Gold roaster to treat refractory ore, Kanowna Belle mine, Stage 2, 18km north-east of Kalgoorlie

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Peko Gold Ltd

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
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Summary and recommendations

Peko Gold Ltd (the proponent) proposes to develop Stage 2 of of its Kanowna Belle Gold Mine. Stage 2 comprises the construction and operation of a sulphide concentrate oxidation plant (roaster) within the existing mine site infrastructure. Stage 1 was previously assessed by the Environmental Protection Authority under the Works Approval and Licence provisions of the Environmental Protection Act.

Stage 2 will provide the necessary facilities to further treat high sulphide containing ores to remove the gold that is not extracted in the Stage one plant. Stage 2 will include the addition of a vacuum filter, storage tanks, a roaster, gas train and stack, and additional cyanidation tanks.

The Authority is also assessing an alternative treatment option for the high sulphide containing ores under the Works Approval and Licence provisions of the Environmental Protection Act. The alternative was identified in the proponent's Consultative Environmental Review as a "Bio-oxidation" process employing bacteria to oxidise the sulphide. A significant advantage of bio-oxidation is that sulphur dioxide would not be discharged to the environment and consequently would be the preferred option if feasible.

The proponent is currently working towards environmental approval for both processes before making a decision on which to employ.

From its evaluation of the proposal, and information gained in submissions, the Authority considers that the key environmental factors for its consideration relate to the emissions of sulphur dioxide. Other issues that have been considered include the handling and treatment of arsenic trioxide and water resource issues.

On the basis that the proponent has provided a proposal that addresses these concerns, and which includes specific commitments, the Environmental Protection Authority recommends that the proposal is environmentally acceptable.

Recommendation 1

The Environmental Protection Authority concludes that the proposal to develop a sulphide concentrate oxidation plant (gold roaster) is environmentally acceptable.

This conclusion is based on consideration of the proponent's Consultative Environmental Review, submissions received from Government agencies, the proponent's responses to issues raised in submissions (Appendix 1) and the proponent's commitments (Attachment 1 to Section 6).

In reaching this conclusion, the Environmental Protection Authority identified the main environmental factors requiring consideration to be:

- **managing sulphur dioxide within the Kalgoorlie Environmental Protection Policy areas;**
- **potential impacts from sulphur dioxide on vegetation;**
- **the management of arsenic trioxide; and**
- **potential impacts of tailings dams on surface and ground waters.**

The Authority considers that these issues have been adequately addressed and that this proposal could proceed subject to its recommendations in this report.

In the Kalgoorlie-Boulder region historical problems with the sulphur dioxide emissions from processing plants located close to residential areas resulted in the development of an Environmental Protection Policy. Today, the plants that contributed to this problem are located away from residential areas.

Controls are, however, still required to provide an acceptable air quality for people in the Kalgoorlie-Boulder region. These controls require that data is collected on the meteorological conditions and levels of sulphur dioxide and is used to predict whether levels in the residential areas defined by the Environmental Protection Policy are likely to be acceptable. If the levels are found to be unacceptable, or predicted to be unacceptable, action must be taken to control the situation. This action may include a shut down of the processing plants until the levels in the defined Policy areas are acceptable.

The proponent is aware of the history of problems with sulphur dioxide emissions and has taken steps, and made commitments, to address the issue. The Environmental Protection Authority considers that it requires more information on sulphur dioxide concentrations in the Kalgoorlie-Boulder area before being in a position to determine the final details of a suitable control strategy for sulphur dioxide emissions at the Kanowna Belle site. The information provided to date is however sufficient, together with the experience gained by the Environmental Protection Authority in managing emissions from existing sources of sulphur dioxide, to permit the Authority to conclude that the proposal could proceed provided it complies with the requirements of the Environmental Protection (Goldfields Residential Areas) (Sulphur Dioxide) Policy 1992. This Policy sets limits and standards within defined residential areas which the proponent is obliged to meet. The Policy applies to all significant sources of sulphur dioxide which may impact on the defined Policy areas of Kalgoorlie, Boulder, Coolgardie, Kambalda and the Kurrawang Mission south west of Kalgoorlie.

Recommendation 2

The Environmental Protection Authority recommends that the proponent ensure the requirements of Environmental Protection (Goldfields Residential Areas) (Sulphur Dioxide) Policy 1992 are met by this project. The sulphur dioxide Policy establishes two objectives for air quality. The first objective is for a limit (1400 micrograms per cubic metre). The limit specifies the sulphur dioxide concentration which is not to be exceeded at any time. The second objective is for a standard (700 micrograms per cubic metre in 1997). The standard is the sulphur dioxide concentration which it is desirable not to exceed (see Section 6 - Recommended Environmental Condition 4).

The EPA has advised the proponent of the need to undertake additional work before a final sulphur dioxide air quality control strategy can be determined. This work has already begun and will be available in the Works Approval and Licence application for this proposal if the Minister for the Environment issues his approval for the project.

Recommendation 3

The Authority recommends that a Works Approval and Licence Condition under the Provisions of Part V of the Environmental Protection Act is set requiring development and operation of a sulphur dioxide control strategy. This strategy should be designed and managed to ensure the roaster never causes or significantly contributes to an exceedence of the Standard. (see Section 6 - Recommended Environmental Condition 5).

Sulphur dioxide emissions can also cause adverse environmental impacts on vegetation. Approvals for the ongoing operation of existing sources of sulphur dioxide in the Kalgoorlie-Boulder region require that vegetation monitoring programmes are put in place. To date the results of these monitoring programmes do not show unacceptable or significant environmental impacts.

However, the Authority is concerned that the effects of sulphur dioxide emissions (on both a local and regional scale) on vegetation are poorly understood. The Authority considers it

important that a better understanding is gained of sulphur dioxide effects and recommends that a co-ordinated approach is taken by the major sulphur dioxide emitters in Kalgoorlie-Boulder.

The EPA is able through Conditions of the licence process under Part V of the Environmental Protection Act to achieve the consultation required on this issue and to implement the necessary monitoring programme.

Recommendation 4

The Authority recommends that the proponents' of significant sulphur dioxide sources develop a co-ordinated approach to the issue of vegetation monitoring and submit that approach, including a co-ordinated vegetation monitoring programme, to meet the requirements of the Environmental Protection Authority. This can be managed through the Works Approval and Licence process of Part V rather than Environmental Conditions attached to this proposal (see Section 6 - Recommended Environmental Conditions, Procedure 4)**.**

Other issues that the Authority considered included the handling of arsenic trioxide (a product of the roaster waste gas handling system) and water resource issues. Both of these issues are subject to requirements of either the Water Authority of WA, Health Department of WA or Department of Minerals and Energy. Additionally, the Environmental Protection Authority will consult these agencies during the setting of Works Approval and Licence Conditions on this project.

Based on its assessment of this proposal, and the recommendations above, the Environmental Protection Authority has developed a list of 'Recommended Environmental Conditions' (see Section 6 of this Report) to the Minister for the Environment. The Authority considers that by setting these conditions on the development and operation of the proposal, the environment would be protected.

1. Introduction

Peko Gold Ltd, the proponent, proposes to develop Stage 2 of the Kanowna Belle gold mine with an expected commissioning date in the last quarter of 1994. The mine is located 18km north-east of Kalgoorlie on Yarri Road (Figure 1). Stage 2 comprises the construction and operation of a sulphide concentrate oxidation plant (roaster) within the existing mine site infrastructure.

Stage 1 has been commissioned and includes an oxide gold recovery plant, utilising cyanide leach adsorption technology. A floatation plant is included in Stage 1 to recover the sulphide concentrate which will be stored for later processing in the Stage 2 plant.

From its evaluation of this proposal, and information gained from similar assessments, the Environmental Protection Authority considers that the key environmental factors are the implications of additional sulphur dioxide emissions:

- on the air quality within the Kalgoorlie Environmental Protection Policy area; and
- on vegetation.

The other issues to be considered are the treatment and handling of arsenic trioxide and management of the tailings dams.

This proposal was referred to the EPA in April 1993 and the level of assessment was set at Consultative Environment Review. The CER was released for a 4 week public review period that began on 3 August 1993 and ended on 31 August 1993. Submissions were received from the Health Department of WA, Water Authority of WA, Department of Minerals and Energy and Department of Resources Development.

The EPA provided a list of issues raised by these agencies and the proponent's response to these are included in Appendix 1 of this report.

The EPA received a referral from the proponent for an alternative process to treat the refractory ore in September 1993. That proposal, involving the use of bacteria to oxidise the sulphide ore, is being assessed under the Works Approval and Licence provisions of the Environmental Protection Act. A significant advantage of bio-oxidation is that sulphur dioxide would not be discharged to the environment and consequently would be the preferred option if feasible. This is consistent with the Authority's waste minimisation pollution prevention principle. The proponent has indicated that it has not committed to either option and that a decision will be made once both proposals have been assessed by the EPA.

2. The proposal

Stage 2 of the Kanowna Belle project is scheduled to begin operating in the last quarter of 1994. It does not directly involve any additional mining activities and there will be no increase in the extent of the mine pit as a result of the implementation of Stage 2.

Development of Stage 1 is now complete. Stage 1 allows the processing of the shallow oxidised ore deposit (present at 35-50 metre depth) at Kanowna. The shallow deposit is amenable to CIP (carbon in pulp) processing and will achieve greater than 95% recovery of gold from the ore. In contrast, the deeper primary ore at Kanowna will only yield approximately a 65% recovery of gold when subject to the same process as the oxidised ore body. The reason for this lower recovery is that the sulphide minerals in the primary ore body tend to lock the gold up and make it unavailable.

