

**PROPOSED CHLORIDE PROCESS
TITANIUM DIOXIDE PLANT
AT AUSTRALIND**

SCM CHEMICALS LTD



Report and Recommendations
of the
Environmental Protection Authority

THE PROPOSED CHLORIDE-PROCESS TITANIUM
DIOXIDE PLANT AT AUSTRALIND

SCM CHEMICALS LTD

Report and Recommendations
by the
Environmental Protection Authority

Environmental Protection Authority
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SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Environmental Protection Authority (EPA) has assessed the proposal by SCM Chemicals Ltd (the proponent) presented in the Environmental Review and Management Programme (ERMP) Stage II and submitted to the EPA by the Company. The proponent proposes to convert its existing sulphate-process titanium dioxide raw pigment plant at Australind to a chloride-process plant producing 51 000 tonnes per annum of unfinished titanium dioxide pigment. In the proposal, this pigment would be finished on site, using the existing finishing plant, and the bulk of the product exported either interstate or overseas.

The Laporte/SCM Plant's waste emissions and their disposal has been a prominent environmental issue in Western Australia since the plant started operations in 1964. The existing Agreement between the Company and the State was made before environmental legislation in the State was enacted. Hence the Company is exempt from the provisions of the current Environmental Protection Act 1986.

Initial public concerns about ocean discharge led to disposal of the acidic waste in the dunes on Leschenault Peninsula. However, the need to restrict the access of the public to the Peninsula, periodic breakdowns of the pipe and lagoon overflow with discharge staining the local beaches has meant that effluent disposal has remained a prominent matter requiring resolution.

After investigating the history of the sulphate-process plant's operations over the last 21 years, including aspects such as wastewater disposal, air and noise emissions, groundwater contamination and visual impact, the Authority's conclusions are that:

- . from an environmental viewpoint (and on today's standards), it would have been inappropriate to initially locate the plant at Australind;
- . however, given the location, from an environmental planning perspective the residential development in proximity to the plant is unfortunate;
- . if there was a simple environmental choice, the Authority would prefer the existing and the proposed plant to be relocated elsewhere; and
- . the Authority believes that the ongoing environmental management of the existing plant, initially by Laporte Pty Ltd and subsequently by SCM Chemical Ltd, has been inadequate and therefore does not provide the Authority with a basis for confidence in future environmental management of the proposal, without strict control conditions. Problems have been exacerbated because the Company is effectively outside the environmental laws applying to other industries in the State.

As part of the Assessment, and arising out of the public release of the 1984 ERMP Stage I, an Environmental Review and Management Programme - Stage II was prepared by the proponent and released for public review for 10 weeks. A total of 51 submissions were received on the proposal.

During the Authority's assessment of the proposal, it became apparent that the following questions required detailed evaluation:

- . Is Australind an acceptable site to locate the proposed plant?
- . Was the Cremer & Warner Preliminary Risk Analysis Study undertaken in an acceptable manner?
- . Will the individual risk levels being experienced by the local residents be low enough to be acceptable to the EPA as in the Authority's guidelines?
- . Has the proponent taken appropriate safety measures to ensure that the likelihood of an accident is reduced to an acceptably low level?
- . Can the plant be designed, constructed, commissioned, operated and maintained in such a manner as to give confidence that environmental and risk management of the plant would be satisfactory such that EPA could recommend that approval be given to the proposal?
- . Will the waste emissions from the plant be kept to an acceptable level and will these be treated and discharged in such a manner as to meet any criteria or standard set by the EPA?

After undertaking a comprehensive assessment, the Authority makes the following conclusions:

- . the Australind site for a chloride-process plant can be made environmentally acceptable;
- . after reviewing the Cremer & Warner study (ERMP Volume 2) and seeking independent expert advice the Authority concludes that the consultant's analysis has been undertaken in an appropriate manner and accepts the risk results presented in the ERMP and shown in Figure 8 of this Assessment Report;
- . that if the proponent's proposed safeguards and the Authority's recommendations on the risk and hazard assessment are implemented; and if the plant is operated in a responsible manner, then the likely risks generated from the plant at Australind would be low enough to be acceptable to the EPA;

- . that additional safeguards are required and recommends a number of these in this report;
- . that provided that EPA monitor all stages of construction and management the environmental and risk management of the proposed plant could be satisfactory; and
- . that with appropriate conditions, wastewater discharge from the plant can be managed in an environmentally acceptable manner.

Given the above, the Authority believes that the proposed plant at Australind can be made environmentally acceptable.

The Authority notes that the operations of the plant were exempt from the provisions of the former Environmental Protection Act 1971-80 and remain exempt from the provisions of the Environmental Protection Act 1986 until the revised Agreement between the Company and the State (the Pigment Factory (Australind) Agreement 1986) is implemented.

However, upon implementation of the Agreement, the whole of the Company's operations fall within the jurisdiction of the Environmental Protection Act 1986.

The Authority has recommended in this Assessment Report that as a condition of approval the existing sulphuric acid plant should cease production. In addition, the Authority would prefer that the redundant sulphate-process equipment (excluding the finishing plant) not be utilized for any purpose at the Australind site.

The Authority has therefore recommended that the environment impact arising from the concurrent operation period needs to be managed and during that period, the waste disposal from the plant site should comply with provisions of the Environmental Protection Act (1986).

The Authority has also made recommendations on the management of the waste disposal on the Leschenault Peninsula until the termination of the current disposal practice.

There are a number of other issues which have been assessed and discussed in this Assessment Report. The general conclusion is that these can be managed and the proposal made environmentally acceptable.

The Authority would require regular reporting from the proponent on the Company's management and monitoring programme and would review and assess these reports in consultation with relevant interested bodies.

In this Assessment Report, the Authority makes the following recommendations:

RECOMMENDATION 1

The Environmental Protection Authority concludes that the proposal as described in the ERMP is environmentally acceptable and recommends that it could proceed subject to:

- . the commitments of the proponent given in the ERMP (and listed in Appendix 4 of this Report);
- . the further commitments given by the proponent in response to issues raised in public submissions and further advice given to the EPA (Appendices 1 and 2 of this Report); and
- . the EPA's recommendations in this Assessment Report.

RECOMMENDATION 2

The Environmental Protection Authority recommends that the management strategy for liquid effluent disposal on the Peninsula until 31 December 1989 (or at an extension of time determined under Section 8 of the Pigment Factory (Australind) Agreement 1986) should maximise the use of existing lagoons and the reactivation of old lagoons so as to avoid further degradation of the northern end of the Peninsula.

RECOMMENDATION 3

The Environmental Protection Authority recommends that a condition of approval be that the existing sulphuric acid plant at the Australind site should not operate beyond the 31 December 1989 (or at an extension of time determined under Section 8 of the Pigment Factory (Australind) Agreement 1986).

RECOMMENDATION 4

The Environmental Protection Authority recommends that a condition of approval be that the existing sulphate-process plant, as described 'redundant' in the ERMP, should not operate beyond the 31 December 1989 (or at an extension of time determined under Section 8 of the Pigment Factory (Australind) Agreement 1986.)

RECOMMENDATION 5

The Authority has undertaken a thorough evaluation of the preliminary risk analysis undertaken by the proponent and described in the ERMP, together with the additional information and commitments made by the proponent to further reduce risks and hazards. The Authority accepts the certification by the proponent's consultants, Cremer & Warner Ltd, that the preliminary risk analysis is reasonable and was undertaken independently.

The Authority has concluded that the project can satisfy the EPA's published guidelines for the evaluation of the risk and hazards of new industrial installations on people living in residential areas.

The EPA acknowledges that the proponent has given a commitment to undertake a Hazard and Operability Study (HAZOP) and to prepare a hazard and risk management strategy.

The Environmental Protection Authority recommends that a condition of approval should be the preparation in stages of a comprehensive and integrated hazard and risk management strategy, to the Authority's satisfaction.

This should consist of the following with the results being forwarded to the Environmental Protection Authority:

- . the HAZOP study to be completed and submitted before construction commences and to be conducted in a manner approved by the EPA;
- . a final risk analysis report incorporating the plant design after HAZOP (and taking into consideration any additional safeguards/modifications proposed by the EPA) to be submitted soon after construction;
- . a hazard analysis update (including fire safety study, study detailing the management of commissioning stage and study of emergency procedures) to be submitted before plant commissioning; and
- . an audit of risk and hazards to be submitted to the EPA upon request.

RECOMMENDATION 6

The Environmental Protection Authority recommends that no more than 25 tonnes of chlorine should be stored at the Australind site.

RECOMMENDATION 7

The Environmental Protection Authority recommends that a condition of approval should be that there be no sale of chlorine from the Australind site and that there be no transport of chlorine to and from the site except during the commissioning stage.

