X	X	X
CAPRIMULGIDAE						
Caprimulgus guttatus	Spotted Nightjar	P		X	X	
ALCEDINIDAE						
Halcyon pyrrhopygia	Red-backed Kingfisher	P	X	X		
MEROPIDAE						
Merops ornatus	Rainbow Bee-eater	P	X	X	X	X
HIRUNDINIDAE						
Cheramoeca leucosternum	White-backed Swallow	P	X	X	X	
Hirundo neoxena	Welcome Swallow	X	X	X	X	
Cecropis nigricans	Tree Martin	P	X	X		
MOTACILLIDAE						
Anthus novaeseelandiae	Richard's Pipit	X	X	X		X
CAMPEPHAGIDAE						
Coracina novaehollandiae	Black-faced Cuckoo-shrike	X	X	X	X	X
C. maxima	Ground Cuckoo-shrike	P	X	X	X	X
Lalage sueurii	White-winged Triller	P	X	X	X	
MUSCICAPIDAE						
Petroica goodenovii	Red-capped Robin	X	X	X	X	X
Melanodryas cucullata	Hooded Robin	P	X			
Microeca leucophaea	Jacky Winter	X	X	X	X	X
Falcunculus frontatus ♠	Crested Shrike-tit	P				
Pachycephala rufiventris	Rufous Whistler	P			X	
Colluricincla harmonica	Grey Shrike-thrush	P	X	X	X	X
Oreoica gutturalis	Crested Bellbird	X	X	X	X	X
Rhipidura leucophrys	Willie Wagtail	X	X	X	X	
ORTHONYCHIDAE						
Cinclosoma castanotum	Chestnut Quail-thrush	P		X	X	X

	SITES	CF	BF	KNS	KHC	KW
	NUMBER OF SURVEYS	-	3	3	3	1
TIMALIIDAE						
Pomatostomus superciliosus	White-browed Babbler	P	X	X	X	
SYLVIIDAE						
Cinclorhamphus mathewsi	Rufous Songlark	X		X		
C. cruralis	Brown Songlark	P	X			
MALURIDAE						
Malurus splendens	Splendid Fairy-wren	X		X	X	X
M. pulcherrimus	Blue-breasted Fairy-wren	P			X	
M. leucopterus	White-winged Fairy-wren	P	X	X		
ACANTHIZIDAE						
Sericornis cautus	Shy Hylacola	P		X	X	
S. brunneus	Redthroat	P	X	X	X	
Smicrornis brevirostris	Weebill	X	X	X	X	X
Gerygone fusca	Western Gerygone	P		X	X	
Acanthiza apicalis	Inland Thornbill	P	X	X	X	X
A. uropygialis	Chestnut-rumped Thornbill	P	X	X	X	X
A. chrysorrhoa	Yellow-rumped Thornbill	X	X	X	X	X
Aphelocephala leucopsis	Southern Whiteface	P			X	
NEOSITTIDAE						
Daphoenositta chrysoptera	Varied Sittella	P	X	X	X	
CLIMACTERIDAE						
Climacteris affinis	White-browed Treecreeper	P				
C. rufa	Rufous Treecreeper	P	X	X	X	
MELIPHAGIDAE						
Anthochaera carunculata	Red Wattlebird	X	X	X	X	X
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	X	X	X	X	X
Manorina flavigula	Yellow-throated Miner	X	X	X	X	X
Lichenostomus virescens	Singing Honeyeater	X	X	X		
L. leucotis	White-eared Honeyeater	X	X	X	X	X
L. ornatus	Yellow-plumed Honeyeater	X	X	X	X	X
L. plumulus	Grey-fronted Honeyeater	P		X		
Melithreptus brevirostris	Brown-headed Honeyeater	P	X	X	X	
Lichmera indistincta	Brown Honeyeater	X	X	X	X	X
Phylidonyris albifrons	White-fronted Honeyeater	P	X	X	X	
Certhionyx niger	Black Honeyeater	P				
EPHTHIANURIDAE						
Ephthianura tricolor	Crimson Chat	X				
E. aurifrons	Orange Chat	P	X			
E. albifrons	White-fronted Chat	P	X	X		
DICAEIDAE						
Dicaeum hirundinaceum	Mistletoebird	P		X	X	
PARDALOTIDAE						
Pardalotus striatus	Striated Pardalote	X	X	X	X	X
PLOCEIDAE						
Poephila guttata	Zebra Finch	X				
GRALLINIDAE						
Grallina cyanoleuca	Australian Magpie-lark	X	X	X		X