For Stage 2, the primary ore would first be processed in the same way as the shallow oxidised ore but then subjected to an additional floatation circuit to form a concentrate. This additional circuit recovers 90% of the residual gold. The concentrate would be stored in purpose built, lined dams for later processing in the roaster. The final wastes (tails) of both ores would

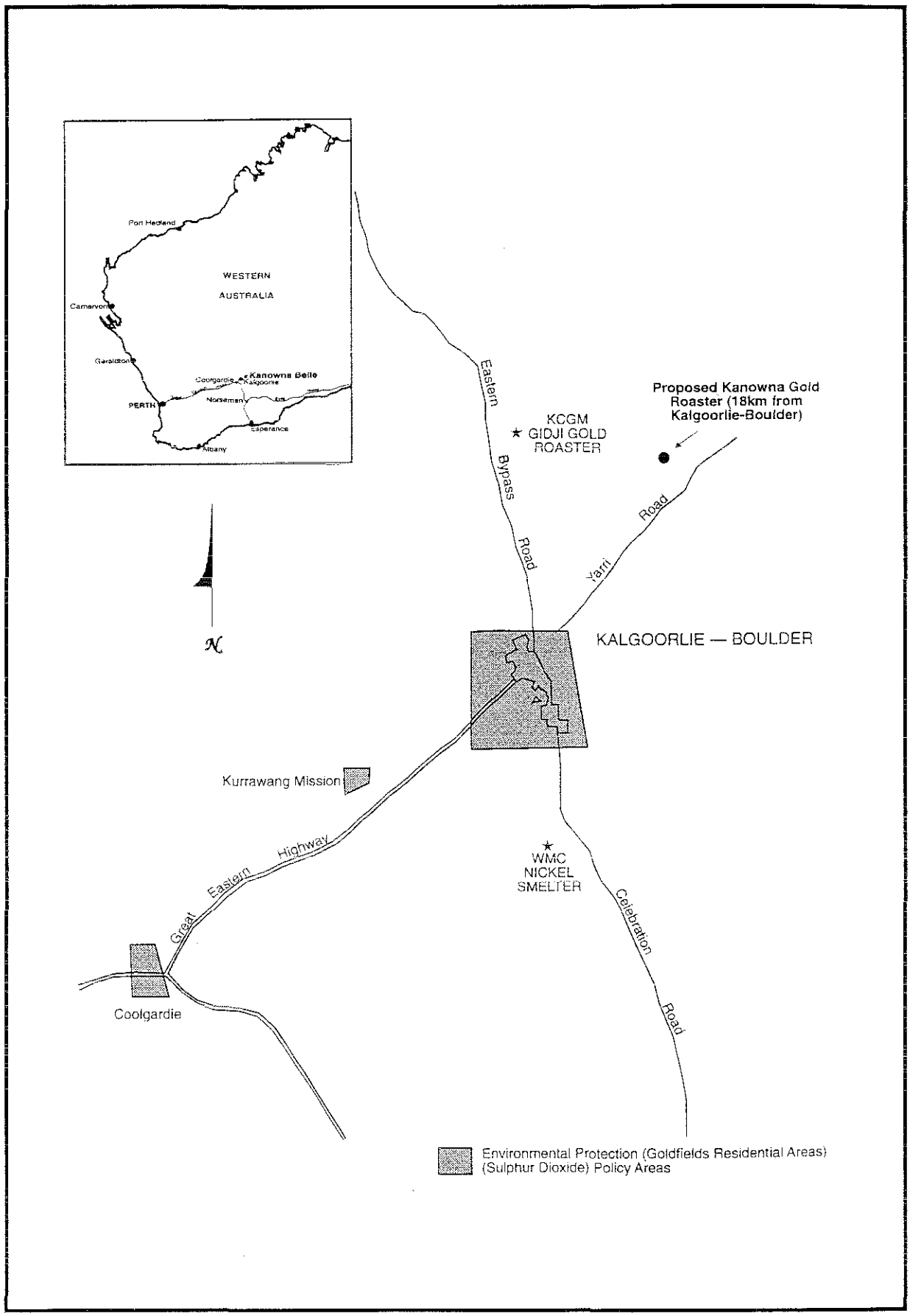


Figure 1. Location of proposed Kanowna Belle Gold Roaster

contain a gold value between 0.15 to 0.2 grams per tonne. These tails will be placed in a tailings dam located on the site.

In Stage 2, the flotation concentrate will be filtered and washed to remove highly saline process waters then processed through a fluidised bed roaster. The roaster will oxidise the gold-bearing sulphide minerals, which at Kanowna are predominantly pyrite. The roasting process operates at temperatures above 500 degrees Celsius by burning the sulphide minerals in air, oxidising them and exposing the gold particles for downstream cyanidation.

The waste gas stream from this process will pass through a cyclone and electrostatic precipitator. The gold bearing dust and the roasted concentrate will be quenched and the slurry processed back through Stage 1. A third gas cleaning system is also included in Stage 2 to remove arsenic from the waste gas stream. The proposed fabric filter will collect the arsenic as an arsenic trioxide dust which will be bagged and stored, prior to sale or further treatment.

3. Issues raised in submissions and advice from other government agencies

Four submissions were received on the proponent's CER. The issues raised related to:

- the location of the tailings dams away from natural water courses and diversion of drainage away from dam embankments;
- likely threat to surface water impoundments used for stock/local fauna;
- monitoring of four identified aquifers and interpretation and provision of data to the EPA and Water Authority of WA;
- handling, treatment, storage and marketing of arsenic trioxide;
- a need to provide for containment of arsenic trioxide solids descaled from the pipework of the gas cleaning system;
- knowledge of wind strength and direction data for the site;
- the likely effect of inversions and resulting fumigation which may have the potential to cause sulphur dioxide levels greater than those specified in the Environmental Protection (Goldfields Residential Areas) (Sulphur Dioxide) Policy 1992;
- the need to ensure that any management plan can operate within the Environmental Protection (Goldfields Residential Areas) (Sulphur Dioxide) Policy 1992 without causing a disproportionate share of the allowed standard exceedences in the policy area; and
- the installation of monitoring equipment at the Kurrawang Mission and need for co-ordinated management of the monitoring system.

The proponent's response to these issues is included in Appendix 1.

The Department of Minerals and Energy submission noted that it would work with the EPA during the works approval stage of this proposal. A Works Approval and Licence would be required if this project is found to be environmentally acceptable. Detailed technical advice may also be sought from other agencies at this time. This arrangement is common and provides for an efficient process whereby Government agencies ensure a project is developed as approved.

4. Environmental issues and their management

The EPA considers that the two key issues of environmental significance in this proposal are those that relate to sulphur dioxide impacts within the Kalgoorlie EPP areas and on vegetation. Two other issues relate to the treatment and handling of arsenic trioxide from the filter fabric and, potential impacts from the tailings dam on water resources . A summary of these issues, the proponent's response and the Authority's assessment is detailed in this Section.

4.1 Sulphur dioxide in the Goldfields residential areas

Background:

In July 1988 the Minister for the Environment declared an Environmental Protection Policy to control sulphur dioxide concentrations in the air within the residential areas of Kalgoorlie-Boulder. The need for this policy related to the unacceptable air quality experienced by residents in the Kalgoorlie-Boulder region. That Environmental Protection Policy was managed by the EPA through Licence Conditions set under the provisions of Part V of the Environmental Protection Act.

In 1992, the Minister for the Environment established the "Environmental Protection (Goldfields Residential Areas) (Sulphur Dioxide) Policy 1992" (EPP) that defined Protected Areas which extend beyond the Kalgoorlie-Boulder residential areas to encompass other residential areas in the greater Kalgoorlie region. These include the towns of Coolgardie and Kambalda and the Kurrawang Aboriginal Reserve between Kalgoorlie and Coolgardie.

The new Policy defines desirable air quality levels to be achieved and maintained. The Policy establishes two objectives for air quality. The first objective is a limit which specifies the sulphur dioxide concentration which must not be exceeded at any time. The second objective is a standard. The standard is the sulphur dioxide concentration which it is desirable not to exceed. This represents an expectation for the air quality "most of the time", while recognising that some higher concentrations may occur.

The Policy also provides for an air quality monitoring network within the protected areas and allows for a review of the policy, or other action, under the Environmental Protection Act if compliance with the standard is not satisfactory.

The 1992 Policy has direct implications for the approval and management of the Kanowna Belle project. The requirements of the Policy relate to all operations with sulphur dioxide emissions which may impact on the Policy areas. The proponent will need to include an air quality management strategy to achieve the objectives of the EPP.

The proponent has recognised this situation and is committed to working with the EPA and other emitters of sulphur dioxide (eg. KCGM and WMC) in Kalgoorlie-Boulder. The proponent has already obtained an "in principle" agreement for access to the existing sulphur dioxide monitoring system, subject to an equitable commercial agreement being reached between Western Mining Corporation Limited (Kalgoorlie Nickel Smelter) and Kalgoorlie Consolidated Gold Mines Pty Ltd (Gidji Roaster).

Issue:

The issue relates to meeting the objectives set out in the Environmental Protection (Goldfields Residential Areas) (Sulphur Dioxide) Policy 1992.

In Kalgoorlie-Boulder, a critical issue is the occurrence of fumigation events. These events can result in the trapping of sulphur dioxide such that a concentration in excess of the allowed Policy values occurs more readily than normal. An understanding of, and predictive capacity for, such events is crucial in order to meet the objectives of the EPP and gaining approval from the EPA.

Proponent's response:

The proponent has recognised its obligations under the EPP. The proponent's CER included modelled ground-level concentrations of sulphur dioxide and commitments (see Attachment 1 to Section 6) have been provided to address the requirements of the EPP. However, it should be recognised that the modelled ground-level concentrations of sulphur dioxide do not include the effects of fumigation events discussed above.

EPA's evaluation:

As discussed in the introduction section above in the Kalgoorlie-Boulder region sulphur dioxide emissions need to be tightly controlled to provide an acceptable air quality. Accordingly, any process which achieves the oxidation of sulphide rich ores without the generation of sulphur dioxide would be viewed favourably by the EPA. The proponent for the proposed gold roaster is also progressing an alternative option, with EPA, which utilises bacteria to effect the oxidation of sulphide rich ore without the generation of sulphur dioxide.

However, with reference to the gold roaster proposal, industries in the Kalgoorlie-Boulder area which emit sulphur dioxide are obliged to manage their operations so as to comply with the standards and limits established under the EPP. The Authority considers that it is important that this issue is reflected in the Environmental Conditions set by the Minister for the Environment.

Recommendation

The Environmental Protection Authority recommends that the proponent ensure the requirements of Environmental Protection (Goldfields Residential Areas) (Sulphur Dioxide) Policy 1992 are met by this project. The sulphur dioxide Policy establishes two objectives for air quality. The first objective is for a limit (1400 micrograms per cubic metre). The limit specifies the sulphur dioxide concentration which is not to be exceeded at any time. The second objective is for a standard (700 micrograms per cubic metre in 1997). The standard is the sulphur dioxide concentration which it is desirable not to exceed.

Both the Gidgi roaster and Kalgoorlie Nickel Smelter have a Licence Condition which makes it an offence to cause or contribute to an exceedence of the EPP sulphur dioxide limit. There is no specified method for enforcing compliance with the standard (i.e. not exceeding the Standard more times in a year than allowed under the EPP), however the EPA has various options available under the Environmental Protection Act.

Both of the existing industries control their sulphur dioxide impacts in the Policy Areas by operating according to customised control strategies whereby they cease operating during periods within which significant impacts in one of the policy areas is predicted. The control room of each industry contains a computer terminal which issues instructions and alarms to the operators based on current measurements of meteorological variables and sulphur dioxide levels. The strategies have been formulated on the basis of extensive data analysis and computer modelling and, as required in licence conditions, have been approved by the EPA.

The Proponent has made a commitment to develop and operate a control strategy and has provided details of the likely shut-down criteria. However, the Authority reserves its judgement on the details of the strategy proposed by the proponent in the CER for the following reasons.