The management of the transport of chlorine for commissioning should be discussed with the relevant Government agencies prior to commissioning.

RECOMMENDATION 8

The Environmental Protection Authority recommends that a condition of approval should be the implementation of the following safeguards on the chlorine storage units:

- . full height concrete bunding;
- . insulation tiles in the bunds;
- . a foam suppression system; and
- . isolating valves on main storage tanks and process items. Storage tank isolation valves require two actuation points.

Other safety features should include the following:

- . a monitoring alarm system for air moisture levels in the titanium tetrachloride building; and
- . if water (or steam condensate) is used in the vaporiser heating system, monitoring is required to give immediate warning if failure of vaporiser occurs.

RECOMMENDATION 9

The Environmental Protection Authority notes that the proponent is investigating sub-contracting the chlor-alkali plant. While the Authority approves of this procedure, it recommends that the proponent be held responsible for the environmental performance of the chlor-alkali plant, regardless of the operating company.

RECOMMENDATION 10

The Environmental Protection Authority recommends that the proponent's emergency plan and procedures be integrated with the proposed State Emergency Services' Bunbury Regional Counter Disaster Plan.

It is understood that the Regional Centre Disaster Plan will cover contingencies for chemical release emergencies as well as natural emergencies such as floods and fire.

RECOMMENDATION 11

The Environmental Protection Authority recommends that the likely risk generated from all operations on the Australind site including the proposed plant should never exceed the risk levels presented in the ERMP and shown in Figure 8 of this Assessment Report.

RECOMMENDATION 12

The Environmental Protection Authority recommends that no residential development should occur within the one in a million per person per year risk contour as shown in Figure 8 of this Assessment Report. The Authority further recommends that this be implemented through appropriate statutory planning mechanisms.

RECOMMENDATION 13

Almost all of the houses in the Australind area fall outside the one-in-a-million risk contour for the proposed plant. This means that these houses are in such a low zone of risk that, according to EPA guidelines, they are classified as "acceptable". No house is inside the contour of risk greater than ten-in-a-million and therefore, according to EPA guidelines, none are classified as "not acceptable".

Three houses lie in the zone between the one-in-a-million contour and the ten-in-a-million contour (all three are located close to a risk of two-in-a-million).

The Environmental Protection Authority recommends that the Government enter into discussion with the owners of these three residences with the objective of determining if further action is necessary to ensure that the owners would not be unreasonably disadvantaged by the proposal proceeding. Such further action should include the examination of additional requirements which could be placed on the proponent by the Government.

RECOMMENDATION 14

The Environmental Protection Authority recommends that the wastewater treatment clarifier accommodates all wastewater requiring disposal including extracted contaminated groundwater.

RECOMMENDATION 15

The Environmental Protection Authority recommends that the wastewater discharge to the Collie River from the Australind site conforms with the marine and esturine water quality criteria in 7(2) of the DCE Bulletin 103 (1981) for the maintenance and preservation of aquatic ecosystems.

RECOMMENDATION 16

The Environmental Protection Authority recommends that the proponent undertakes ongoing wastewater monitoring including:

- . temperature of the wastewater discharge and of the surface waters of the Collie River 10 metres upstream and downstream from the point of discharge;
- . pH, total dissolved solids, level of radioactivity, levels of Chromium and Manganese, and total suspended solids of the effluent;
- . baseline (that is pre-discharge) and post-discharge characterisation of the benthos of the Collie River in the vicinity of the outfall; and
- . volume and velocity of flow of the Collie River under low flow conditions.

The proponent should develop a monitoring programme for approval by the EPA and Leschenault Inlet Management Authority which includes proposals for timing of sampling and for the reporting of results.

RECOMMENDATION 17

The Environmental Protection Authority recommends that the proponent prepare a contingency plan to the satisfaction of the Authority and the Leschenault Inlet Management Authority, which addresses the management actions to be taken in the event of failure of any part of the effluent management or chemical containment and handling systems of the proposed plant as they may impact upon the Collie River or Leschenault Inlet.

RECOMMENDATION 18

The Environmental Protection Authority recommends that the pipeline across Leschenault Peninsula be maintained until monitoring results of wastewater effluent discharge to the Collie River demonstrate to the Authority's satisfaction that unacceptable environmental impacts have not occurred.

RECOMMENDATION 19

The Environmental Protection Authority recommends that the proponent should install a chlorine scrubbing system on the chlor-alkali plant with sufficient back-up capacity to be able to absorb all of the chlorine produced at the full production rate for one hour.

RECOMMENDATION 20

The Environmental Protection Authority recommends that the disposal site(s) for solid waste, including that generated during concurrent operation of both plants, should be approved by appropriate Government agencies including the Radiological Council.

RECOMMENDATION 21

The Environmental Protection Authority recommends that a radiation management programme should be developed by the proponent for the commissioning and operation of the proposed plant to the satisfaction of the Radiological Council.

RECOMMENDATION 22

The Environmental Protection Authority recommends that the proponent be subject to the provisions of the Environment Protection Act 1986 during the period of the concurrent operation.

RECOMMENDATION 23

The Environmental Protection Authority recommends that the monitoring commitments made by the proponent and requirements of the Authority be set as part of the works approval and licensing process under the Environmental Protection Act 1986.

RECOMMENDATION 24

The Environmental Protection Authority recommends that this proposal be re-scheduled under the definition of 'prescribed premises' in Regulations under the Environmental Protection Act 1986 for the purpose of setting fees on licenses issued under the Act to more closely cover the monitoring costs by the EPA.

1. INTRODUCTION

The proponent, SCM Chemicals Ltd (previously Laporte Pty Ltd), proposes to convert its existing sulphate-process titanium dioxide raw pigment plant at Australind (see Figure 1) to a chloride-process plant producing 51 000 tonnes per annum (tpa) of unfinished titanium dioxide pigment. This material would be finished on site, using the existing finishing plant, and the bulk of the material exported either interstate or overseas.

The main raw materials for the proposed plant would be titanium-rich ore (either rutile or synthetic rutile), chlorine, oxygen, carbon and nitrogen. The plant's main products would be titanium dioxide pigment and caustic soda. Titanium dioxide pigment is predominately used in the paint and plastic industries.

The total cost of the project is estimated to be approximately \$70 million.

The Laporte/SCM plant's waste emissions and their disposal has been a prominent environmental issue in Western Australia since the plant started operations in 1964. Initial public concerns about ocean discharge led to dunal disposal of the acidic waste on the Leschenault Peninsula. However, restriction of access on the Peninsula, periodic breakdowns of the pipe and lagoon overflow with discharge staining the local beaches has meant that effluent disposal has remained a prominent matter requiring resolution.

The Environmental Protection Authority (EPA) has been reviewing the history of environmental aspects of the sulphate-process plant at Australind since the Authority came into existence in 1971. After investigating the sulphate-process plant's operations over the last 21 years, including aspects such as wastewater disposal, air and noise emissions, groundwater contamination and visual impact, the Authority's conclusions are that:

- . from an environmental viewpoint (and on today's standards), it would have been inappropriate to initially locate the plant at Australind;
- . however, given the location, from an environmental planning perspective, the residential development in proximity to the plant is unfortunate;
- . if there was a simple environmental choice, the Authority would prefer the existing and the proposed plant to be relocated elsewhere; and
- . the Authority believes that the ongoing environmental management of the existing plant, initially by Laporte Pty Ltd and subsequently by SCM Chemicals Ltd, has been inadequate and therefore does not provide the Authority with a basis for confidence in future environmental management of the proposal, without strict control conditions. Problems have been exacerbated because the Company is effectively outside the environmental laws applying to other industries in the State.