	SITES	CF	BF	KNS	KHC	KW
	NUMBER OF SURVEYS	-	3	3	3	1
ARTAMIDAE						
Artamus personatus	Masked Woodswallow	P		X	X	
A. cinereus	Black-faced Woodswallow	P	X		X	X
A. cyanopterus	Dusky Woodswallow	P	X	X	X	
CRACTICIDAE						
Cracticus torquatus	Grey Butcherbird	X	X	X	X	X
C. nigrogularis	Pied Butcherbird	P	X	X	X	X
Gymnorhina tibicen	Australian Magpie	X	X	X	X	X
Strepera versicolor	Grey Currawong	P	X	X	X	X
Corvus coronoides	Australian Raven	X		X	X	
C. bennetti	Little Crow	P		X	X	X
C. orru	Torresian Crow	P				
NATIVE MAMMAL SPECIES						
TACHYGLOSSIDAE						
Tachyglossus aculeatus	Short-beaked Echidna	P		X	X	X
DASYURIDAE						
Sminthopsis dolichura	Common Dunnart	P	X?	X	X	
S. crassicaudata	Fat-tailed Dunnart	P	X	X		X
Ningaui yvonneae	Yvonne's Ningaui	P		X	X	X
BURRAMYIDAE						
Cercartetus concinnus	Western Pygmy-possum	P	X	X	X	X
MACROPODIDAE						
Macropus fuliginosus	Western Grey Kangaroo	P	X	X	X	X
M. robustus	Euro	P	X	X	X	X
M. rufus	Red Kangaroo	P	X	X		
Macropus sp.	Unidentified Kangaroo	S				
MURIDAE						
Pseudomys hermannsburgensis	Sandy Inland Mouse	P		X	X	X
P. albocinereus	Ashy-grey Mouse	P		X		
P. bolami	Bolami's Mouse	P	X	X		
Notomys mitchelli	Mitchell's Hopping-mouse	P		X	X	X
MOLOSSIDAE						
Tadarida australis	White-striped Mastiff-bat	P	X			
Mormopterus planiceps	Little Mastiff-bat		X			
VESPERTILIONIDAE						
Nyctophilus major	Greater Long-eared Bat	P				
N. geoffroyi	Lesser Long-eared Bat	P	X			
Chalinolobus gouldii	Gould's Wattled Bat	P	X			
C. morio	Chocolate Wattled Bat	P	X			
Scotorepens balstoni	Broad-nosed Bat	P	X			
Eptesicus regulus	Little Brown Bat	P	X			
CANIDAE						
Canis familiaris dingo	Dingo	P				