Trapping of chimney plumes within morning temperature inversions and subsequent fumigation of those plumes to ground level in concentrated form is an important feature of sulphur dioxide impacts in the Kalgoorlie area, and elsewhere. Such events have been the cause of the highest sulphur dioxide levels recorded in Kalgoorlie. Whilst fumigation is identified in the CER as being important and is considered in the suggested control strategy, it is not included in the computer modelling described in Section 6 of the CER. The Authority believes that the predicted impact of the proposed roaster would be greater if fumigation was properly considered, particularly in view of the relatively low chimney exit temperature. Accordingly, the Authority has requested, and the proponent has agreed, that further work be undertaken to model fumigation of the plume from the proposed roaster to provide a clearer understanding on which to formulate a control strategy and to determine the necessary chimney height. It is likely that all industries in the area will need to upgrade their strategies relating to fumigation conditions in order to meet the annually reducing allowance for exceeding the EPP standard.

By 1997, the exceedence allowance for the EPP standard (700 micrograms per cubic metre) will have reduced to 8 times per year, this being the total allowed, irrespective of which industry or industries caused them. Achieving compliance to this level will be a significant challenge to the KNS and Gidgi Roasters. The Authority is of the opinion that the proposed roaster could, in the absence of diligent adherence to a sound control strategy, cause concentraions in policy areas in excess of the standard during fumigation conditions. However, it is very unlikely that the proposed roaster would cause concentrations exceeding the limit (1400 micrograms per cubicv metre in 1997) and face the penalty of so doing. Since the sulphur dioxide emissions from the proposed roaster are only one tenth of those from either of the existing sources, it would be unfortunate (unfair to existing industries) if the proposed roaster caused exceedences of the standard due to lack of diligence. **The Authority considers that the control strategy for the proposed roaster should be designed and managed to ensure the roaster never causes or significantly contributes to an exceedence of the Standard** (700 micrograms per cubic metre). This issue will be managed by EPA through the Works Approval and Licence provisions of the Environmental Protection Act.

In summary, the Authority considers that a sulphur dioxide control strategy based on ceasing operations during periods of possible significant impact on policy areas is necessary and that the development of a successful strategy is quite feasible.

Recommendation

The Authority recommends that a Works Approval and Licence Condition under the Provisions of Part V of the Environmental Protection Act is set requiring development and operation of a sulphur dioxide control strategy. This strategy should be designed and managed to ensure the roaster never causes or significantly contributes to an exceedence of the Standard.

Recommendation 3 in the Summary and Recommendations section of this report relates to this issue. The implementation of this recommendation is proposed as a procedure in the Recommended Environmental Conditions in Section 6 of this Report.

4.2 Sulphur dioxide and vegetation monitoring in Kalgoorlie-Boulder

Background:

In its assessment of the Gidji Gold Roaster in April 1988 (Bulletin 327), the Environmental Protection Authority recommended that a vegetation monitoring programme be prepared. That programme was agreed and monitoring has continued up to the present. Currently, the EPA is expecting KCGM to submit a proposal to amend the vegetation monitoring programme in the light of results to date.

Under Licence Conditions set on the Western Mining Corporation nickel smelter, a vegetation monitoring programme is also required. Western Mining completed a review of results from this programme, for the years 1988 to 1992, in May 1993.

Issue:

Given the concern with this issue as expressed by the EPA in Environmental and Licence conditions in 1988, and based on the results of data collected by KCGM and WMC to date, together with other papers and considerations of this issue (see Appendix 2), the issue of vegetation monitoring required addressing.

Proponent's response:

In the CER for the Kanowna Belle project the proponent considered that "The inference to be drawn from documented research suggests that high concentrations of sulphur dioxide close to

the emission source must occur if impacts are to be identified.". The proponent then suggested that "Given the relatively small contribution of sulphur dioxide from the proposed Kanowna Belle roaster, it is possible that impacts on vegetation may not occur, or may be too small or masked by external factors to be readily identified." Nonetheless, the proponent recognises that it is desirable to undertake vegetation monitoring. The first stage of this work has already begun and includes a soil sulphur content survey for the area.

EPA's evaluation:

The Authority considers that it is important to be in a position where it can confidently address questions that relate to sulphur dioxide impacts on vegetation. This is an important issue and should be weighed together with the fact that sulphur dioxide emissions from the Kalgoorlie-Boulder region are amongst the highest in the Australia.

The EPA recognises the current limitations of vegetation monitoring programmes which include:

- difficulties in determining whether visual effects such as leaf curling or browning are due to sulphur dioxide or some other cause alone or in combination;
- difficulties due to the apparently wide sulphur content within and between different species;
- difficulties in comparing results which are drawn from often significantly different monitoring programmes; and
- difficulties in defining a clear relationship between leaf tissue sulphur levels and leaf damage.

Although the EPA recognises these potential limitations, it considers that the issue of vegetation monitoring is important. In contrast to much of the effort that has been expended in the past on air quality issues that relate to human health, the EPA considers that the local and regional impacts of sulphur dioxide on vegetation remain poorly understood. The issue of vegetation impacts has received some attention in recent years and Appendix 2 provides a copy a paper prepared by the Victorian EPA.

The EPA considers that the impacts of sulphur dioxide from the Kalgoorlie-Boulder region on vegetation should be better understood and considers that this issue should receive greater emphasis in the future.

The EPA has Licence Condition mechanisms established under Part V of the Environmental Protection Act to achieve the consultation required on this issue and to implement controls.

Recommendation

The Authority recommends that the proponents' of significant sulphur dioxide sources develop a co-ordinated approach to the issue of vegetation monitoring and submit that approach, including a co-ordinated vegetation monitoring programme, to meet the requirements of the Environmental Protection Authority. This can be managed through the Works Approval and Licence provisions of the Environmental Protection Act rather than Environmental Conditions attached to this proposal.

Recommendation 4 in the Summary and Recommendations section of this report relates to this issue. The implementation of this recommendation is proposed as a procedure in the Recommended Environmental Conditions in Section 6 of this Report.

The timing of this work is not considered to be a critical factor in the development of the Kanowna Belle roaster. Additionally, existing and proposed vegetation monitoring programmes are not expected to be terminated while a co-ordinated approach is developed.

The purpose of this work is for industry to have the data that have been collected to date critically assessed and considered in view of the need to gain a better understanding of both local and regional vegetation impacts. Advice from the Department of Conservation and Land Management could prove useful in this regard. The expected result is a revised vegetation monitoring programme with clearly defined objectives. It is expected that the revised programme will provide a base with which all results can be compared and, hopefully, the limitations cited above addressed.

4.3 Arsenic trioxide

Issue:

Arsenic trioxide dust will be one by-product of the roaster off-gas cleaning system that will require careful management. It will be collected in the proposed filter baghouse and stored in bags or steel drums.

Proponent's response:

In response to this issue, the proponent has indicated that approximately 250 tonnes of arsenic trioxide will be produced each year. It is proposed to store the product on site and under cover, in a fully concreted and bunded area, prior to sale. As a consequence of the need for short-term storage, the proponent proposes to store, on site, in either sealed bulka bags or drums, up to 800 tonnes of arsenic trioxide. It is proposed to sell the arsenic trioxide product, however, other options for disposal, including chemical fixation, are being considered. Such methods of disposal, if shown to be feasible and preferred by the proponent, would be referred to the EPA for a separate environmental assessment.

EPA evaluation:

The Authority considers that the proponent's response will be adequate to protect the environment. The details and management of the storage area could be finalised through the Works Approval and Licence mechanism of the Environmental Protection Act. Additionally, the requirements of the Department of Minerals and Energy will ensure that the product is properly managed.

Given that a Government approvals process is already established to manage this issue, the Authority does not consider it necessary to include a specific environmental condition to manage this issue within the environmental approvals that will be issued if this proposal is found to be environmentally acceptable.

4.4 Water resources

Issue:

It will be necessary to prevent ground and surface waters from being polluted by arsenic, cyanide or high salt loadings found in the process wastes.

Proponent's response:

The waste from the oxidised ore process circuit was analysed and found to contain relatively low concentrations of metals and cyanide. The cyanide content of the waste was also found to contain weak acid dissociable cyanide which is known to rapidly convert to stable cyanide complexes. This waste will be placed in large tailings dams. Accordingly, any leachate developing from this source is not expected to have a significant impact on groundwater.

Waste from the primary ore circuit (calcine tailings) has been shown to contain elevated levels of salts and high concentrations of arsenic that is susceptible to leaching under strongly oxidising, and neutral to alkaline, conditions. This waste will be placed in a dedicated dam lined with an impervious liner to eliminate seepage.

A monitoring programme has already been established for Stage 1 of this proposal and will be expanded to accommodate the Stage 2 development.

EPA's evaluation:

The Authority considers that the proponent's response will be adequate to protect the environment. The details and management of the storage dams are subject to approval of the Department of Minerals and Energy and Water Authority of WA.

Given that a Government approvals process is already established to manage this issue, the Authority does not consider it necessary to include a specific environmental condition to manage this issue within the environmental approvals that will be issued if this proposal is found to be environmentally acceptable.

5. Conclusion

The Environmental Protection Authority has assessed the potential environmental impacts of the proposal, as described in the Consultative Environmental Review, and utilised additional information supplied by other Government agencies in response to issues raised in submissions. Additionally, officers of the Environmental Protection Authority have carried out site inspections.

The Authority considers that it could be necessary or desirable to make minor and non-substantial changes to the designs and specifications of the proposal which were examined as part of the Environmental Protection Authority's assessment. Accordingly, the Environmental Protection Authority considers that subsequent statutory approvals for this proposal could make provision for such changes, where it can be shown that the changes are not likely to have a significant effect on the environment.

Furthermore, the Authority believes that any approval for the proposal based on this assessment should be limited to five years. Accordingly, if the proposal has not been substantially commenced within five years of the date of this report, then such approval should lapse. After that time, further consideration of the proposal should occur only following a new referral to the Environmental Protection Authority.

Finally, it should be recognised that this project may not ultimately proceed as proposed. The alternative bio-oxidation process may finally be chosen by the proponent. Nonetheless, it is important to note that the project will be managed by the EPA under Works Approval and Licence Conditions no matter which process is used.

Recommendation

The Environmental Protection Authority concludes that the proposal to develop a sulphide concentrate oxidation plant (gold roaster) is environmentally acceptable.

This conclusion is based on consideration of the proponent's Consultative Environmental Review, submissions received from Government agencies, the proponent's responses to issues raised in submissions (Appendix 1) and the proponent's commitments (Attachment 1 to Section 6).

In reaching this conclusion, the Environmental Protection Authority identified the main environmental factors requiring consideration to be:

- **managing sulphur dioxide within the Kalgoorlie Environmental Protection Policy areas;**
- **potential impacts from sulphur dioxide on vegetation;**
- **the management of arsenic trioxide; and**
- **surface and ground water protection.**

The Authority considers that these issues have been adequately addressed and that this proposal could proceed subject to its recommendations in this report.

6. Recommended environmental conditions

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

1. Proponents Commitments

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

1-1 In implementing the proposal, the proponent shall fulfil the commitments (which are not inconsistent with the conditions or procedures contained in this statement) made in the Consultative Environmental Review and included in the Environmental Protection Authority's Bulletin 710. (see Attachment 1 following these recommended environmental conditions.)