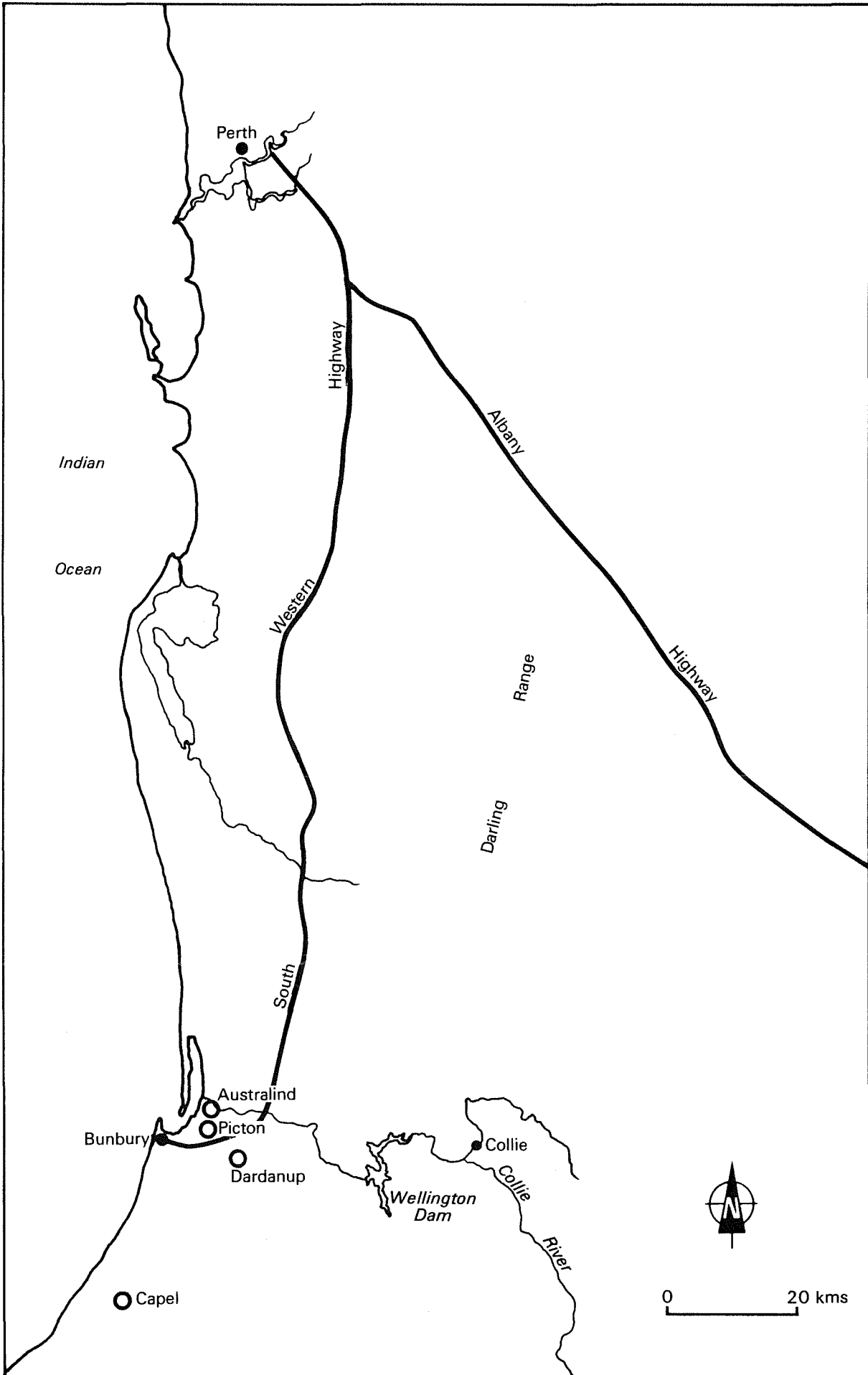


Figure 1. Australind site and alternative site locations.

Arising out of a sequence of events (see Table 1) discussed in Chapter 2 of this Assessment Report, an Environmental Review and Management Programme (ERMP) Stage 1 document prepared by the consultants Dames & Moore on behalf of Department of Resources Development was released in January 1984 for a public review of 12 weeks. This document investigated potential disposal options for the sulphate-process acidic liquid waste including the option to convert to a chloride-process plant. The Authority received 30 submissions (and a petition from 216 persons) discussing matters raised in the ERMP Stage 1. The Authority did not issue an Assessment Report on the ERMP Stage 1 document but provided advice to the Laporte Steering Group (LSG), a committee which has the brief from Government to manage the sulphate-process liquid waste disposal on the Leschenault Peninsula. The Authority noted that the main option preferred in the Dames & Moore report was to change the sulphate-process to the chloride-process. The Authority commented that such a proposal would require environmental assessment.

The EPA subsequently received a Notice of Intent (NOI) from the proponent in May 1986. The Authority recommended that an ERMP Stage II, including a separate Preliminary Risk Analysis (as Volume 2 of the ERMP), should be prepared and issued guidelines to the proponent. The Authority required a 10 week public review period for the ERMP Stage II which ended on 30 January 1987.

The Authority has received 51 submissions on this proposal, 11 from government agencies and 40 public submissions. Issues raised in the submissions were forwarded to the proponent for written response. The proponent's response is included as Appendix 1 of this Assessment Report. In addition, the Authority forwarded a list of issues, mostly dealing with the matter of risk and hazards, to the proponent. The proponent's response to the EPA is included as Appendix 2.

Given the concern this proposal has raised in the local community, the Authority sought further input from local organisations and the community, in the form of a series of meetings including a public meeting. The Authority found the comments provided by the public meeting on 30 March 1987 to be very constructive, and wishes to thank those who attended for their assistance to the Authority.

In its charter to provide advice to the Minister for the Environment, the EPA can make the following recommendations regarding a project:

- . the project is environmentally unacceptable;
- . the project is environmentally acceptable; or
- . the project is environmentally acceptable subject to conditions.

Given the above, the Authority initially had the following two options for assessment. These were:

TABLE 1 CHRONOLOGY OF SIGNIFICANT EVENTS

1961	Laporte Industrial Factory Agreement enacted. The Agreement is binding on the parties for 50 years, ie until the year 2011.
1964	Factory production commenced. The effluent was discharged directly to the ocean via a shore discharge.
1968	Ocean disposal terminated on environmental grounds and disposal on the dunes commenced.
1970	The Laporte Effluent Disposal Committee was constituted to investigate alternative disposal methods.
1974	The Laporte Factory Agreement Review Committee was constituted to review changes to the Agreement necessary to provide for other disposal methods.
1975-77	Investigations carried out on submarine disposal of strong effluent.
1982	The Laporte Effluent Disposal Committee report on disposal options was submitted to the EPA for evaluation and released for public comment.
1983	The EPA published its assessment on the Laporte Effluent Disposal Committee report.
1984 (Jan)	A joint submission on effluent disposal was presented to Cabinet by the Minister for the Environment, the Minister for Minerals and Energy and the Minister for Water Resources.
1984 (Sept)	SCM Chemicals Ltd purchased the Laporte plant. SCM commenced a 12 month feasibility study on conversion of the plant to the chloride-process.
1985	Stage I ERMP submitted to EPA who recommended that it be released for public review and comment. Cabinet endorsed this action.
1985	A report on environmental management proposals for land disposal to 1987-88 was completed by Public Works Department and submitted to EPA for their comment.
1985	EPA commented on ERMP Stage I forwarded to the Minister for Minerals and Energy.
1985	Leschenault/Kemerton Regional Park concept presented to public in draft form and comments sought.
1986 (Nov)	ERMP Stage II released for 10 week public review.

- . Determine the proposal environmentally unacceptable. The consequences of this option would include:
 - the proponent has stated that if the proposal is rejected then the existing sulphate-process plant would continue until 2011;
 - the project would require an ERMP Stage III discussing ocean disposal, deep-well injection or any other option;
 - cessation of disposal on Leschenault Peninsula would be postponed for a number of years. In fact, total cessation may not occur as standby facilities might be required on the Peninsula; and
 - the existing waste emissions from the plant, including discharges of sulphur dioxide, noise, etc may continue in the future.

- . Determine the proposal as outlined in the ERMP Stage II environmentally acceptable with or without conditions.

The Authority finds both of the above options undesirable. As mentioned earlier, the Authority would prefer the total (or partial) relocation of the titanium dioxide pigment plant from the Australind area. However, this option lies in the domain of the proponent and cannot be imposed on the Company given the 1961 Agreement Act.

The EPA was not completely satisfied with the proposal for the chloride-process titanium dioxide plant as put forward by the proponent in the ERMP Stage II. The Authority believes that an assessment for such a proposal needs answers to the following questions:

- . Is Australind a suitable site to locate the proposed plant?
- . Was the Cremer & Warner Preliminary Risk Analysis Study undertaken in an acceptable manner?
- . Will the individual risk levels being experienced by the local residents be low enough to be acceptable to the EPA as per the Authority's guidelines?
- . Has the proponent taken appropriate safety measures to ensure that the likelihood of an accident is reduced to an acceptably low level?
- . Can the plant be designed, constructed, commissioned, operated and maintained in such a manner as to give confidence that environmental and risk management of the plant would be satisfactory such that the EPA could recommend that approval be given to the proposal?
- . Will the waste emissions from the plant be kept to an acceptable level and will these be treated and discharged in such a manner as to meet any criteria or standard set by the EPA?

The Authority notes that during the environmental impact assessment process, the proponent in consultation with a number of government agencies modified the proposal from that put forward in the ERMP (see Section 4.2 for details). The Authority's subsequent assessment has shown that a 51 000 tpa titanium dioxide plant is technically capable of being operated and managed in such a manner as to be environmentally acceptable. Currently, there are a number of such plants in the world. The Authority's objective in its assessment was to determine whether the proposal under investigation is environmentally acceptable (or unacceptable) or whether it can be made environmentally acceptable with further safety measures, additional conditions and controls. The Authority concludes that a chloride-process titanium dioxide plant could be made environmentally acceptable at the Australind site.