	SITES	CF	BF	KNS	KHC	KW
	NUMBER OF SURVEYS	-	3	3	3	1
INTRODUCED MAMMAL SPECIES						
MURIDAE						
Mus musculus	House Mouse	P	X	X	X	X
Oryctolagus cuniculus	Rabbit	X	X	X	X	
CANIDAE						
Canis familiaris	Dog	X		X		
Vulpes vulpes	Fox	S	X	X	X	
FELIDAE						
Felis catus	Feral Cat	P		X	X	
BOVIDAE						
Capra hircus	Feral Goat	P		X	X	
AMPHIBIAN AND REPTILE SPECIES						
LEPTODACTYLIDAE	**Frogs**					
Neobatrachus kunapalari		P		X		
N. sutor		P				
N. wilsmorei		P	X	X		
Pseudophryne occidentalis		P	X		X	
GEKKONIDAE	**Geckos**					
Crenadactylus o. ocellatus		P			X	
Diplodactylus assimilis		P		X	X	X
D. elderi		P	X			
D. g. granariensis		P	X	X	X	X
D. maini		P	X	X	X	X
D. pulcher		P	X	X	X	X
Gehyra purpurascens		P		X	X	
G. variegata		P	X	X	X	X
Heteronotia binoei		P	X	X	X	X
Nephrurus vertebralis		P	X			
Oedura reticulata		P	X			
Rhynchoedura ornata		P	X	X	X	
Underwoodisaurus milii		P	X	X	X	X
PYGOPODIDAE	**Legless Lizards**					
Delma australis		P	X	X	X	
D. nasuta		P				
Lialis burtonis		P	X	X	X	
Pygopus lepidopodus		P			X	
P. n. nigriceps		P				
AGAMIDAE	**Dragon Lizards**					
Ctenophorus cristatus		P	X	X	X	X
C. fordi		P	X	X		X
C. reticulatus		P	X	X	X	
C. scutulatus		P	X	X		
Pogona m. minor		P	X	X		
Tympanocryptis cephala		P		X	X	

	SITES	CF	BF	KNS	KHC	KW
	NUMBER OF SURVEYS	-	3	3	3	1
SCINCIDAE	**Skinks**					
Cryptoblepharus carnabyi		P				
C. plagiocephalus		P	X	X	X	
Ctenotus atlas		P	X	X	X	X
C. leonhardii		P		X	X	
C. schomburgkii		P	X	X		X
Cyclodomorphus melanops		P	X	X		X
Egernia depressa		P		X		
E. formosa		P	X			
E. inornata		P	X			
E. multiscutata bos		P		X		
Eremiascincus richardsonii		P		X		
Hemiergis i. initialis		P		X	X	
Lerista gerrardii		P				
L. m. macropisthopus		P				
L. muelleri		P	X	X	X	
L. picturata		P	X	X	X	
Menetia greyii		P	X	X	X	X
Morethia adelaidensis		P	X			
M. butleri		P	X			
M. obscura		P		X		
Tiliqua occipitalis		P		X	X	X
T. r. rugosa		P	X	X	X	X
VARANIDAE	**Monitors**					
Varanus caudolineatus		P	X			
V. gouldii		P	X	X	X	
V. t. tristis		P		X	X	
TYPHLOPIDAE	**Blind Snakes**					
Ramphotyphlops australis		P		X	X	
R. bituberculatus		P		X		
R. hamatus		P		X		
Ramphotyphlops (sp nov.)		P		X		
BOIDAE	**Pythons**					
Liasis s. stimsoni		P				
Morelia spilota imbricata ♠		P				
Aspidites ramsayi ♠		P				
ELAPIDAE	**Elapid Snakes**					
Demansia p. psammophis		P			X	
Denisonia fasciata		P				
Neelaps bimaculatus		P		X		
Pseudechis australis,		P		X	X	
Pseudonaja modesta		P	X	X		
P. nuchalis		P	X	X		
Rhinoplocephalus gouldii		P	X			
R. monachus		P	X			
Simoselaps bertholdi		P	X	X		
S. s. semifasciatus		P		X		

TAILINGS DISPOSAL FACILITY

Appendix D

APPENDIX D
TAILINGS DISPOSAL FACILITY

The mineral processing plant will generate tailings in the form of a slurry containing 40% solids by mass. The tailings will be deposited into an engineered storage impoundment, constructed to minimise the potential for seepage of process water into the surrounding environment.

D 1.0 STORAGE LOCATION

The tailings storage facility will be located to the east of the process plant site as shown on Figure 6 of the CER.