2. Implementation

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

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

3. Proponent

These conditions legally apply to the nominated proponents.

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

4. Sulphur dioxide Environmental Protection Policy

The Environmental Protection Authority recommends that the requirements of Environmental Protection (Goldfields Residential Areas) (Sulphur Dioxide) Policy 1992 or as amended, be applied to this project. The sulphur dioxide Policy 1992 establishes two objectives for air quality. The first objective is for a limit (1400 micrograms per cubic metre). The limit specifies the sulphur dioxide concentration which is not to be exceeded at any time. The second objective is for a standard (700 micrograms per cubic metre in 1997). The standard is the sulphur dioxide concentration which it is desirable not to exceed.

5. Sulphur dioxide control strategy

The proponent shall develop and when approved implement a sulphur dioxide control strategy for this proposal to meet the requirements of the Environmental Protection Authority.. This strategy shall be designed and managed to ensure the proposed roaster never causes or significantly contributes to an exceedence of Standard specified in the Environmental Protection (Goldfields Residential Areas) (Sulphur Dioxide) Policy.

6. Time Limit on Approval

The environmental approval for this proposal is limited.

6-1 If the proponent has not substantially commenced the project within five years of the date of this statement, then the approval to implement the proposal as granted in this statement

shall lapse and be void. The Minister for the Environment shall determine any question as to whether the project has been substantially commenced. Any application to extend the period of five years referred to in this condition shall be made before the expiration of that period, to the Minister for the Environment by way of a request for a change in the condition under Section 46 of the Environmental Protection Act. (On expiration of the five year period, further consideration of the proposal can only occur following a new referral to the Environmental Protection Authority.)

Procedure

1. The Environmental Protection Authority is responsible for verifying compliance with the conditions contained in this statement, with the exception of conditions stating that the proponent shall meet the requirements of either the Minister for the Environment or any other government agency.

2. If the Environmental Protection Authority, other government agency or proponent is in dispute concerning compliance with the conditions contained in this statement, that dispute will be determined by the Minister for the Environment.

3. The proponent shall apply for a Works Approval and subsequent Licence for the construction and operation of Stage 2 of this project. Stage 1 of this project is already subject to Licence Conditions and the Environmental Protection Authority will monitor and require the ongoing environmental performance of this proposal through this mechanism.

4. The Licence Conditions set on this project will include the development of a vegetation monitoring programme that considers both the local and regional context of this issue. The management of the arsenic trioxide waste and surface and ground water issues will occur in consultation with the Health Department of Western Australia, Department of Minerals and Energy and Water Authority of WA.

Attachment 1

Peko Gold Ltd's list of environmental management commitments

The major commitments to environmental management for the operation of a gold roaster at Kanowna Belle are as follows:

1. The proponent will instal a sulphur dioxide monitor at the mine site. This monitor will be linked to the current monitoring system in Kalgoorlie-Boulder.

2. An air quality management system will be developed and installed as part of operational procedure for the roaster. The system will be centred on an impact predictive capability, and will include:

   (i) a sulphur dioxide monitoring network in Kalgoorlie-Boulder;

   (ii) telecommunications link from the mine to the central data processing facility;

   (iii) an on-site weather station;

   (iv) plume monitoring and tracking capability; and

   (v) a shut-down procedure based on wind velocity and direction.

   The air quality management programme will be developed during the Stage II construction phase.

3. A vegetation monitoring programme will be implemented to assess the effects of sulphur dioxide on plant health.

4. A groundwater monitoring system will be installed and a programme carried out to monitor changes in groundwater quality.

5. Monitoring programmes will be put in place when works become available and prior to the commencement of roaster operations.

6. An Environmental Management Programme, containing these commitments will be designed and carried out by the proponent in consultation with the Mines Department to the satisfaction of the EPA.

Appendix 1

Proponents responses to issues raised in submissions

Kanowna Belle Gold Mines

Perth Project Office
16-18 Stirling Highway
Nedlands
Western Australia 6009

Postal Address
PO Box 403
Nedlands
Western Australia 6009

Telephone 09 347 4866
Facsimile 09 386 2205

292rd.vf
KB2.4

24 September 1993

The Chairman
Environmental Protection Authority
8th Floor
Westralia Square
141 St George's Terrace
PERTH WA 6000

ATTN: MR STEVE WATSON

Dear Sir

KANOWNA BELLE PROJECT STAGE 2
CONSULTATIVE ENVIRONMENTAL REVIEW

Further to your letter of 8 September 1993, we have the following responses to the submissions made by the various government departments in respect of the Kanowna Belle roaster CER:

1.0 Tailings Dam

The dedicated calcine tailings dam will be located near and to the east of the existing tailings dam. It will be considerably smaller and will be fully lined with an impervious HDPE or PVC liner to eliminate any seepage. All runoff water in the area has already been diverted from the operations and tailings storage areas by the construction of a diversion channel, as part of the Stage 1 development.

2.0 Water impoundments

The only surface water impoundment in the area, Grave Dam, originally located in the area now occupied by the existing tailings dam, has been reconstructed well away from the operations, and is fed by clean runoff via the new diversion channel. The new location for Grave dam was determined after consultation with the Mt Vetters pastoral leaseholder.

3.0 Groundwater monitoring

Seven monitoring bores are located around the perimeter of the existing tailings dam. These bores are sampled regularly and the results are reported annually to the Department of Minerals and Energy as required by the Mining Licence. Structural performance of the dam embankment is also reported.

Additional monitoring bores will also be installed around the calcine tailings structure and sampling results will be provided as required.

Monitoring of the groundwater aquifers supplying process water to the operation is carried out on a three monthly basis as required by the Abstraction Licence.

4.0 Arsenic trioxide management

Arsenic is contained in the concentrate (approximately 1% by weight) and is volatilised during the roasting process. The arsenic by-product is recovered as arsenic trioxide (AS_2O_3) in the baghouse and collected into steel drums or bulka bags. Drumming (or bagging) is carried out automatically in a totally sealed environment. Entry to the drumming area is via double sealed doors and stringent safety precautions will apply to all personnel entering this area. A Safe Work Procedure will be developed for all activities within the arsenic collection and drumming area.

The arsenic product is in the form of a dry powder, and the drum (or bags) will be stored in a concrete bunded and sheeted building until sufficient material is available for either shipping to its final destination or fixation and disposal. The building will be locked and access will be restricted to authorised personnel. As noted in the CER document, a licence will be sought to store on site up to 800 tonnes of arsenic trioxide.

Sale of the arsenic trioxide is the preferred method of disposal. Several potential overseas customers exist, but no commitments to purchase will be made until the final product quality has been established. Marketing of the product will be actively pursued when samples of the material are available.

The pipework contained within the gas cleaning system will be checked periodically and descaled and cleaned out as necessary. Safe working procedures will be developed and all personnel involved will be suitably trained in the safe handling and disposal of arsenic trioxide material. The small quantities of arsenic likely to arise from this source will be reslurried with the roaster feed and fed back into the roaster for collection via the baghouse.

5.0 Air quality management

The Golden Valley Joint Venture partners have reached agreement with the existing roaster and smelter operators to share the SO_2 monitoring system presently in place in the Kalgoorlie area. Subject to EPA approval to proceed with the Kanowna roaster, and a final decision from the JV for the Stage 2 development, Kanowna Belle Gold Mines will contribute to the capital cost of the new SO_2 monitors to be located at Coolgardie and Kurrawang Mission. Data from these monitors will be fed into the existing system and used for air quality management in the area.

Kanowna Belle Gold Mines will develop a predictive shut down strategy similar to that currently used by KCGM & KNS. The predictive strategy will use a combination of site specific and regional weather data to maximise predictive capability, particularly in regard to potential fumigation events. The proposed air quality management programme has, as its central theme, the maintenance of air quality as prescribed for the environmental protection policy areas.

6.0 The likely effect of inversions and resulting fumigation within the policy areas

The concept of temperature-induced inversions and the potential for break-up fumigation has been addressed in Section 6.6 of the report 'Air Quality Assessment. Proposed Kanowna Belle Roaster Near Kalgoorlie, W.A.' prepared by Nigel Homes & Associates. A copy of this report was provided to the EPA.

Following on-site discussions with personnel from the Department of Resource Development and Environmental Protection Authority, officers from the CSIRO Division of Atmospheric Research have been commissioned to carry out a modelling exercise to determine the relation ship between the Kanowna plume and inversion/fumigation events within the policy area.

The results of this modelling exercise will be used to further refine the management plan for the proposed Kanowna Belle roaster.

7.0 Wind strength and direction data for the Kanowna Belle mine site

There are no data presently available on wind strength and direction at Kanowna Belle.

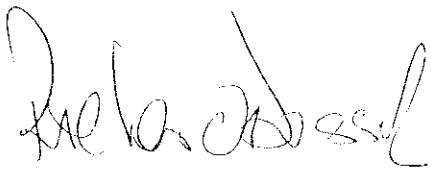
It is proposed to install appropriate weather monitoring instruments as part of the proposed Stage II development programme, and as part of the requirements for environmental management.

In the meantime, wind strength and direction data from Kalgoorlie - Boulder are taken as being representative of wind conditions at Kanowna. Two sets of wind data have been used for plume dispersion modelling. The first set is derived from the EPA'a meteorological station at the Kalgoorlie Technical School (KTS) and the second set of data is derived from the Metals Exploration meteorological station operated by KCGM.

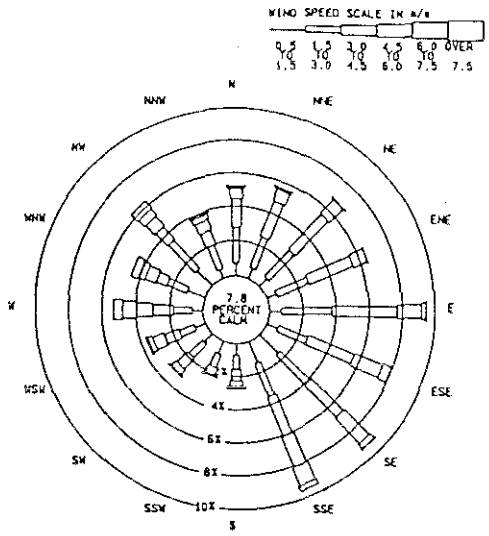
Wind roses complied from KTS data for 1984-86 and from Metals Exploration for 1988-91 are attached.

Should you have any queries in respect of the above please do not hesitate to contact the undersigned.

