

Proposed Phase II Expansion of  
Gidji Roaster Kalgoorlie,  
Western Australia

Kalgoorlie Consolidated Gold Mines Pty Ltd

Report and Recommendations  
of the  
Environmental Protection Authority

PROPOSED PHASE II EXPANSION OF GIDJI GOLD ROASTER

KALGOORLIE, WESTERN AUSTRALIA

KALGOORLIE CONSOLIDATED GOLD MINES PTY LTD

Report and Recommendations of the  
Environmental Protection Authority

Environmental Protection Authority  
1 Mount Street, Perth  
Bulletin No 396. August 1989



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## MAP

1. Location Diagram . . . . .	
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Areas closer to the stack will receive higher levels of sulphur dioxide. The vegetation monitoring programme, which was begun as a condition for approval of Phase I of the roaster, will be refined and used to compare the vigour of vegetation prior to the commissioning of Phase I with its subsequent condition after emissions have begun. The Environmental Protection Authority will take appropriate action to curtail or reduce emissions if this monitoring shows significant environmental impacts are occurring.

The original proposal to pump the concentrate in a pipeline to the roaster was found to be not economically feasible and an alternative was put forward. The chosen option will require about 15 return trips daily of a triple trailer road train. The route will be partly on a dedicated haul road and the remainder via the main sealed road from Kalgoorlie to Leonora. The option of a private haul route all the way from Fimiston to Gidji was ruled out because of the high cost of construction and maintenance, and the attendant severe environmental impacts.

This proposal is in keeping with the Environmental Protection Authority's objective of reducing sulphur dioxide levels in the Kalgoorlie-Boulder residential area, although it is recognised that there will be some impact to areas adjacent to the roaster. Accordingly the Authority recommends:

#### RECOMMENDATION 1

The Environmental Protection Authority concludes that the proposal as outlined in the Notice of Intent for Phase II is environmentally acceptable and recommends that it may proceed subject to the EPA's recommendations in this Report, and subject to the proponent abiding by the environmental commitments listed in the proponent's Public Environmental Report (for Phase I) and subsequent Notice of Intent referred to above (see Appendix I).

These include considerations on flora and fauna; safety measures and controls; and management of dangerous goods.

In addition the Authority makes the following recommendations:

#### RECOMMENDATION 2

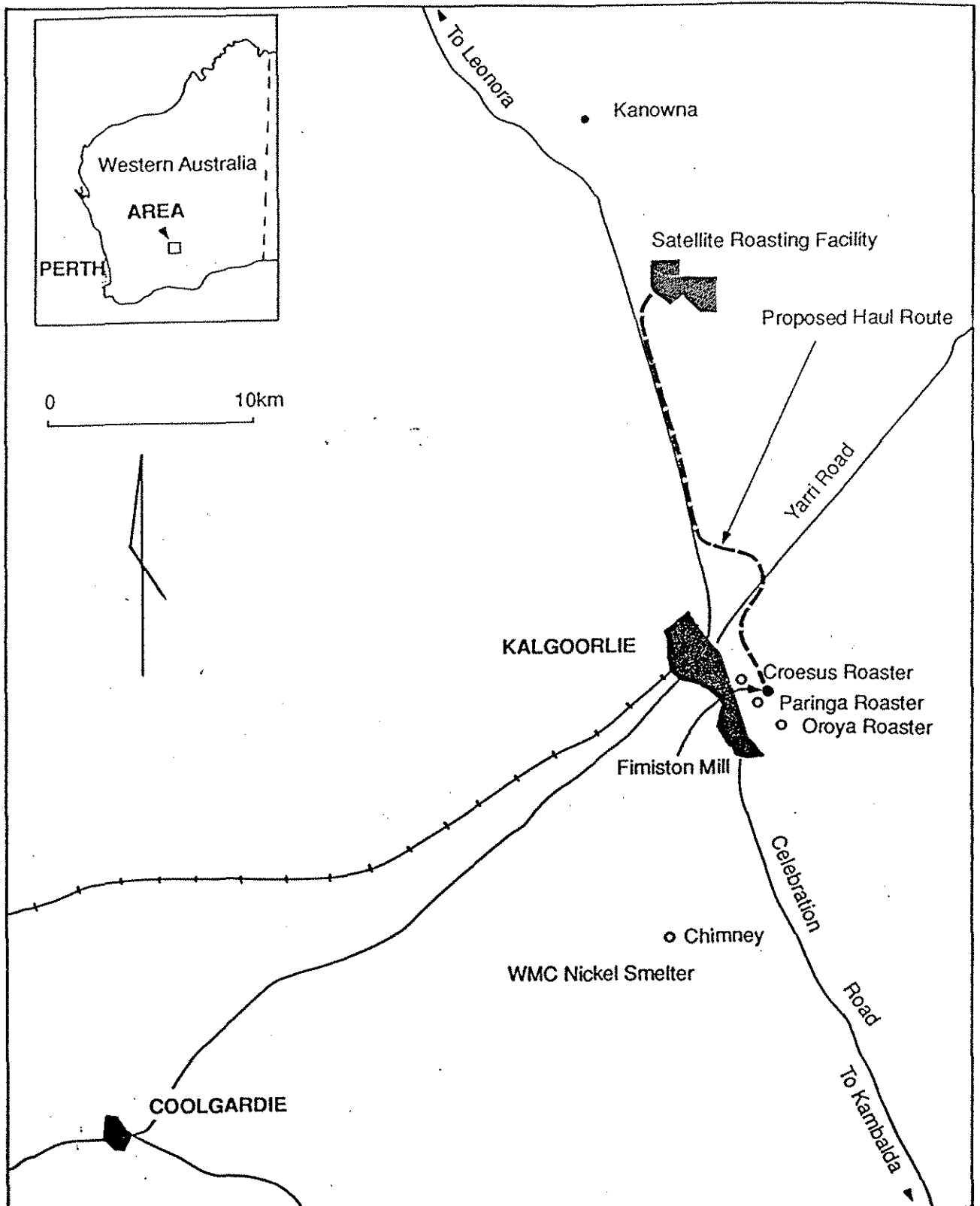
The Environmental Protection Authority recommends that prior to commissioning of the second stage of the roaster, the proponent's existing sulphur dioxide monitoring programme for Phase I be upgraded as necessary to take into account the greater output of Phase II.