D 2.0 SITE GEOLOGY

The tailings storage is located on an alluvial plain of subdued relief, with a fall towards the east. The site is characterised by a thin alluvial soil cover overlying a well developed lateritic hardpan, with areas of calcareous hardpan. Both the hardpan and highly weathered granite subcrops across the site. The surficial soils consist of transported silts, sands, clays and gravel and are typically less than 0.3 m thick. The underlying laterite is typically strong and laminated, predominantly consisting of ferruginous silt, sand and gravel with some calcareously cemented areas. In some places uncemented gravel and sand lenses occur within the laterite horizon. Where encountered, weathered granite is massive and of medium strength. Geological information on the surrounding area indicates that the basement rock underlying the storage is low permeability granite.

D 3.0 STORAGE LAYOUT

The storage will be divided into 4 cells, each measuring 500 m x 500 m and progressively constructed during the life of the Project. The first 12 months of storage will be deposited into I cell and the next cell will be then be constructed, allowing 12

months of drying and consolidation of the tailings beaches. Discharge of tailings to each cell will be alternated at sufficient intervals to optimise drying and consolidation.

D 4.0 CONSTRUCTION METHOD

Construction of the storage will involve the initial construction of a starter embankment, with ongoing embankment lifting carried out by the upstream construction method.

Starter embankment construction will involve the following:

D 4.1 Clearing and Stripping

All trees and other vegetation will be removed from beneath the storage embankments, within the storage area, and to 50 metres outside the storage perimeter. Vegetation will be stockpiled in designated areas adjacent to the storage.

Following clearing, a nominal 150 mm of topsoil will be removed from the cleared area and stockpiled in designated areas to the west and south of the initial storage area (Cell 1)

D 4.2 Perimeter Embankment Construction

The perimeter starter embankments will be constructed with a combination of low permeability silty clay material, and higher permeability lateritic gravel sourced from the open pit operation. The embankment will be constructed with the low permeability material placed and compacted to form a zone on the upstream (tailings) side of the embankment inclusive of the seepage cut-off trench (Zone 1). The higher permeability material will be placed and compacted to form a zone on the downstream side of the low permeability zone (Zone 2).

Material in Zone 1 will be placed in layers not exceeding 300 mm in thickness parallel to the axis of the embankment and compacted to a minimum of 95 % of the Maximum

Dry Density (MDD) at a moisture content within 0 and +2% of the Optimum Moisture Content (OMC). Material in Zone 2 will be placed in layers not exceeding 300 mm in thickness and compacted to 95% MDD at OMC 0%-+4%. Depending on the dispersion characteristics of the embankment construction materials a filter zone may be constructed between the zones to prevent possible piping of material from Zone 1 to Zone 2.

To ensure that the specified levels of compaction have been achieved the embankment fill in both zones will be tested by a NATA registered soil testing laboratory using a Nuclear Moisture Density Meter. Any fill that does not meet either the compaction or moisture content requirements will be reworked until it complies with the specification.

Depending on the availability of suitable low permeability fill materials sourced from ongoing mining operations, it may be possible to construct additional storage cells, subsequent to the first year of operation, without embankment zoning.

D 4.3 Internal Embankments

The decant access embankments will be constructed using lateritic gravel sourced from the open pit operations. The material shall be moisture conditioned and placed in layers not exceeding 500 mm in thickness, and compacted with a minimum of 4 passes of a vibrating roller to ensure stability.

D 4.4 Area

The total storage area after 20 years of operation will be 100 ha comprising an external embankment measuring 1000 m x 1000 m.

D 4.5 Capacity

The initial starter embankment (Cell 1) will have a volume of approximately 665,000 m^3 available for tailings deposition. For initial volume calculations a conservative settled density of 1.1 t/m^3 has been assumed. This is likely to be exceeded

with good storage management, and densities of up to 1.25 t/m^3 may be achievable. For the conceptual design a beach slope angle of 1 in 100 has been assumed.