Yours sincerely
PEKO GOLD LTD
KANOWNA BELLE PROJECT



R D DOSSOR
PROJECT MANAGER



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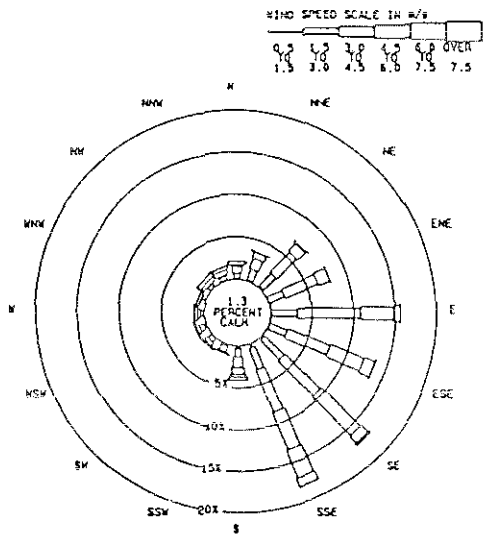
Metals Exploration - Annual 1991



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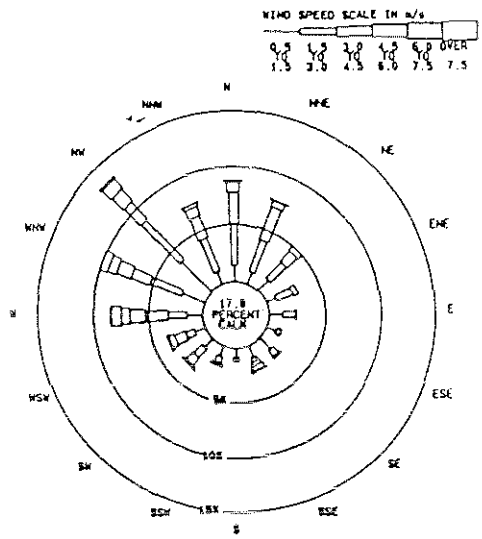

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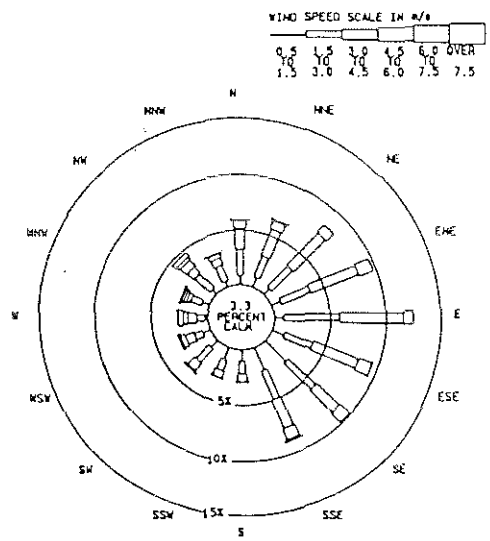

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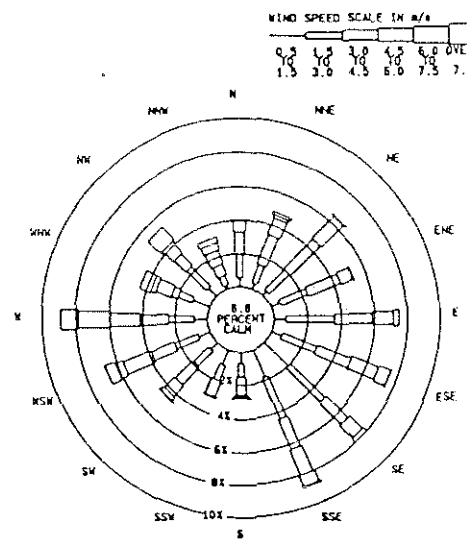

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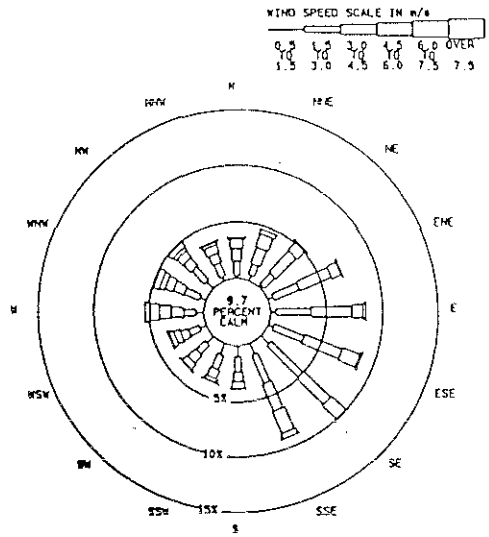

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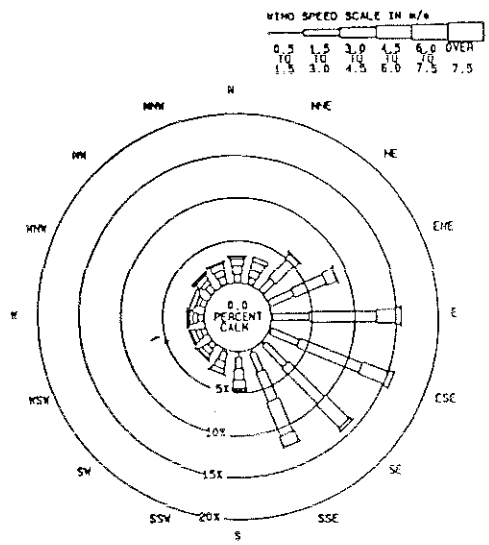

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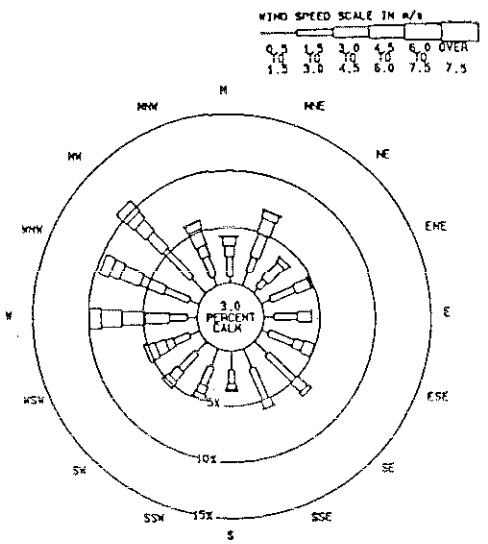

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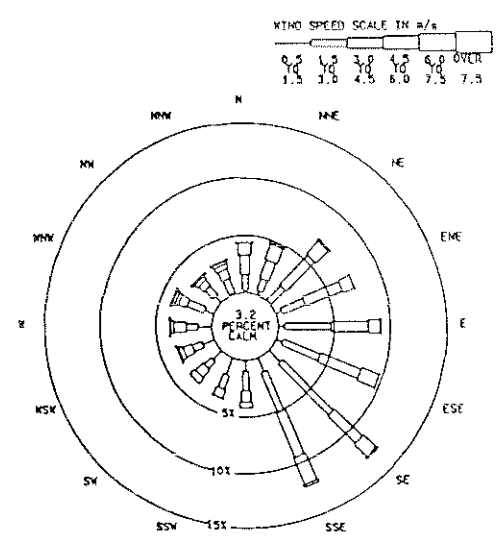

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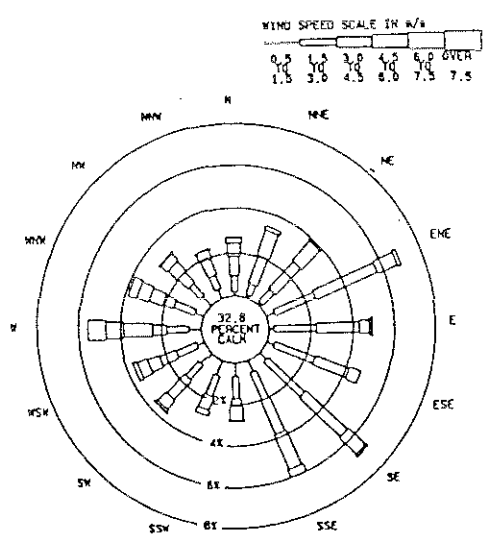

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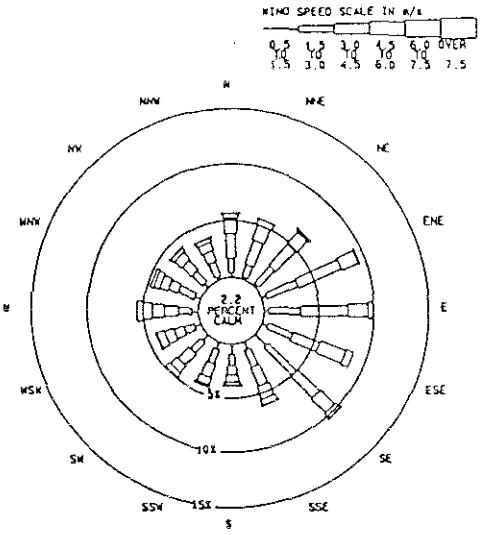

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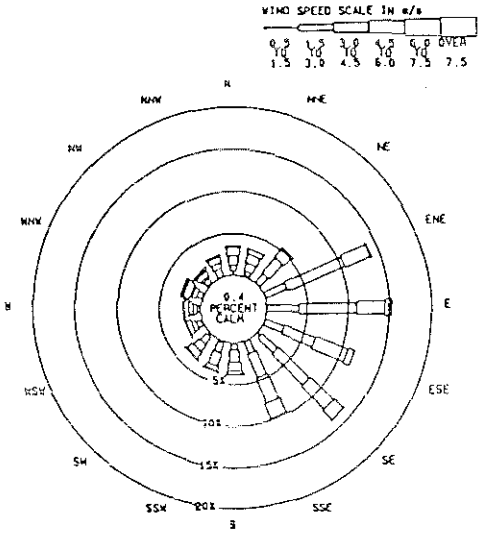

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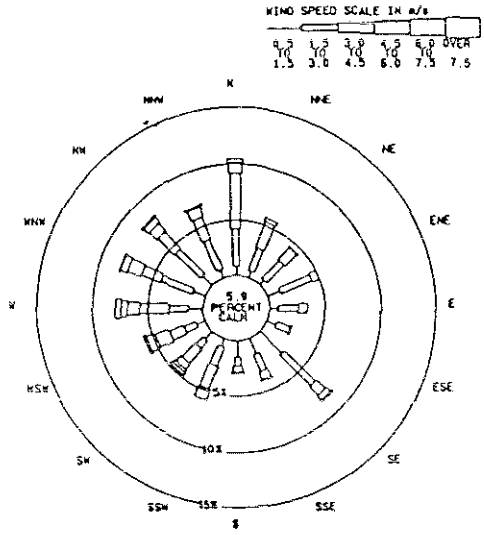

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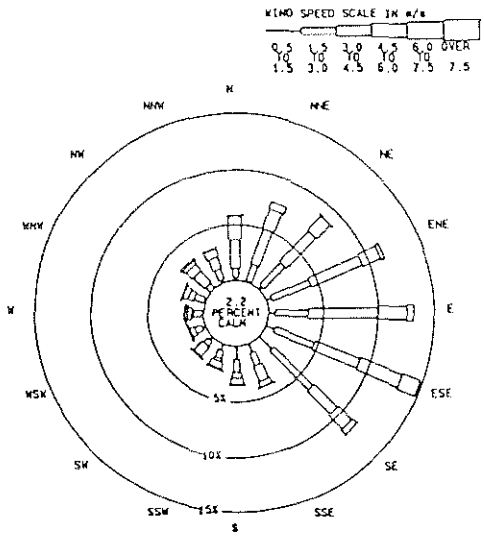