To assess earlier predictions of sulphur dioxide levels made in the Phase I PER, the Environmental Protection Authority requires a report detailing the performance of those predictions and highlighting any deficiencies which may have become apparent. Additionally, this report should identify improvements in accuracy of the predictions which may be necessary due to the increased output of the plant following the commissioning of Phase II.

#### RECOMMENDATION 3

The Environmental Protection Authority recommends that the proponent, prior to commissioning of the Phase II roaster, submit to the EPA a report detailing the performance of the predictive strategy designed to reduce the number of fumigation events in Kalgoorlie-Boulder for Phase I, and identifying improvements which may be necessary to accommodate the increased throughput of Phase II.





**LOCALITY PLAN**

Source : Notice of Intent Dames and Moore 1989



## 1. INTRODUCTION

In April 1988 the Environmental Protection Authority's Report and Recommendations on a proposal by North Kalgurli Mines Ltd for the construction of a gold roaster at a site 17 km NNW of the town centre of Kalgoorlie, known as Gidji, was released. The Report and Recommendations (Bulletin 327) found the project to be environmentally acceptable provided a number of commitments were met. The most important were the development of a predictive control strategy for the control of sulphur dioxide over Kalgoorlie-Boulder, and the closure of the Paringa roaster (immediately east of Kalgoorlie-Boulder) within two months of the final commissioning of the Gidji roaster. Commissioning of the Gidji plant is currently under way.

This proposal deals with the construction of a second roaster unit in parallel with the first, to facilitate the processing of increased amounts of milled product from the rationalisation of the previously separate operations of three companies: Gold Mines of Kalgoorlie Ltd; North Kalgurli Mines Ltd; and Homestake Gold of Australia Ltd. The assessment also deals with the transport, by road train, of the gold concentrate from Fimiston to the Gidji roaster. The combined development is commonly known as operations related to the 'Super Pit' and the proponent is Kalgoorlie Consolidated Gold Mines Pty Ltd (KCML).

## 2. PROJECT DESCRIPTION

The roaster process was described in the original assessment report which should be referred to for details.

### 2.1 RELATIONSHIP WITH EXISTING INDUSTRY

The reason for siting the Gidji roaster away from the main populated area of Kalgoorlie-Boulder is to progressively divert atmospheric emissions of sulphur dioxide away from this population centre. This is to be achieved by progressively phasing out the three currently operating Kalgoorlie roasters.