The EPA has assessed the environmental aspects of the project discussed in this Assessment Report using information provided in the ERMP Stage II documents, public and government agencies submissions to the Authority, including the input through the public meetings, the proponent's response to the Authority's questions and comments made in the submissions, and the Authority's own investigations. The Authority also acknowledges the expert advice on risk analysis provided by the NSW Department of Environment and Planning and has incorporated this advice in this Assessment Report.

The Authority concludes that the proposed plant at Australind can be made environmentally acceptable and makes the following recommendation.

RECOMMENDATION 1

The Environmental Protection Authority concludes that the proposal as described in the ERMP is environmentally acceptable and recommends that it could proceed subject to:

- . the commitments of the proponent given in the ERMP (and listed in Appendix 4 of this Report);
- . the further commitments given by the proponent in response to issues raised in public submissions and further advice given to the EPA (Appendices 1 and 2 of this Report); and
- . the EPA's recommendations in this Assessment Report.

2. BACKGROUND

2.1 INTRODUCTION

The purpose of this Section of the Assessment Report is to discuss a number of issues which are relevant to understanding the background context in which the current proposal has been assessed. This proposal is unusual in that:

- . The proposal is a change in technology to an existing process and proposes to construct a new plant on an existing industrial site.
- . The existing plant, however, was initially inappropriately located. In addition, residential development has since encroached upon the plant site.
- . The existing plant operates under a 1961 Agreement Act which exempts the Company from complying with the State's environmental legislation.
- . There are environmental benefits in converting the plant to a chloride-process in that the proposal will make available the Leschenault Peninsula which currently is being used for dunal disposal of acidic liquid waste. Furthermore, under the proposed new Pigment Factory (Australind) Agreement, the plant's emissions would have to comply with the Environmental Protection Act (1986).
- . If the proposal proceeds, then dunal disposal on the Peninsula would continue until December 1989. There are two options for managing the disposal over this period. These should be discussed and a preferred option recommended.
- . The Company's existing operations have caused environmental impacts and nuisance to the local community such as air emissions, (eg sulphur dioxide), odours, noise and groundwater contamination.
- . The Company's historical record in the environmental management of its operation has been inadequate.
- . The Company's existing factory consists of a sulphuric acid plant and sulphate-process semi-processing plant. The proponent proposes to continue manufacturing sulphuric acid and plans to investigate an alternative use for the redundant sulphate-process plant. While these matters are ancillary to the main proposal, they still need assessment.

2.2 BRIEF HISTORY OF (LAPORTE/SCM) TITANIUM DIOXIDE PLANT

In 1961 the State and Laporte Pty Ltd signed a 50 year Agreement which enabled the establishment of a titanium dioxide manufacturing plant at Australind near Bunbury. In 1964 the plant commenced

production with an annual production capacity of 10 000 tonnes. In subsequent years the capacity of the plant was expanded to 12 000 tonnes in 1966, 18 000 tonnes in 1969 and 36 000 tonnes in 1975.

Table 1 shows the chronology of significant events in the history of Laporte Pty Ltd/SCM Chemicals Ltd.

Under the Laporte Industries Factory Agreement Act (1961), the State has the total responsibility for the disposal of all existing and future effluent, and cannot interfere with the works site with the object of altering the effluent composition, or compel the Company to neutralise or otherwise treat the effluent. In addition, the Company did not have to comply with requirements of the State's Environmental Protection Act.

The Company has been an important source of employment (currently providing approximately 300 jobs in the Bunbury region), and has invested over \$25 million since its establishment in 1964. Most of the current product from the plant is exported and has a value in excess of \$60 million per year at full production (36 000 tonnes titanium dioxide per annum).

The Australind plant is one of two titanium dioxide plants in Australia, the other being at Burnie, Tasmania.

2.3 PAST EPA INVOLVEMENT IN (LAPORTE/SCM) WASTEWATER DISPOSAL

In February 1974, the matter of the Laporte effluent was referred to the EPA by the then Minister for Development and Decentralisation. In March 1975, the EPA indicated preference for ocean disposal of the plant's wastewater beyond the continental shelf. The Authority also felt that the then proposed 5.5 km pipeline was likely to cause problems of beach and ocean staining by effluent.

Later in April 1975, the Authority set two broad criteria for an ocean pipeline:

- . no significant adverse effect on marine life; and
- . no discolouration of water or beaches visible from the shore.

The EPA also set up an ad hoc Committee to advise on marine studies for an ocean pipeline.

In December 1976, the Authority provided comment on criteria for the existing practice of dune disposal proposed by the Chairman of the Laporte Industrial Factory Agreement Review Committee.

The EPA considered dune disposal should also meet the criteria specified by EPA in April 1975 for ocean pipeline disposal.

Intermittently up to May 1976, the EPA provided comment on progress reports of marine studies for an ocean pipeline.

In 1983, the EPA issued a detailed report which made a number of conclusions and recommendations about the sulphate-process. The main thrust of the EPA's report was that disposal on the Peninsula should cease as soon as possible. The Authority's preferred strategy involved an ocean pipeline (with greater length than that suggested by the Laporte Effluent Disposal Committee's studies) conveying the sulphate effluent with reduced iron loadings, and disposal of solids in an appropriate land fill site.

The 1983 EPA Report also issued guidelines and objectives on how the Peninsula and effluent disposal should be managed.

Another development that year was the need for more disposal lagoons (and hence more land) on the Peninsula. Cabinet made funds available to purchase additional land, 100 hectares of which was to be used for waste disposal in the short term of three years. Cabinet also terminated all of the Laporte committees and sub-committees and established the Laporte Steering Group (LSG). This Group had the objective of terminating the waste disposal on the Peninsula, reviewing disposal options, and implementing the preferred disposal option. The Group was also to investigate and implement the rehabilitation of the Peninsula and ensure that the effluent disposal being carried out would be undertaken in an environmentally acceptable manner as laid down by the EPA in its advice to Government.

2.4 EFFLUENT DISPOSAL ON THE LESCHENAULT PENINSULA (1986-1989)

Currently there are 44 lagoons on the Peninsula, of which a handful are used for disposal. The remaining lagoons are oversaturated and because of their highly acidic contents have impacted upon the surrounding vegetation in places. The loss of vegetation has meant that some areas surrounding the lagoons have become unstable. In addition, some of the lagoons are located in naturally unstable areas. The effluent disposal and associated activities have meant that the rate of instability of these areas has increased.

Two options exist for waste disposal on the Peninsula until December 1989 when it is desirable for dunal disposal on the Peninsula to cease whether the proposed chloride-process project proceeds or not. One option would mean opening up new lagoons in environmentally sensitive areas. The other option would mean the disposal of waste in existing or previously used lagoons. However, this second option has the slight possibility of staining local beaches.

The Authority strongly supports the second option which proposes to maximise use of existing lagoons and the reactivation of old lagoons so as to avoid further degradation of the northern end of the Peninsula. The Authority is aware that this disposal option may result in some seepage of effluent into the ocean and consequent localised discolouration. However, it is considered that localised ocean discolouration is a preferable outcome to the construction of additional lagoons in the northern section of the Peninsula.

RECOMMENDATION 2

The Environmental Protection Authority recommends that the management strategy for liquid effluent disposal on the Peninsula until 31 December 1989 (or at an extension of time determined under Section 8 of the Pigment Factory (Australind) Agreement 1986) should maximise the use of existing lagoons and the reactivation of old lagoons so as to avoid further degradation of the northern end of the Peninsula.

The Laporte Steering Group's objectives for disposal on the Peninsula have recently been outlined in the Group's document "Effluent Disposal on the Leschenault Peninsula 1986-1989" (LSG 1986). The Authority finds these environmental objectives for the management of effluent disposal on the Peninsula until December 1989, environmentally acceptable.

As mentioned earlier, the Authority is committed to the cessation of dunal disposal on the Peninsula irrespective of the proposed chloride-process plant's future outcome.

2.5 ENVIRONMENTAL IMPACT OF THE PRESENT WASTEWATER DISPOSAL SYSTEM

The ERMP (ppl2-13) identifies the following to be the major impacts of the existing disposal system, as perceived by the general public:

- . inappropriate use of the coastal environment, precluding the promotion of the area for recreational, tourism or conservation purposes;
- . the need to increase the area used in this way, as the present disposal area is inadequate for the life of the Laporte Agreement;
- . pollution of the Inlet through seepage of effluent throughout the groundwater system, or release due to pipeline rupture or leakage;
- . pollution of the Collie River;
- . contamination of the groundwater system;
- . visual degradation of the environment through staining of beach sand and water, and the presence of the pipeline across the Inlet;
- . threat to marine and estuarine life, particularly crabs, fish and sea-grass, through seepage or accidental release of effluent (toxic effects are short-lived and localised to the immediate area of entry);

- . threat to coastal vegetation (in some cases, sulphuric acid fumes have caused burning of vegetation in the immediate vicinity of the lagoons);
- . continued expenditure by the State on effluent disposal, management and research;
- . doubts concerning the ability to successfully rehabilitate the coastal environment upon decommissioning of the lagoons;
- . perceived high levels of radioactivity in the effluent; and
- . erosion of the Peninsula through clearing or damage of vegetation, which adversely affects the already unstable nature of the dunes.