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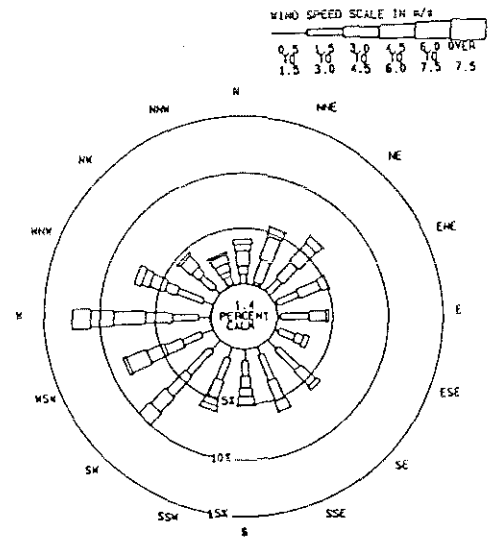

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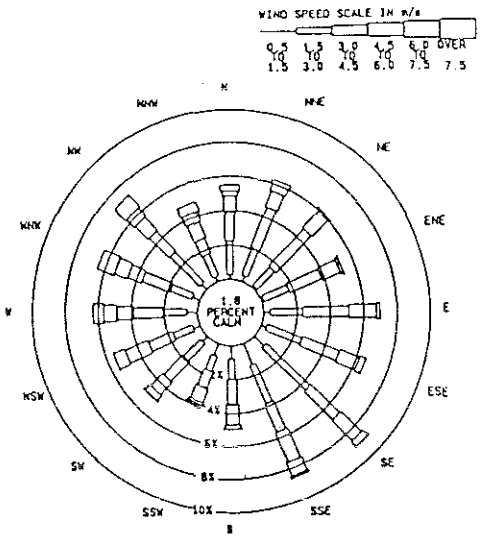

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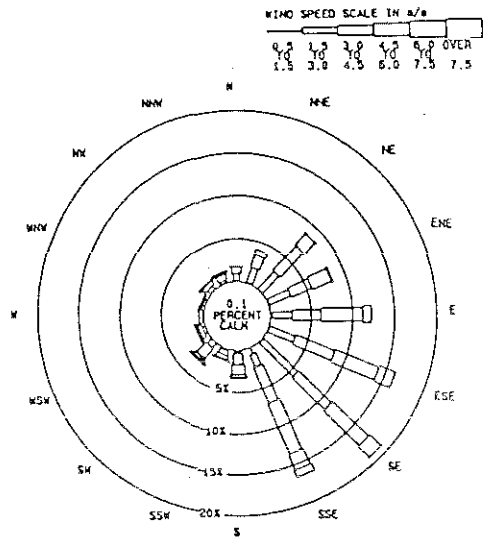

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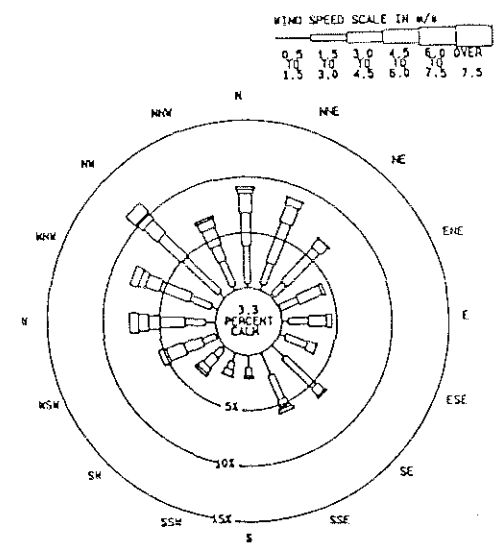

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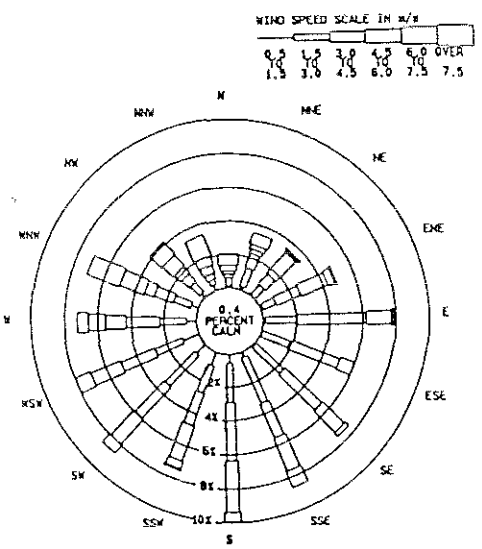

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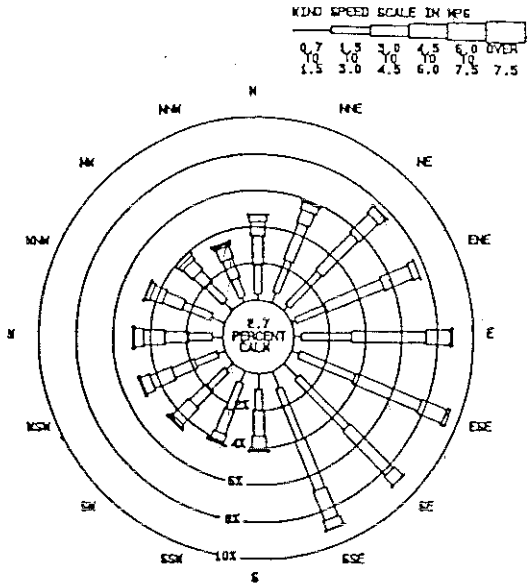
KALGOORLIE WIND DATA
(KTS)



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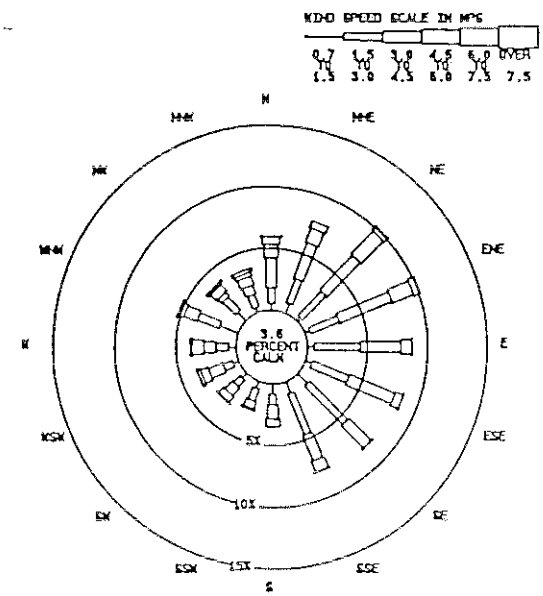

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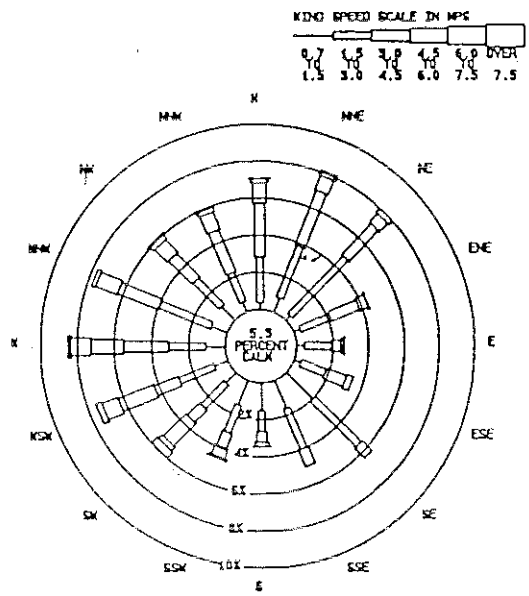

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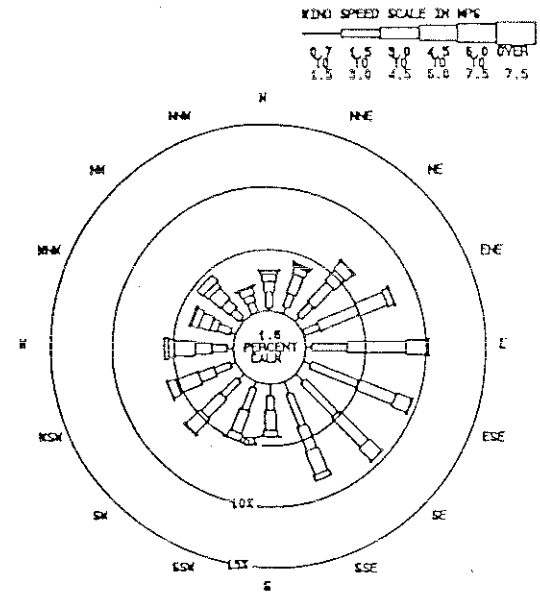

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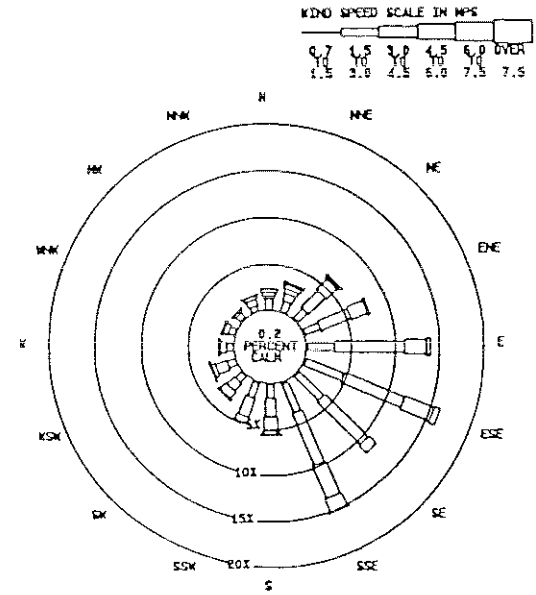

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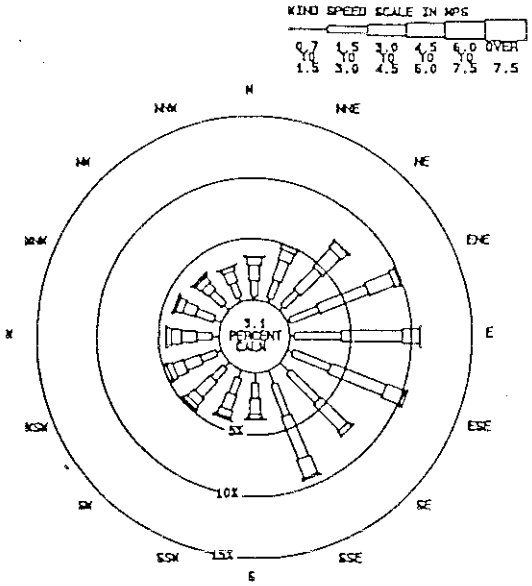