The Paringa roaster will be shut down two months after commissioning of Phase I of the Gidji roaster or by 31 October 1989. The commissioning of the second phase of Gidji will coincide with the closure of the Croesus roaster (about mid 1990) and the Oroya roaster will be decommissioned by the end of 1991.

The Western Mining Corporation nickel smelter 10 km south of Boulder, itself a significant emitter of sulphur dioxide will continue to operate.

### 2.2 GIDJI PHASE II PROPOSAL

An increased throughput of ore from 2 to 4.2 million tonnes per year is proposed.

Primary gold ore will be milled and upgraded to a concentrate estimated to contain 33% sulphur and 35 grammes per tonne of gold at the uprated Fimiston plant, from where it will be trucked to the Gidji roaster in a triple trailer unit. The route is shown on Figure 1 and follows existing haul roads to the east of Kalgoorlie before crossing the Kanowna Road and joining the main sealed road to Leonora, about 5 km north of Kalgoorlie. This is a departure from the original (Phase I) proposal in which the slurry was to be piped to the roaster. The current (Phase II) proposal is to transport all concentrate by road to the roaster rather than by pipeline and this report addresses this alternative.

At Gidji the proposed expansion will run in parallel with the Phase I roasting and leaching facilities, which were assessed in the original Report and Recommendations. Elements common to both process trains will be:

- . road transportation of all concentrate and reagents;
- . concentrate storage;
- . bore and scheme water supplies and storage;
- . grid power supply and back-up generator set;
- . cyanide and other reagents;
- . control room and laboratory;
- . the 180 m high exhaust stack (no height increase from Phase I); and
- . tailings disposal ponds.

Leached calcines will be disposed of in a tailings pond. There will be a number of "cells", each covering an area of about 9 ha. This disposal area will need additional capacity (up from 170,000 to 235,000 tonnes per year) but the configuration and scheduling for this work has yet to be finalised and will be the subject of a separate application for Works Approval, under Part V of the Environmental Protection Act 1986.

With the increased throughput of ore the level of stack emissions is predicted to increase by about 63% (total gas flow and mass flow rate of sulphur dioxide - details in Appendix II) over the level predicted for Phase I of the roaster. This is lower than might be expected with double the throughput, because the sulphur content of the ore is lower than originally expected.

#### 2.2.1 WATER REQUIREMENTS

Saline water for the treatment circuit is supplied from the Gidji borefield via an existing pipeline. An increase of 6000 L/h to a total of 20,600 L/h would be required via three extra bores for Phase II operations.

Fresh water is piped from the Water Authority of WA tank at Mt Percy on the northern edge of Kalgoorlie. Approximately 53,300 L/h will be required for the expanded facility, but this quantity will be accommodated from supplies already committed to the facilities under Phase I.

#### 2.2.2 POWER REQUIREMENTS

The existing supply is considered adequate for the proposed expansion.

#### 2.2.3 WASTE DISPOSAL

Solid wastes will be disposed of into a designated landfill facility, to be sited at least 5 m above the water table and away from any natural flow lines. Septic wastes will be disposed of via septic tanks, and no significant incremental impacts are envisaged over those of the original proposal.

#### 2.2.4 WORKFORCE

The construction and operations workforces will commute daily from Kalgoorlie - Boulder. Thus there will be no requirement for an on-site accommodation camp. An extra four people will be required over the Phase I levels, increasing operative staff levels to 16 operating on a shift basis.



#### 4.2 SULPHUR DIOXIDE LEVELS UNDER NORMAL ATMOSPHERIC CONDITIONS

The increased sulphur dioxide emission of Phase II (up 63%) is expected to have greater impacts upon the surrounding areas; this is seen as a direct consequence of achieving the objective of better air quality for the greatest number of people at Kalgoorlie - Boulder. The stack for Phase I was designed to accommodate the extra output, and consequently has the greater dispersive capacities necessary for Phase II output. There is thus no requirement for a second stack.

As a result, predicted ground level concentrations of sulphur dioxide near the roaster are considered to be within acceptable limits.

As a condition for approval of Phase I of the Gidji roaster a vegetation monitoring programme was required to be instigated. A number of 8 km long transects were outlined, these being radially arranged away from the roaster stack in the northwest quadrant, the quarter towards which the prevailing winds are expected to blow the plume.