2.6 AIR POLLUTION PROBLEMS ASSOCIATED WITH THE EXISTING PLANT

Complaints by residents living near the plant have been made since the plant commenced operation in 1964. The complaints included choking gases that cause severe irritation of the eyes, nose, throat and skin, and severe corrosion damage to property and motor vehicles.

These complaints were considered to be justified by Clean Air officers investigating and monitoring the plant in the early 70s. Evidence of severe property damage by sulphuric acid mist was obtained by the identification of white deposits associated with corroded roofs and gutters as zinc and iron sulphates.

Table 2 summarises the calculated emissions of sulphur dioxide from the plant up until the conversion to natural gas in 1985.

TABLE 2 EMISSIONS OF SO₂ (kg/minute) FROM THE SULPHATE PLANT UNTIL 1983.

	1964	1968	1972	1976	1980	1983
Boilers	1.1	1.1	2.0	4.1	4.1	0.6
Sulphuric acid plant	1.2	1.2	4.0	4.1	4.5	4.0
Calciners	1.2	1.2	2.4	3.6	3.0	3.0
Sulphation unit	0.15	0.15	0.1	0.2	0.2	0.05
TOTAL	3.65	3.65	8.5	12.0	11.8	7.6

Source: EPA

The significant reduction in sulphur dioxide emissions from the boilers resulted from the conversion from heavy oil fuel to coal in 1981.

During the mid 1970s, when the sulphur dioxide emissions were probably near the maximum, the Public Health Department monitored SO₂ at two locations about 700-800 m from the plant, to the north and north-east.

The results of the monitoring are shown in Table 3.

TABLE 3 LONG-TERM SO₂ LEVELS EMITTED FROM THE SULPHATE PLANT (1974-1975)

SITE	SEVEN HIGHEST 24 HOUR VALUES FOR PERIOD IN µg/m ³							ANNUAL MEAN µg/m ³
Laura Ave	156	138	119	42	41	36	33	6
Cecil St	169	128	120	104	103	89	87	12

Source: EPA

The above results in Table 3 show that short-term (24 hours) SO₂ levels up to 169 µg/m³ have been experienced at Cecil Street, Australind.

The visible emissions from the plant in the 1970s originated from the sulphate plant, the calciners and the sulphuric acid plant. As the other units are proposed to be discontinued if the proposed chloride-process plant proceeds, the main concern centres around the sulphuric acid plant.

The sulphuric acid plant is a single contact plant capable of achieving approximately 98 per cent conversion efficiency. It is likely that emissions of sulphur dioxide from the 45 m stack exceed 200 kg/hour during operation. Under certain meteorological conditions it can be anticipated that sulphur dioxide ground level concentrations would become high enough to be unacceptable. As the plant continues to operate, the catalyst deteriorates. At a predetermined efficiency of conversion of sulphur dioxide to sulphur trioxide, usually determined on economic grounds, the plant is shut down and the catalyst replaced. Sulphur dioxide emissions are significantly greater by this stage.

Up until 1984, the discharge emissions from the acid plant fluctuated, and in the periods leading up to shut-downs for essential maintenance, the emissions were heavy and easily visible from a distance. Table 4 summarises the results of emissions testing of the acid plant.

TABLE 4 EMISSION TESTING OF THE SULPHURIC ACID PLANT (1981-1984)

	FEB 81	MAR 81	AUG 81	JUNE 82	NOV 82	AUG 83	NOV 83	FEB 84	JULY 84	NOV 84
Acid mist (g/m ³)	0.16	0.23	0.1	0.27	0.06	0.09	0.1	0.12	0.4	0.06
Sulphur dioxide (g/m ³)	10.7	7.2	7.2	7.0	4.5	9.1	15.8	6.7	11.5	11.50
Production (t/day)	250	220	220	235	270	300	285	270	280	250

Source: EPA

The emissions shown in Table 4 can be anticipated as the minimum achievable for the acid plant for the long-term future. These levels showed that emissions from the sulphuric acid plant were high enough to cause a significant impact.

A new converter was commissioned in the acid plant in July 1985. Tests of the acid plant with the new converter and new catalyst are shown in Table 5.

TABLE 5 PERFORMANCE OF THE SULPHURIC ACID PLANT DURING 1985

	SEPT 85	NOV 85	DEC 85
Acid mist (g/m ³)	0.07	0.08	0.06
Sulphur dioxide (g/m ³)	7.1	7.0	6.80
Production (t/per day)	-	305	310

Source: EPA

The National Health and Medical Research Council (NHMRC) Emission Limits (1972) state that the emission of sulphur dioxide from a new sulphuric acid plant should not exceed 3 g/m³. Theoretically, the best that the SCM acid plant could achieve is 5 g/m³, but testing as shown in Table 5 states that the emissions are about 7 g/m³ when most efficiently operated.

The Authority believes that this level of sulphur dioxide emission from the sulphuric acid plant is unacceptable and if the proposed chloride-process plant proceeds then a condition of consent should be that the sulphuric acid plant ceases operation at the Australind site.

RECOMMENDATION 3

The Environmental Protection Authority recommends that a condition of approval be that the existing sulphuric acid plant at the Australind site should not operate beyond 31 December 1989 (or at an extension of time determined under section 8 of the Pigment Factory (Australind) Agreement 1986).

The Authority notes that the age of the sulphate-process plant increases the propensity for the plant to have accidental emissions, resulting in excessive emissions of harmful and injurious gases and vapours until the end of 1989. The proponent needs to take this into account and manage the existing sulphate-process plant during this period so as to minimise air emissions from the site.

2.7 NOISE POLLUTION PROBLEMS ASSOCIATED WITH THE EXISTING PLANT

The EPA's Pollution Control Division has received complaints regarding the SCM plant for a number of years. Noise readings taken in 1984 are shown in Table 6. Table 6 shows that the local residents experience excess noise levels ranging from 11 to 17 dB(A) which was evidence of commission of a nuisance under Section 8(3)(b) of the Noise Abatement Act.

The ERMP states that the proposal involves the decommissioning of the existing sulphate-process plant which produced the excess noise being experienced by the local community.

However the Authority notes that the ERMP also states that "the proponent would explore productive ways of utilizing the redundant sulphate equipment" (ERMP p16). The Authority believes that it would be inappropriate at the Australind site, given the proximity of residential development and the likelihood of excess noise levels from the equipment currently installed in the plant. (The Authority would also not favour any refurbishing of the existing equipment on air pollution grounds.)

TABLE 6 NOISE LEVELS IN dB(A) (NIGHT TIME SITUATION) IN PROMINITY OF SCM PLANT (JULY, 1984)

NO	LOCATION	MEASURED NOISE LEVEL	ADJUSTED MEASURED NOISE LEVEL	EXCESS NOISE LEVEL
1.	Hawkins Court	41	46 (tonal)	11
2.	Mague Way	44*	49 (tonal)	14
3.	Eastwell Road	47	52 (tonal)	17
4.	Coast Road	42	47 (tonal)	12

* day time measurement assumed for night time.

Source: EPA

Note: assigned noise level (LA) = 35 dB(A) catag A2 (2200 - 0700).

RECOMMENDATION 4

The Environmental Protection Authority recommends that a condition of approval be that the existing sulphate-process plant, described as 'redundant' in the ERMP, should not operate beyond 31 December 1989 (or at an extension of time determined under Section 8 of the Pigment Factory (Australind) Agreement 1986).

The Authority would prefer that the redundant sulphate-process equipment (excluding the finishing plant) not be utilised for any purpose at the Australind site.

2.8 GROUNDWATER POLLUTION OF THE SITE

In 1984, it was found that the groundwater beneath the Australind plant site was contaminated. Exploratory drilling at the site by Groundwater Resource Consultants Pty Ltd (GRC) has shown that:

- . the groundwater contamination is mainly manifested as high sulphate and low pH;
- . the major sources of groundwater contamination are within the main process area near the northern perimeter fence where acid storages and effluent drains and ponds are sited. Minor sources of contamination have been identified at the waste dump, on the eastern margin of the site near the Collie River, and the sulphur stockpile near the central-southern boundary of the site;

- . an area of approximately 55 ha of the superficial aquifer shows some degree of groundwater contamination. Some 32 ha is moderately to strongly contaminated and will require remedial measures to reduce contamination levels. Of this 32 ha, 10 ha is north of the site perimeter and affects all domestic bores on the south side of Laura Avenue. A further 1 ha is outside the site perimeter, north of the waste dump, adjacent to the Collie River;
- . the total volume of moderately to strongly contaminated groundwater is about 560 000 kL, and is equivalent to 2 280 tonnes of 100 per cent sulphuric acid; and
- . the three specific areas of groundwater contamination have the characteristics shown in Table 7.