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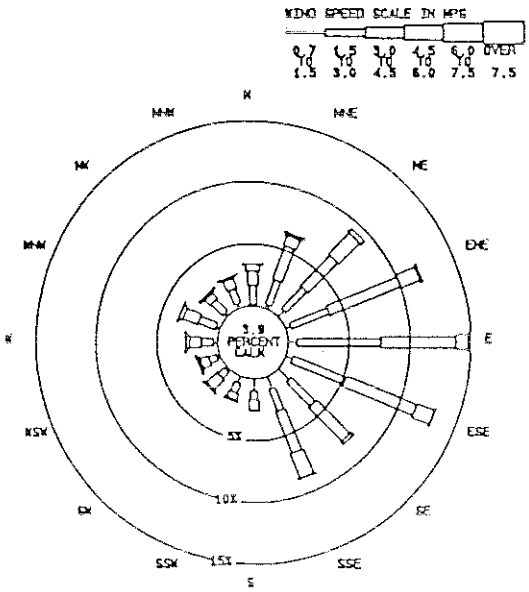

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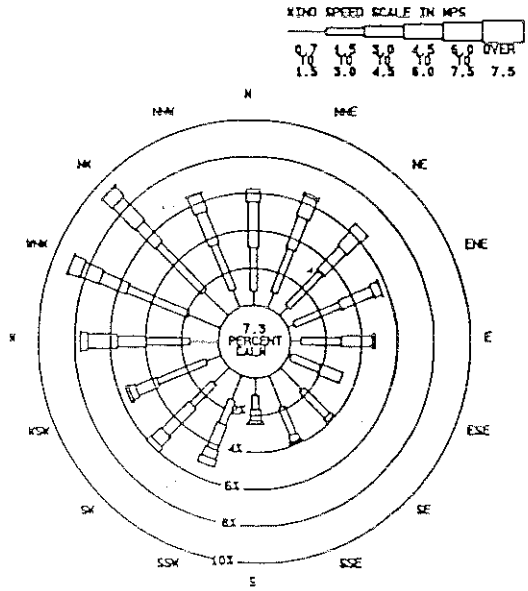

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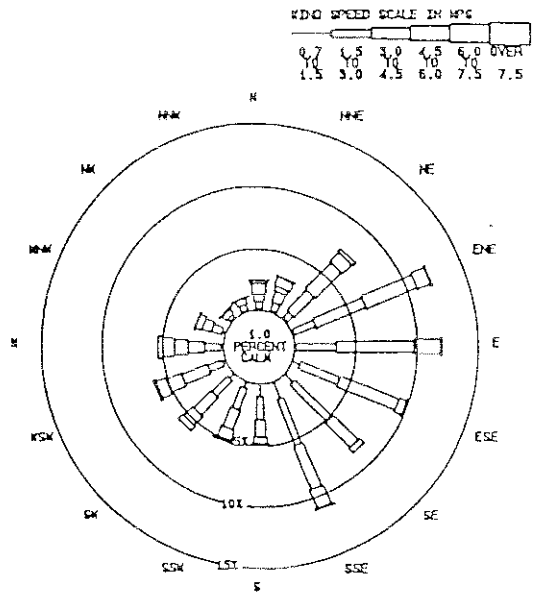

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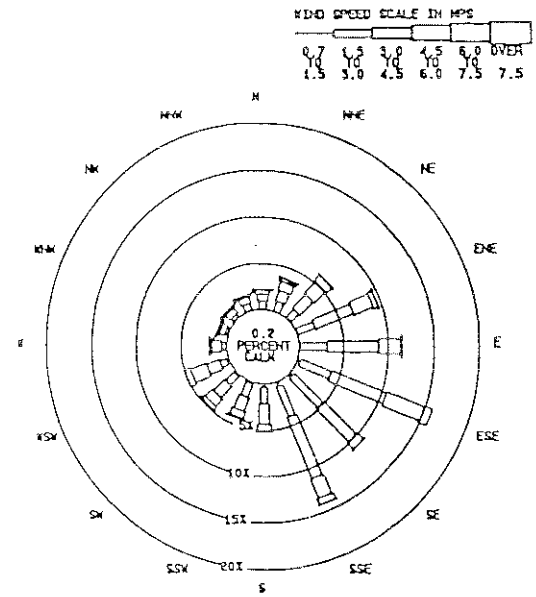

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SUMMER 1985

Appendix 2

Discussion paper on sulphur dioxide (courtesy of Victorian EPA) and additional references

ENVIRONMENT
PROTECTION
AUTHORITY

DISCUSSION PAPER
ON
SULFUR DIOXIDE

Publication No. 298

ENVIRONMENT PROTECTION AUTHORITY

FOREWORD

Setting environment objectives is not an easy task, particularly when there is controversy in the scientific community.

EPA believes strongly that a precautionary approach should be taken while recognising the economic and social significance of objectives that are too stringent or too lax.

This paper summarises the current view of the Authority concerning Sulfur dioxide following the receipt of the "Streeton Report". It does not necessarily represent the final view on which the Authority's recommendation to Government will be based.

Any changes to the view represented in this paper will depend on the validity of any cases put forward during the public comment phase.

In finalising its view before publishing a formal draft amendment to the State Environment Protection Policy (The Air Environment), the Authority will take into account any substantiated case put before it.

To that end submissions on this paper are invited from interested persons. Submissions should reach the Authority by 28 February 1992, addressed to:

The Assistant Director Strategic Policy
Environment Protection Authority
GPO Box 4395 QQ
Melbourne 3001

BRIAN ROBINSON
CHAIRMAN

DISCUSSION PAPER ON SULFUR DIOXIDE

CONTENTS

DISCUSSION PAPER ON SULFUR DIOXIDE

INTRODUCTION

A review of the current State Environment Protection Policy (The Air Environment), [SEPP (Air)], commenced with the circulation of a discussion paper entitled "Review of State Environment Policy" in 1988. Response to the document provided the EPA with valuable comment from a wide range of organisations and individuals. This material is being taken into consideration during the development of the new SEPP (Air).

Subsequently, as part of the consultative process, Dr Jonathan Streeton, a consultant chest physician from Melbourne, prepared an extensive report on "Air Pollution, Health Effects and Air Quality Objectives in Victoria".

The Streeton report was circulated for public comment in October 1990.

Both the report and comments of interested organisations and individuals have now been considered by the EPA.

Dr Streeton recommended that an annual average of 0.02 ppm for sulfur dioxide, not to be exceeded, be introduced to protect vegetation. He also recommended that no changes be made to the existing one hour and eight hour Acceptable and Detrimental Levels as he considered them adequate for the protection of human health.

This document has been prepared as part of the consultative process. As it is not intended to alter the one-hour and eight-hour objectives, that were set to protect human health, discussion in this paper is confined to the direct effects of sulfur dioxide on vegetation. The paper summarises the EPA's understanding of currently available knowledge on the effects of sulfur dioxide on vegetation, ambient levels of sulfur dioxide in Melbourne and the Latrobe Valley, existing controls, the EPA's proposal concerning adoption of new objectives, possible control strategies and proposed further consultation.

It is recognized that sulfur dioxide may have indirect as well as direct adverse effects on vegetation since sulfates derived from it are present as a component of acid rain. These indirect effects are not considered in this paper. It is noted in passing that acid rain has been implicated in forest dieback in Europe and North America, (Welburn, 1988; WHO, 1987; Elsom, 1987).