D 4.6 Wall Angle

During operation of the storage the perimeter embankment batter angle will be 1 vertical to 2.75 horizontal (1V:2.75H) on the downstream side and 1V:1.5H on the upstream side. Decant access embankments will be constructed with batter angles of 1V:1.5H. With these batter angles stability is unlikely to be a problem.

Following decommissioning of each cell the outer slope will be battered back to 20 degrees.

D 4.7 Tailings distribution

Tailings will be conveyed to the storage facility by pipeline and deposited via a series of spigotted discharge points from the perimeter embankments. Care will be taken to ensure that tailings are deposited in a manner that maximises beaching and air drying of tailings.

D 4.8 Decant/Underdrainage System

Water return from the tailings storage will be predominantly via a centrally located decant system in each tailings cell. The decant structure will consist of slotted well liners on a reinforced concrete plinth surrounded by graded decant rock. The decants will be accessed via a causeway from the perimeter embankment, to allow maintenance and lifting of the structure. Due to the topographic fall across the site and the proximity of cemented materials to the surface, a pump out system will be used to return water to the process plant. The water will be returned via an HDPE fusion welded pipeline to a return water storage pond at the plant site.

return water storage pond at the plant site. The pipeline will be contained within the slurry distribution line bunded corridor.

D 4.9 Liners

The tailings return water storage will be lined with a 1.5 mm fusion welded HDPE liner. The liner will be installed by a quality certified contractor, and tested using a combination of destructive testing (e.g. tensile grab test) of selected welds and nondestructive testing (e.g. compressed air leak detection).

D 5.0 TAILINGS PROPERTIES

Preliminary assay work has been conducted on tailings material produced from the bulk sample and pilot process testing material. Results are presented in the following table:

TABLE D5-1

CHEMICAL COMPOSITION OF TAILINGS MATERIAL

Element	Concentration (ppm except as indicated)
Arsenic	12
Calcium	7.82%
Cobalt	232
Copper	122
Magnesium	5991
Aluminium	1.52%
Cadmium	<1
Chromium	6192
Iron	15.35%
Manganese	171
Sodium	1.25%
Lead	<5
Zinc	200
Sulphur (as sulphate)	10.56%

Indicative levels for tailings solution composition are presented in Table D5-2.

TABLE D5-2

TAILINGS SOLUTION COMPOSITION

Element	Concentration (g/L)
Sodium	14.3
Chloride	25.2
Manganese	1.4
Cobalt	0.01
Zinc	0.001
Magnesium	21.9
Calcium	1.33
Iron	0.003
Nickel	0.08

It is estimated that the pH of the tailings solution will be approximately 5.0. Salinity will vary depending on process water quality which will be in the range of 30,000 to 60,000 ppm TDS.

Further tailings material testing will be undertaken as part of the detailed design phase.

D 6.0 STORAGE WATER BALANCE

A preliminary water balance has been conducted on the tailings storage, taking into account the tailings slurry inflow seepage, evaporation, rainfall, retained water in the tailings pore volumes and decanted water.

Based upon an initial tailings slurry at 40% solids (by mass), delivering 87.9 tonnes per hour for 7500 hours per year, and assuming an initial deposited tailings dry density of 0.9 t/m^3; the average decant water recovery is estimated at 1,550 kL/day, which represents approximately 49% of the tailings slurry water content of 3,150 kL/day.

Under average climatic conditions, the average recovery is expected to vary seasonally by around ±250 kL/day, depending on prevailing evaporation rates and rainfall events.

The tailings return water quality will be dependent on the quality of the process water supply, which is presently under investigation.

D 7.0 MONITORING

The tailings storage facility has been designed and will be constructed to minimise the potential for seepage of process water into the surrounding environment.

Monitoring bores and piezometers will be installed around the tailings facility to detect any leakage that may occur. If leakage is detected which would adversely effect surrounding vegetation or water resources, remedial measures will be undertaken to rectify the problem. These may include:

- interceptor bores;
- cut off trenches;
- grouting; and
- constructing additional containment cells over affected area (with first five years).