TABLE 7 GROUNDWATER CONTAMINATION OF THE AUSTRALIND SITE

	CONTAMINATED AREA SQ M	EFFLUENT VOLUME KL	MEAN SULPHATE CONCENTRATION	MEAN pH	100% SULPHURIC ACID EQUIVALENT TONNES
Process area	227 000	397 000	4 380	2.8	1 780
Waste dump	64 000	113 000	4 370	3.3	490
Sulphur stockpile	27 000	47 000	2 180	3.4	50

Source: (GRC 1985)

As a consequence of this groundwater contamination:

- . the Company was directed to extract the contaminated groundwater and proposes to do this over the next 10 years;
- . the Company proposes to recover the contaminated groundwater by a series of small capacity production bores located within the contamination plumes associated with the main process area and waste dump; and
- . the Company has replaced six domestic bores on the south side of Laura Avenue by deeper bores into the Leederville Formation aquifer.

2.9 COMPANY'S PERFORMANCE RECORD DURING RECENT YEARS

The EPA has received a large number of submissions from local residents regarding the poor performance record of the Company in maintaining the plant and preventing pollution incidents from occurring. The Authority notes the Company's recent environmental record listed below:

2.9.1 Air Emissions

- . In January 1983 a damper jammed on one of the boilers and residents of Australind up to a kilometre from the plant were showered with soot.
- . In February 1984 a fault developed with the caustic scrubbing system on the sulphate plant and the alarm did not operate. This resulted in excessive emissions of sulphur dioxide for a number of days.
- . Complaints of excessive emissions in July 1984 were received. A failure of the boiler system resulted in fan failure on sulphuric acid plant pollution control equipment.
- . During July 1985 there was a series of incidents associated with, and following the commissioning of the acid converter.
- . About midnight, Sunday 28 July 1985, the absorbing acid pump on the acid plant stopped with a power dip but the air blower and sulphur burner kept going, causing excessive pollution. The situation was recreated the following morning to determine the cause of the problem and another pollution incident resulted with an acid mist forming across the road and creating a possible traffic hazard. Within a few days the plant was shut down after several leaks in the superheater were found.
- . Although the equipment around the plant has audio-visual alarms, the local community express little confidence in the management of the Company to respond to breakdowns and accidents in a reasonable time. In the interests of ensuring public confidence, the Director of the Department of Conservation and Environment wrote to the Company in September 1985 requesting them to install continuously operating chart recorders on current and voltage measuring equipment to all precipitations. These charts were to be available for inspection by Departmental officers whenever necessary.
- . In December 1985 it was discovered that the scrubbing system to the sulphate plant did not have a stand-by pump. A stand-by pump was immediately requested, and its purchase immediately authorised by the Company.
- . Complaints from nearby residents over Christmas 1985 resulted from the failure of the high tension feed cable to one of the precipitators on No 3 calciner. A replacement cable took several weeks to obtain and refit.

- . In early February 1987, when the distributor plates in one of the precipitators collapsed, the recording equipment to that precipitator had an intermittent fault. This resulted in an approximately 1 km long visible plume from the stack. However, this excessive emission went unnoticed by the Company for several days. The Authority received a number of complaints on this incident of acid fumes.

2.9.2 Noise

The Authority has received a number of complaints regarding excess noise from the plant. This has been discussed in Section 2.7 of this Assessment Report.

2.9.3 Groundwater Contamination

The Company's record of groundwater contamination is discussed in Section 2.8 of this Assessment Report.

2.9.4 Incidence of Pipe Breakages into the Inlet

During the last two years there have been approximately a twenty failures resulting in spillages into the Inlet. However, this is the responsibility of the State at present.

3. ASSESSMENT OF THE PROPONENT'S PREFERRED SITE AT AUSTRALIND

This Chapter presents the assessment of the proponent's preferred site at Australind. The description of the proposal is presented in Chapter 4.

3.1 RATIONALE FOR THE PREFERRED SITE AT AUSTRALIND PRESENTED BY THE PROPONENT

The proponent has presented the following reasons why Australind is the Company's preferred site for locating the proposed chloride-process plant:

- . The Australind site is the Company's regional headquarters and contains infrastructure and personnel required to operate and maintain the pigment plant and the distribution facilities for the finished product.
- . The Company would still need to use the current finishing plant at the site as "duplication of this section would require an approximate doubling of the capital expenditure required to establish the chloride-process" (ERMP p20).
- . The Australind site satisfies the following criteria:
 - proximity to supply of raw material;
 - proximity to the finishing plant;
 - proximity to workforce and industrial infrastructure;
 - minimisation of development costs;
 - ease of wastewater disposal; and
 - availability of land of appropriate size and zoning.
- . The locations investigated for alternative sites for the proposed plant were Picton, Dardanup and Capel. Of these Capel was considered a possibility. However, the extra cost of locating the chloride-process plant at Capel would be \$15.6 million rather than \$14 million mentioned in ERMP (DRD correspondence to EPA, 13 February 1987). The total cost of relocation of the whole complex from Australind to Capel, ie: total decommissioning and removal of all facilities at the Australind site and construction of these facilities at an alternative site (say Capel) would increase the cost of the \$70 million project by an extra \$100 million.
- . The abovementioned extra costs of partial relocation (\$15.6 million) and total relocation (\$100 million) are unacceptable to the Company. If the proposed chloride-process project is rejected then the Company would continue with the existing sulphate-process plant at least until year 2011.

- . The alternative sites (see Figure 1), however, including Capel, have two major disadvantages. These are:
 - lack of suitable means of disposing of wastewater without the need to install long pipelines to suitable disposal points; and
 - additional costs and technical problems in transporting the base pigment in slurry form to the finishing section at Australind.
- . The proponent believes that the environmental and risk impacts from the proposed plant at Australind site can be managed so as to comply with all environmental requirements of the EPA. Given this fact, the proponent argues that the proposed plant's preferred site should be at Australind.

3.2 EPA ASSESSMENT STRATEGY

The Authority, in undertaking its assessment of proposals, such as this, examines the following three matters:

- . Whether the proponent's preferred site is the most appropriate of the alternative sites available/investigated. On this matter the Authority issues guidelines for ERMPs/PERS directing the proponent to establish site selection criteria and identify a number of regional and local sites, and encourages the developer to choose the appropriate site through a process of elimination.
- . After the proponent has presented the preferred site, the Authority investigates to determine critical or major environmental constraints which would make the proposed development environmentally unacceptable or unfeasible on the proponent's chosen site. If this is the case, the Authority may either reject the proposal or direct the proponent to investigate an alternative site through a further review of the site selection process.
- . If the proposed site for development is found to be acceptable, the Authority then identifies and examines any impacts that the proposal might have on the surrounding land and land uses, as well as wider impacts due to transportation, etc. The extent of these impacts is investigated and the proponent's calculations/studies normally verified by the Authority. These environmental impacts are then reviewed against any existing or proposed criteria, standards or guidelines. The assessment of the acceptability or otherwise of the proposal then depends upon whether the proposal as put forward by the proponent does, or can be made through EPA modifications and/or recommendations/conditions to comply with these criteria, standards or guidelines.

3.3 EPA ASSESSMENT OF PROPONENT'S PREFERRED SITE

In its assessment of the proposed chloride-process titanium dioxide plant at the proponent's preferred site (on the Company's existing facility) at Australind, the EPA makes the following comments:

- . The Authority has reviewed the regional site selection process presented in the ERMP and finds this process to be adequate and acceptable;
- . As stated earlier, the Authority would prefer the proposed plant to be relocated at an alternative site. However, if this were to happen, then the new proposal at an alternative site would require further environmental assessment.
- . The Authority has requested the Department of Resources Development (DRD) to examine and verify the \$15.7 million extra cost for partial relocation calculated by the Company. The DRD has informed the EPA that "the Department has investigated the Company estimate ... and considers it to be of the correct order of magnitude" (DRD correspondence to EPA, 13 February 1987).
- . The EPA's assessment on the suitability of the proponent's preferred site is based on the following:
 - one of the key issues associated with this project concerns risk and hazards. The proponent had commissioned a preliminary risk analysis study by the UK based consultants Cremer & Warner Ltd and presented this study (ERMP Volume 2) as part of the public review documents for the proposal. The Authority has examined in detail the risk results generated by the proposed plant, and finds that these risk levels, shown in Figure 8, comply with the EPA guidelines on risk and hazards as set out in the document "Evaluation of Risks and Hazards of Industrial Development on Residential Areas in Western Australia" (EPA November 1986) and can be made, through conditions, to be so small as to be acceptable to the Authority;
 - another key issue concerning this project involves wastewater disposal. The Company commissioned an appraisal study of proposed discharge of the plant's treated wastewater into the Collie River by the consultant Dr John Hunter from the Centre for Marine Science and Technology, Curtin University. The Authority has examined this study and finds its findings to be acceptable. The Authority believes that with appropriate conditions, wastewater discharge from the plant can be managed in an environmentally acceptable manner (see Section 7.4 for details).