FIGURE 1
SULFUR DIOXIDE IN THE ATMOSPHERE

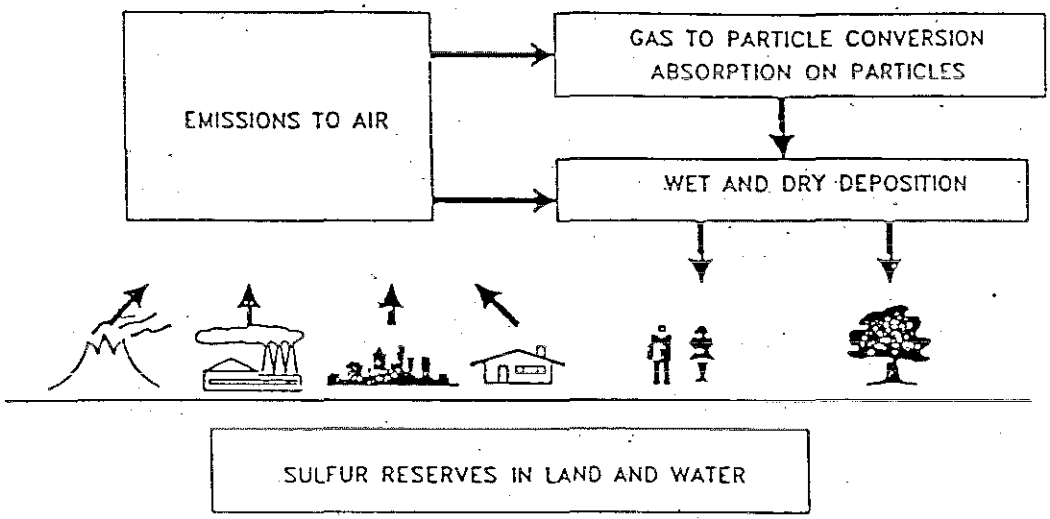


FIGURE 2
CROSS SECTION OF LEAF

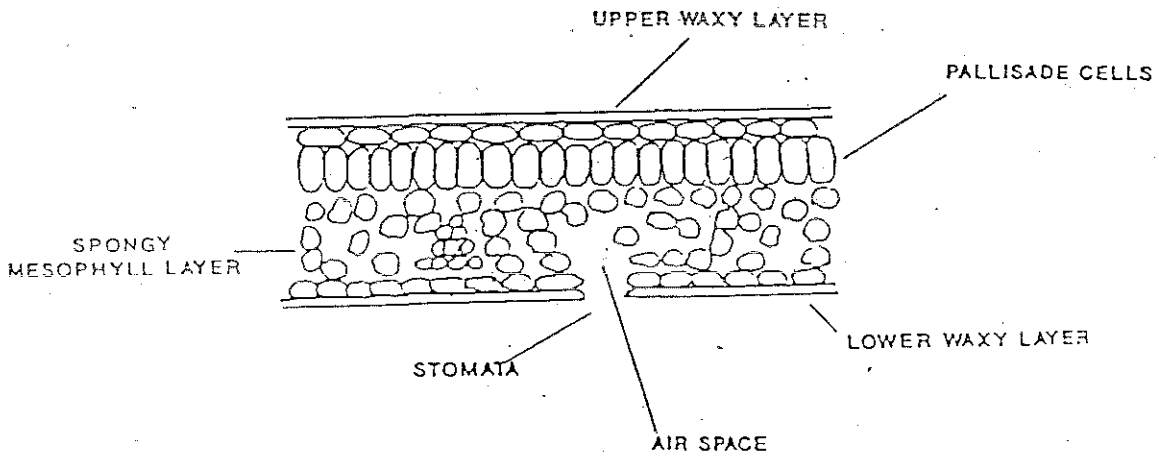
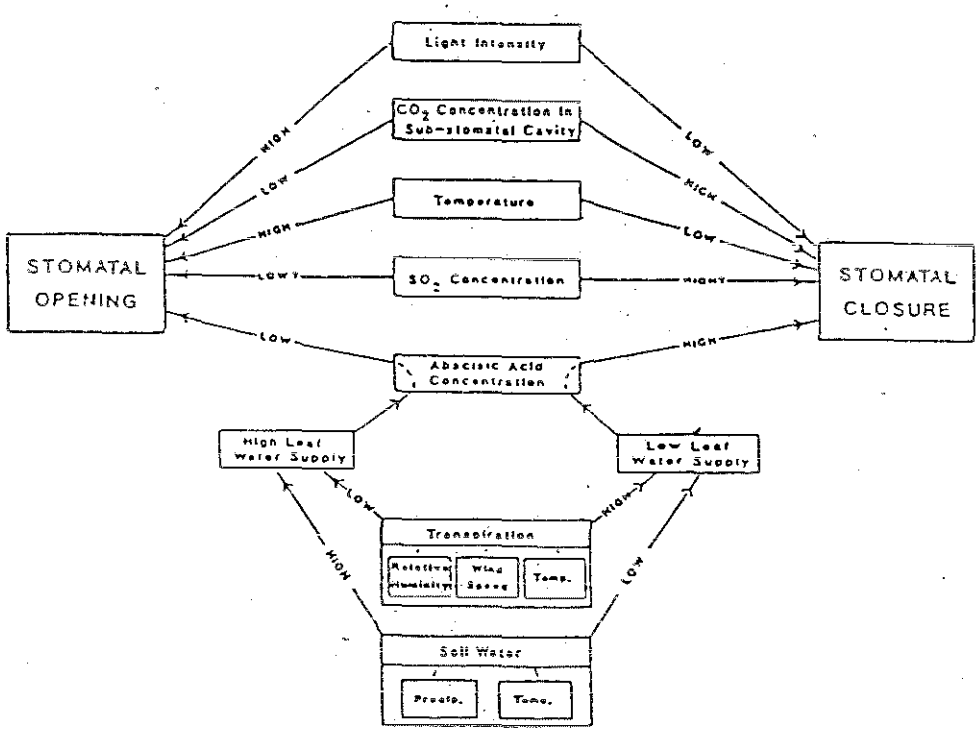


FIGURE 3
FACTORS AFFECTING STOMATAL OPENING



TAKEN FROM MURRAY ET AL ,1991

With the lower concentrations of ambient sulfur dioxide that now prevail, concern is centred on more subtle effects that occur as a result of extended exposure of the plant to these lower concentrations. The effects include reduced growth, greater susceptibility to climatic extremes and to attack by pathogens, or to the influences from soil modified by acid rain. There is also evidence of sulfur dioxide having a combined effect in association with other air pollutants, notably ozone and nitrogen oxides (WHO, 1987).

Fumigation of agricultural species with mixtures of sulfur dioxide and nitrogen oxides, (mixtures of nitric oxide and nitrogen dioxide), gave differing results. For non-nitrogen fixing species the gas mixtures had a beneficial effect at low concentrations. This became detrimental at higher concentrations. The nitrogen fixing species exhibited a no threshold response, and were affected at all concentrations. Growth depression of eucalypts was less severe at low concentrations, of sulfur dioxide - nitrogen oxides mixtures, but detrimental effects were still evident.

Murray et al (1991) proposed the following standard for sulfur dioxide based on vegetation response:

- a one-hour arithmetic mean of 0.20 ppm not to be exceeded, coupled with
- a four-hour arithmetic mean value of 0.025 ppm not to be exceeded more than once per week.

STANDARDS FOR SULFUR DIOXIDE

The current Victorian Air Quality Objectives for sulfur dioxide are based on health effects. They are presented in Table 1.

TABLE 1

AIR QUALITY OBJECTIVES FOR SULFUR DIOXIDE

Averaging Period	Acceptable Level (ppm)	Detrimental Level (ppm)
1 hour	0.17	0.34
24 hours	0.06	0.11

Dr Streeton has advised that existing Acceptable and Detrimental Levels for sulfur dioxide are adequate to protect human health. However he has recommended a new annual average objective of between 0.01 and 0.02 ppm to protect vegtation. The recommendation is compared with overseas standards in Figure 4.

FIGURE 5
PEAK ONE HOUR SULFUR DIOXIDE LEVELS
MELBOURNE AND LATROBE VALLEY

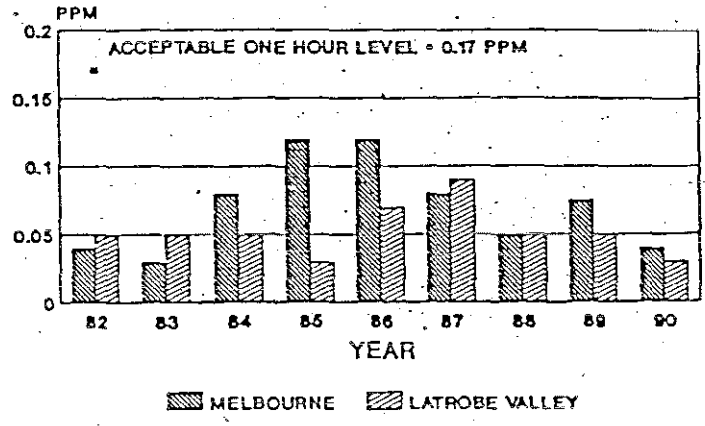


FIGURE 6
PEAK 24 HOUR SULFUR DIOXIDE LEVELS
MELBOURNE AND LATROBE VALLEY

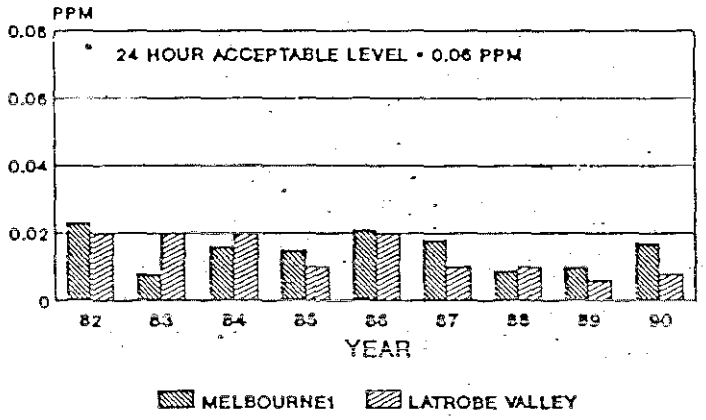
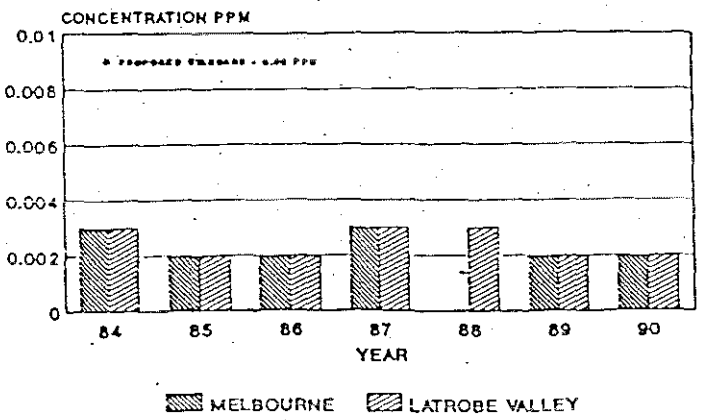


FIGURE 7
ANNUAL AVERAGE SULFUR DOIXIDE LEVELS
MELBOURNE AND LATROBE VALLEY



INSUFFICIENT DATA MELB. 1988

TABLE 2

ESTIMATE OF SULFUR DIOXIDE EMISSIONS

PORT PHILLIP CONTROL REGION

	SUMMER DAY		WINTER DAY	
	kg	%	kg	%
MOBILE				
Motor Vehicles	4800	11.4	4800	11.2
Other Mobile Sources	191	0.5	191	0.5
Marine	856	2.0	359	0.8
Aviation	131	0.3	131	0.3
SUB TOTAL	5978	14.2	5481	12.8
DOMESTIC				
Law Mowing/Miscellaneous	140	0.3	50	0.1
Waste Combustion	30	0.1	30	0.1
National Gas Combustion	9	0.0	41	0.1
Oil and Kerosene Combustion	28	0.1	215	0.5
Wood Combustion	0	0.0	1000	2.3
SUB TOTAL	207	0.5	1336	3.1
INDUSTRIAL/COMMERCIAL				
Motor Vehicle Manufacturing	13	0.0	13	0.0
Petroleum Refining	12799	30.4	12799	30.0
Petrochemical Manufact.	6472	15.4	6472	15.1
Major Fuel Storage	137	0.3	137	0.3
Bitumen	na	na	na	na
Car Manuf.& Fabric Metals	21	0.0	21	0.0
Textiles/Clothing	147	0.3	147	0.3
Other Chemical Manuf.	5440	12.9	5440	12.7
Other Machinery Manuf.	45	0.1	45	0.1
Hospitals/Colleges	616	1.5	616	1.4
Food and Beverage	268	0.6	268	0.6
Major Incinerators	36	0.1	36	0.1
Waste Combustion	70	0.2	70	0.2
Non-Metallic Miner. Process.	2298	5.5	2298	5.4
Paper Manuf.& Paper Product	2	0.0	2	0.0
Power Generation	15	0.0	15	0.0
Basic-Metal Manufact.	7507	17.8	7507	17.6
SUB TOTAL	35886	85.3	35886	84.1
VEGETATION	0	0.0	0	0.0
GRAND TOTAL	42071	100	42703	100

content of crudes imported for subsequent processing in installations that were not equipped to minimise sulfur emissions from the high sulfur oil.

Provision of plant in a refinery, to reduce sulfur dioxide emissions from high sulfur Middle East crudes to an acceptable level, is likely to cost between $50 million and $100 million, (Dillon and Angus, 1990).

CONSULTATIONS RELATING TO THE PROPOSED STANDARD

It is intended that this document will form a basis for discussion with interested parties prior to the EPA deciding on a new standard for sulfur dioxide.

Comments are invited on any of the issues raised in this document. Submissions should be in writing and reach the Authority by 28 February 1992 addressed to:

The Assistant Director Strategic Policy
Environment Protection Authority
GPO Box 4395 QQ
Melbourne 3001

It is intended to hold a symposium on Class 1 Indicators in March 1992 using the responses to this document and other discussion papers as a basis for input. Industry and public interest groups will be given the opportunity to present their views on the discussion papers.

It is anticipated that working groups having industry representation may need to be formed to resolve matters raised at this symposium.

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