Studies at each site along each transect included leaf sulphur analyses; condition rating studies; and photographic monitoring of each site in general as well as of soil surface lichens and algae.

Monitoring took place in August and October 1988, and February and May of 1989, in order to assess results from the four seasons of the year. The last study was completed before Phase I of the roaster was first tested so that the vegetation had experienced no sulphur dioxide output. (Dames & Moore, July 1989).

These results will be used to compare the condition of vegetation after the roaster is commissioned via a continuing programme of monitoring at the same sites.

The Gidji roaster site was chosen north of Kalgoorlie because studies of winds have shown that those from a northerly direction during stable atmospheric conditions are infrequent compared to other directions. The EPA has been monitoring meteorological data from Kalgoorlie since mid 1982. Analysis of this information shows that the plume from the Gidji roaster could be blown in the direction of Kalgoorlie - Boulder on about 4% of the time per year. Analysis of the same data showed that the range between different years was 3.3% (in 1985) to 4.1% (1984).

The prevailing winds derive predominantly from the east and south east (Fig 5, Notice of Intent, Dames & Moore, 1989). Emissions would therefore be expected to travel mainly in a west to north westerly direction away from the main centre of population. However, the Kanowna and Mt Vettors pastoral lease homesteads (each of which has six residents) are located 10 km and 24 km (respectively) north northwest of the roaster site, close to the path of the prevailing winds from the stack. As a result the pollution levels around Kanowna homestead are expected to rise. The proponent's modelling indicates that the levels at Kanowna could be comparable with predicted levels around Kalgoorlie once all three existing roasters in town have been closed.

Modelling of emission levels by the proponent shows that significant improvements in air quality can be expected in Kalgoorlie under normal atmospheric conditions after closure of the Croesus roaster, which is a condition for the approval of Phase II of Gidji. The Environmental

Protection Policy (EPP) Guidelines (EPA Bulletin 315) would, however, be exceeded in southern parts of the Policy Area (see Figs 8a, 8b Dames & Moore 1989). After closure of the last roaster in Kalgoorlie by the end of 1991 a further improvement to air quality is expected (Figs 9a-9c Dames & Moore, 1989).

The Environmental Protection Authority has reviewed the proponent's data and is in agreement with the conclusions presented.

#### 4.3 THE POTENTIAL FOR FUMIGATION EVENTS

Fumigation events are more difficult to model accurately but the data point to the possibility of such events occurring on about ten separate occasions per year in Kalgoorlie. KCML is in the process of developing predictive modelling programmes and a sulphur dioxide predictive control programme which will reduce the chances of the occurrence of a fumigation event in Kalgoorlie. New operating procedures are to be established which will permit the roaster operators to shut down the roaster more quickly, so that a shut down could be effected long before high levels of sulphur dioxide would otherwise reach the city.

#### 4.4 TRANSPORT OF CONCENTRATES

With regard to the issue of road transport of concentrates, KCML has obtained the necessary approvals from the Kalgoorlie - Boulder City Council and Department of Main Roads to run a specifically designed triple trailer road train, requiring about 15 return trips daily. These are generally expected to be accomplished during daylight hours only. Traffic counts show that this would amount to about a 4% increase in total traffic numbers.

The chosen route (shown on Fig 1) would join the main sealed road to Leonora about 5 km north of Kalgoorlie. It was chosen in preference to a dedicated haul road all the way to the roaster because of the high construction and maintenance costs and the associated environmental impacts of the latter (bush clearing and dust problems).

The Environmental Protection Authority is satisfied that these arrangements are environmentally acceptable.

### 5. CONCLUSION AND RECOMMENDATIONS

This proposal is in keeping with the Environmental Protection Authority's objective of reducing sulphur dioxide levels in the Kalgoorlie residential area. There is expected to be an increase in the levels in the vicinity of the roaster which will have further impacts on nearby vegetation and, to a lesser extent, on the Kanowna homestead. A satisfactory agreement should be negotiated between the proponent and the leaseholders which recognises the extra potential for degradation to vegetation and increased atmospheric pollution that the Phase II output would be expected to produce.

The Authority makes the following recommendations:

#### RECOMMENDATION 1

The Environmental Protection Authority concludes that the proposal as outlined in the Notice of Intent for Phase II is environmentally acceptable and recommends that it may proceed subject to the EPA's recommendations in this Report, and subject to the proponent abiding by the environmental commitments listed in the proponent's Public Environmental Report (for Phase I) and subsequent Notice of Intent referred to above (see Appendix I).