- . The Authority's investigations have not identified any critical or major environmental constraints which would make the proposal environmentally unacceptable or unfeasible on the proponent's preferred site.
- . In conclusion, the EPA has undertaken extensive investigations and has sought independent advice in undertaking its assessment of this proposal. The Authority has concluded that if a chloride-process plant is designed, commissioned and managed properly, then there are no environmental (including risk) reasons or constraints why such a plant cannot be located at Australind.
- . Given the above, the Authority finds the proponent's preferred site at Australind acceptable to locate a chloride-process titanium dioxide plant.

The Authority's assessment of the risk and environmental impacts of the proposed plant at the Australind site are discussed in Chapter 7 of this Assessment Report.

4. DESCRIPTION OF THE PROPOSAL

4.1 THE PROPOSAL AS PUT FORWARD BY THE PROPONENT

The proposal as put forward by the proponent in the ERMP consists of the following:

- . construction of a 51 000 tpa titanium dioxide manufacturing plant based upon the chloride-process;
- . construction of a 12 000 tpa chlor-alkali plant with 50 tonne refrigerated chlorine storage in 3 x 25 tonne tanks (one tank is on standby);
- . construction of an air separation plant to supply 42 000 tpa of oxygen and 60 000 tpa of nitrogen;
- . continued use of the existing finishing plant;
- . decommissioning of the existing sulphate-process plant which would be investigated for alternative process use in the future;
- . continuation of the existing sulphuric acid plant;
- . disposal of 4 500 kL/day of treated wastewater by discharge into the Collie River;
- . disposal of 300 kL/day of untreated wastewater by ground infiltration at the plant site;
- . disposal of 60 t/day of neutral solid waste by burial offsite; and
- . disposal of a small quantity of mildly radioactive waste by burial offsite at Capel.

The proposal's major inputs and outputs are shown in Table 8.

The proponent has argued (ERMP pp15-17) that the proposal would have benefits to the following:

- . the local community;
- . the proponent;
- . the State; and
- . the Australian economy.

TABLE 8 MAJOR INPUTS AND OUTPUTS OF THE PROPOSAL (IN TONNES PER YEAR)

MAJOR INPUTS		MAJOR OUTPUTS	
Titanium-rich feedstock	55 000	Titanium dioxide pigment	51 000
Process water	1 095 000	Caustic soda (30%)	42 000
Salt (NaCl)	20 000	Solid wastes	20 000
Oxygen	42 000	Wastewater*	1 752 000
Carbon	12 000	Gaseous wastes:	
Nitrogen	60 000	. carbon monoxide and dioxide	34 000
		. nitrogen	60 000
		. hydrogen	300

*Includes 657 000 tonnes per annum from the contaminant recovery programme (Section 6.7).

Source: ERMP

An artist's impression of the proposed plant is shown in Figure 2.

4.2 THE PROPOSAL AS MODIFIED BY THE EIA PROCESS

During the environmental impact assessment process, the proponent modified the proposal at the request of a number of government agencies to include the following:

- . no discharge of untreated wastewater by groundwater infiltration;
- . all wastewater to be further treated to prevent any discharge of heavy metal or radioactive nuclei into the receiving waters. The proponent has undertaken to do this by increasing the pH of the wastewater which would cause these constituents to settle in the clarifier (see Figure 3); and
- . further commitments to chlorine storage safeguards. These are discussed in Section 7.3.6.7 of this Assessment Report.

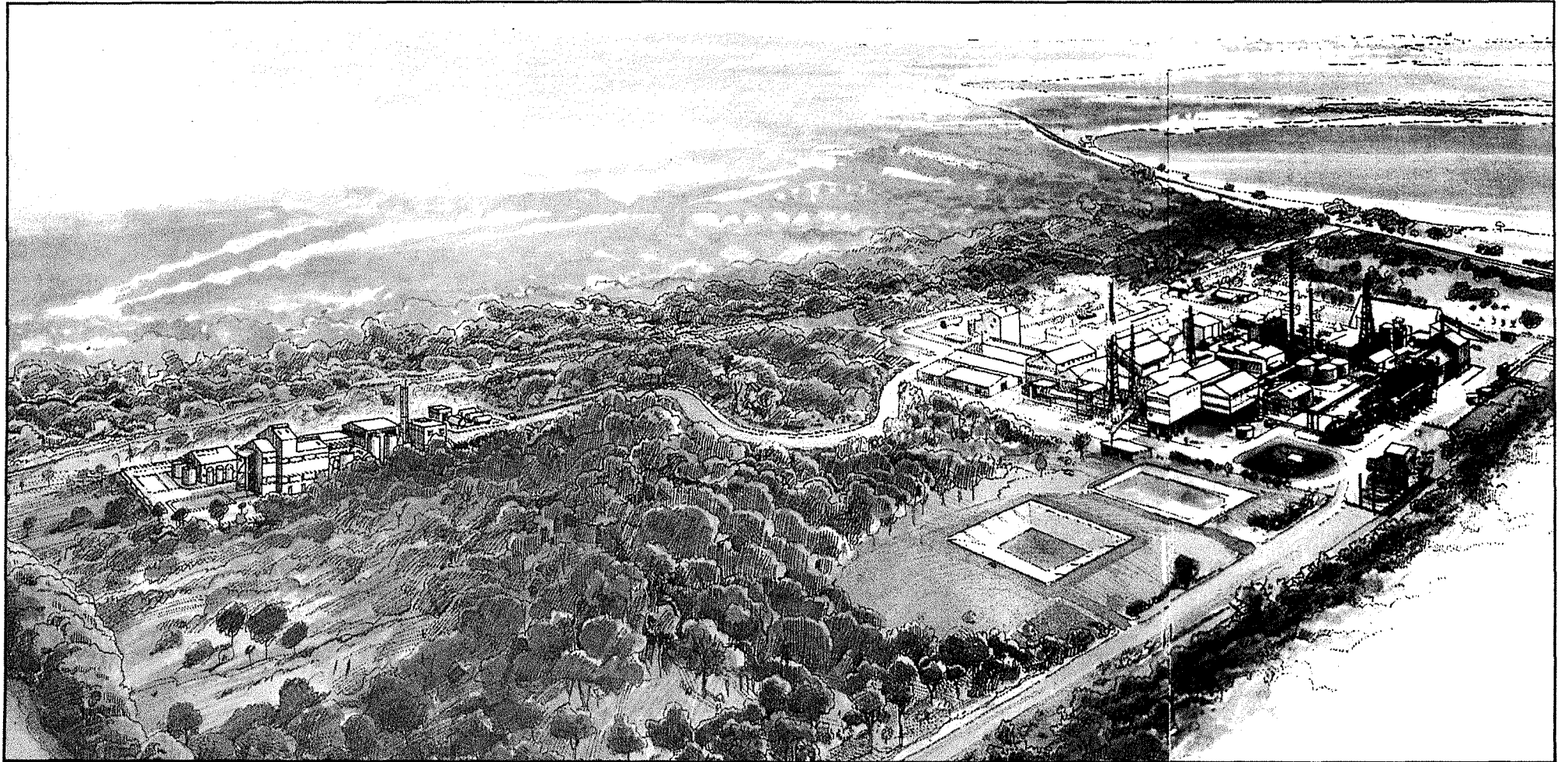


Figure 2. An Artist's Impression of the Proposed Plant

Source: SCM Chemicals Ltd.