These include considerations on flora and fauna; safety measures and controls; and management of dangerous goods.

In addition the Authority makes the following recommendations:

#### RECOMMENDATION 2

The Environmental Protection Authority recommends that prior to commissioning of the second stage of the roaster, the proponent's existing sulphur dioxide monitoring programme for Phase I be upgraded as necessary to take into account the greater output of Phase II.

To assess earlier predictions of sulphur dioxide levels made in the Phase I PER, the Environmental Protection Authority requires a report detailing the performance of those predictions and highlighting any deficiencies which may have become apparent. Additionally, this report should identify improvements in accuracy of the predictions which may be necessary due to the increased output of the plant following the commissioning of Phase II.

#### RECOMMENDATION 3

The Environmental Protection Authority recommends that the proponent, prior to commissioning of the Phase II roaster, submit to the EPA a report detailing the performance of the predictive strategy designed to reduce the number of fumigation events in Kalgoorlie-Boulder for Phase I, and identifying improvements which may be necessary to accommodate the increased throughput of Phase II.

#### RECOMMENDATION 4

Public awareness and concern at the local and regional effects of uncontrolled sulphur dioxide emissions is far higher now than in the past. In order to develop a better understanding of the impacts on arid terrain in the area with the potential to be affected by the Gidji roaster the Environmental Protection Authority recommends that, prior to commissioning, the vegetation monitoring programme outlined in the proponent's PER for Phase I be modified as necessary to take into account the output from Phase II. This shall be in the form of a report also detailing the regional and broader scale impacts of the continued emission of sulphur dioxide upon the environment.

#### RECOMMENDATION 5

The Environmental Protection Authority recommends that the proponent shall, at intervals of no more than 2 years, assess the environmental impacts of sulphur dioxide emissions and report on these impacts to the Environmental Protection Authority. On the basis of a report by the Environmental Protection Authority the Minister for Environment may order appropriate mechanisms to remove sulphur dioxide emissions.



**APPENDIX I**

**Proponent's List of Environmental Commitments**







TABLE 3

COMPARISON OF PHASE I AND PHASE II SATELLITE ROASTER EMISSION PARAMETERS

	PHASE I	PHASE II
Ore Throughput (Mtpa)	2	4.2
Sulphur Content of Ore (%)	3.5	2.7
Concentrate Feed, dry		
- t/h	24.0	39
- t/d (assuming 90% availability)	518	940
- t/a	189,216	310,000
Sulphur in Concentrate		
- %	33	33
- tpa	63,000	102,000
Stack Parameters		
- height (m)	180	180
- internal diameter (m)	2	2
- exit temperature (°C)	340	340
Stack Gas Composition (Nm <sup>3</sup> /h)		
- Water vapour H <sub>2</sub> O	32,327	52,650
- Nitrogen N <sub>2</sub>	31,339	51,000
- Oxygen O <sub>2</sub>	370	600
- Sulphur dioxide SO <sub>2</sub>	5,180	8,400
- Sulphur trioxide SO <sub>3</sub>	111	180
- Acid gas HCL	31	50
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* TOTAL GAS FLOW:	69,358	113,000
Mass Flow Rate (kg/s)		
- Sulphur dioxide SO <sub>2</sub>	4.11	6.70
- Sulphur trioxide SO <sub>3</sub>	0.110	0.180
- Acid gas HCL	0.014	0.023
- Dust (100mg/Nm <sup>3</sup> )	0.002	0.003
Flow at Stack Exit (Am <sup>3</sup> /h)	166,000	270,000
Exit Velocity (m/s)	14.7	23.9

Notes:

N refers to 0°C, 101.33 kPa absolute.

\* Total is not exact due to the rounding off of various figures.

**APPENDIX III**

Points Raised in Submissions and Proponent's Response

## SUMMARY OF POINTS RAISED IN SUBMISSION

1. Concern about sulphur dioxide levels in areas downwind from stack, especially at KANOWNA and MT VETTERS station homesteads, where 12 people live permanently.

What consideration will proponent give to maintaining maximum sulphur dioxide levels below harmful limits for:

- a. the human population; and
- b. the sheep, vegetation and water supplies likely to be effected in the zone of highest sulphur dioxide levels near the stack?

1. Mt Vettters Station homestead is located approximately 30 km north of the roaster, as compared to the Kalgoorlie/Boulder urban area approximately 15 km to the south of Gidji. While modelling has not been undertaken with the specific objective of predicting groundlevel concentrations at this location, they are likely to be much less than those for Kalgoorlie/Boulder.

Kanowna Station homestead is located 10 km to the north of the roaster, and at the time of writing the Notice of Intent, was permanently inhabited by two people. Gaussian modelling indicates that maximum groundlevel sulphur dioxide concentrations in the order of 1,000ug/m<sup>3</sup> (on an hourly basis) can be expected at this location. Higher levels may be anticipated as a result of relatively infrequent fumigation events. These levels are above the NH & MRC recommendation of 700ug/m<sup>3</sup> although they are lower than the levels set for the Environmental Protection Policy Area of Kalgoorlie/Boulder. While it is recognised that the EPP levels do not apply for emissions from the roaster, they should be seen to reflect levels that are not unacceptable in an area whose primary industry is mining and mineral processing.

North Kalgoorlie Mines Limited recognises the sulphur dioxide levels on Kanowna Station will increase as a result of the operation of the Satellite Roaster, and has made financial arrangements with the leaseholder in recognition of this fact.

Effects on human health of exposure to sulphur dioxide are discussed in section 6.1.4 of the Notice of Intent. While the operation of the Satellite Roaster will increase the exposure of sulphur dioxide of a very small number of residents on adjacent pastoral leases, it will also permit the eventual closure of the existing roasters in Kalgoorlie/Boulder and will therefore lead to much lower sulphur dioxide exposure for the many thousands of people in the urban area.

The effects of sulphur dioxide on vegetation is the subject of a substantial monitoring programme that has been developed and put in place as an EPA condition of works approval and licensing of the roaster.

The proponent knows of no effects of sulphur dioxide on sheep and water supplies resulting from long term operation of other significant sulphur dioxide emitters in the Goldfields, and none are expected in the case of the roaster. In the unlikely event that effects are evident, their impact on the generally hypersaline groundwater of the area will be inconsequential.

2. Concern that existing monitoring and predictive programmes are inadequate to prevent the occurrence of fumigation events in and around Kalgoorlie - Boulder.

Reassurance sought that better predictive capacity will be developed, before Phase II is given approval to begin. The point was made that almost all other developed nations are now committed to reducing atmospheric sulphur dioxide levels, and that scrubbers ought to be likewise installed at Gidji.

2. The monitoring and control programme that is currently in place for the Kalgoorlie roasters is of necessity a reactive programme. That is, it depends on the identification of high groundlevel concentrations of sulphur dioxide before management measures are implemented.

The monitoring and control programme that is being developed for the Satellite Roaster is a predictive programme. This means that management measures will be implemented when monitoring predicts that impacts may occur, rather than after the event.

In addition to this change in nature of the monitoring and control programme, which has been made possible by the location of the Satellite Roaster some distance from the Kalgoorlie/Boulder urban area, the change from a reactive to a predictive control strategy will allow the use of sophisticated monitoring equipment, as indicated in Section 7.1 of the NOI.

Alternatives for reducing the levels of sulphur dioxide emissions to atmosphere from the Satellite Roaster were discussed in the Public Environmental Report for Stage 1 of the Satellite Roaster project (Dames & Moore 1987) including:

- . production of industrial grade sulphuric acid;
- . production of elemental sulphur; and
- . lime absorption.

These alternatives were not preferred due to a combination of cost factors (including the restricted Western Australia markets for products such as acid and sulphur) and environmental disadvantages (such as the need to dispose of the waste slurry generated by lime absorption, and the issues of storage, handling and transportation of sulphuric acid). Furthermore, all of the above alternatives involve the use of additional large quantities of fresh water which is not readily available.

3. Confusion as to the total throughput and emissions expected from implementation of Phases I and II. Proponent should clarify what is the total planned throughput and volume of stack emissions to allay these concerns.
3. Table 3 of the NOI clearly states the throughput and emission parameters for Phases I and II of the Satellite Roaster development. It is perhaps helpful to note that the Phase II figures include those for Phase I, ie. those figures listed under Phase II comprise the total throughput and emissions for which approval is currently being sought.