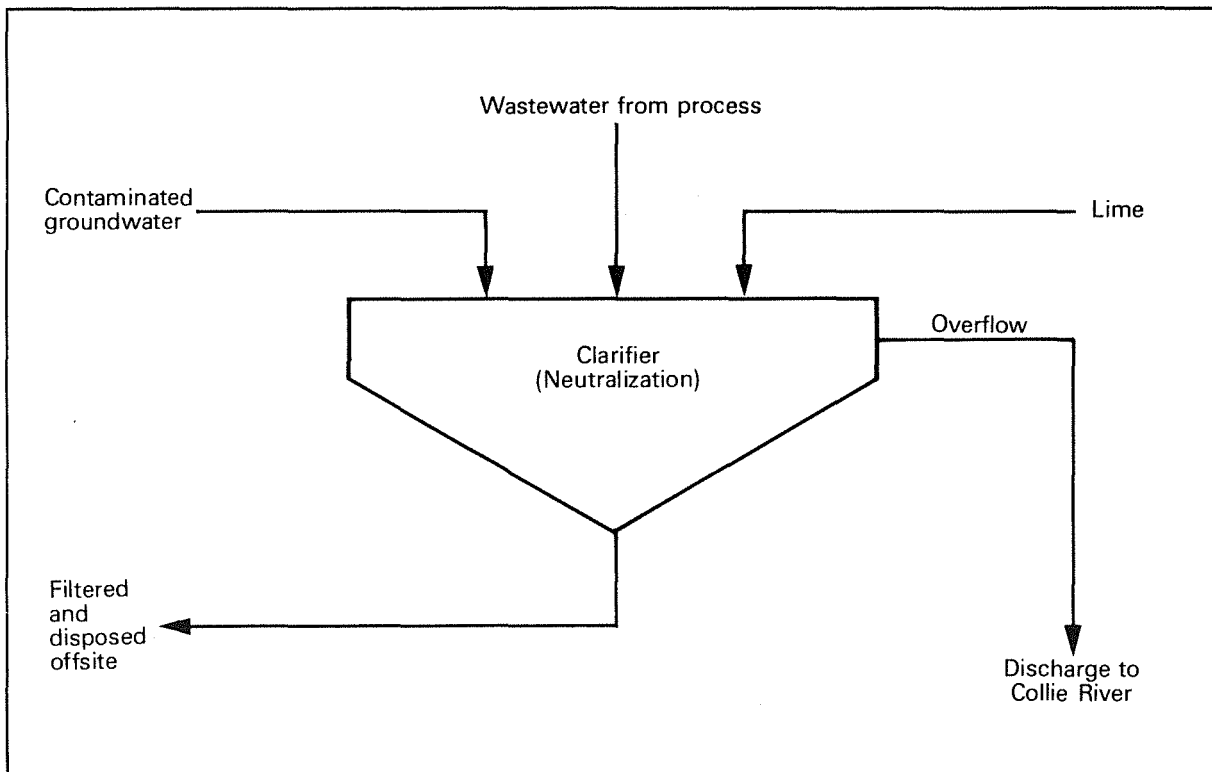


Figure 3. Modified wastewater disposal system.

4.3 THE PROCESS

4.3.1 The Chloride-Process

The chloride-process for producing titanium dioxide pigment (see Figure 4) consists of the following stages:

- . Chlorination: titanium-rich feedstock is reacted with chlorine to produce titanium tetrachloride;
- . Purification: impurities are separated from the titanium tetrachloride;
- . Oxidation: titanium tetrachloride is reacted with oxygen to produce titanium dioxide; and
- . Pigment separation: produces solid pigment through filtration.

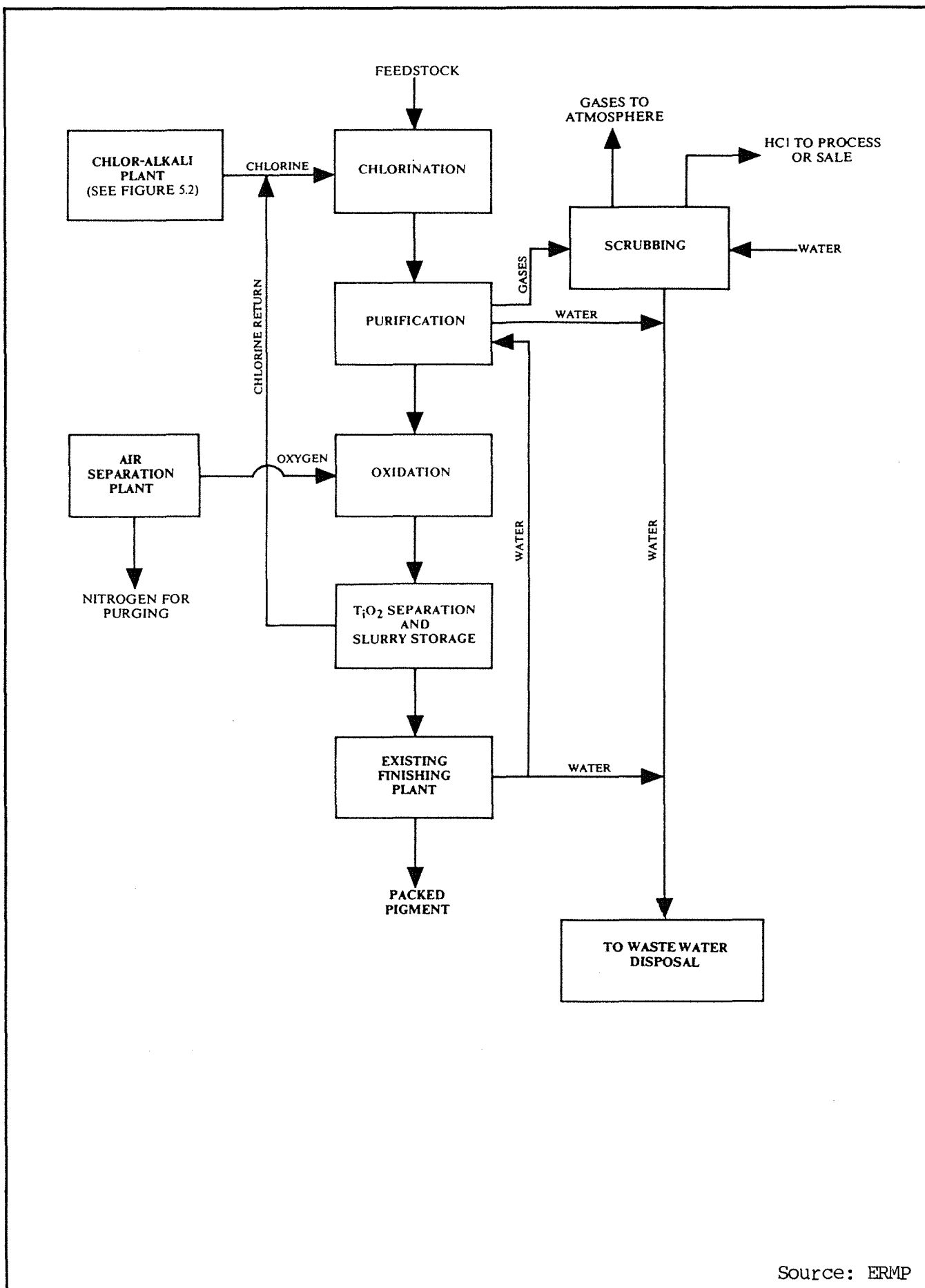


Figure 4 Chloride process and ancillary support processes

4.3.2 The Chlor-alkali Plant Process

Chlorine is produced through membrane technology which separates the chlorine and sodium chloride solution (anolyte) from hydrogen and caustic soda (catholyte) through electrolysis (see Figure 5).

The hot chlorine gas from the membrane cells is cooled then dried with concentrated sulphuric acid. The dry chlorine is compressed and condensed in a liquefaction unit, with the liquid chlorine flowing by gravity, at a temperature of about -34°C , to either chlorine storage tanks or for use in process.

The ERMP states that a total storage capacity of 50 tonnes is required as intermediate storage between the two processing plants. The storage system proposed comprises two refrigerated tanks, each of 25 tonnes capacity, and a further refrigerated tank of 25 tonnes capacity, which acts as a standby and emergency receiving tank. The ERMP states that these would be maintained at -34°C and atmospheric pressure.

The sodium hypochlorite production unit could, in an emergency, absorb the full quantity of chlorine in the cell room for a period of up to 15 minutes. The ERMP states that this is adequate to diagnose and rectify any abnormal condition, or to shut down the cells, while keeping a sufficient margin available for safety.

4.3.3 Air Separation Plant Process

The ERMP states that the air separation process involves the extraction and separation of specific gases from the atmosphere. Repeated compression and expansion allow the controlled refrigeration of the air stream to temperatures sufficiently low that the oxygen and nitrogen would be successively liquefied and removed for storage. Remaining unwanted gases would be returned to the atmosphere.

4.4 WASTE PRODUCTS AND DISPOSAL

The ERMP states the following waste products would be discharged.

4.4.1 Air Emissions

The following gas would be discharged from the plant under normal operations:

- . carbon monoxide and carbon dioxide: 34 000 tpa from the purification section;
- . 1-5 parts per million of chlorine from the discharge of the chlor-alkali scrubber system; and
- . atmospheric gas emissions from the air separation plant.

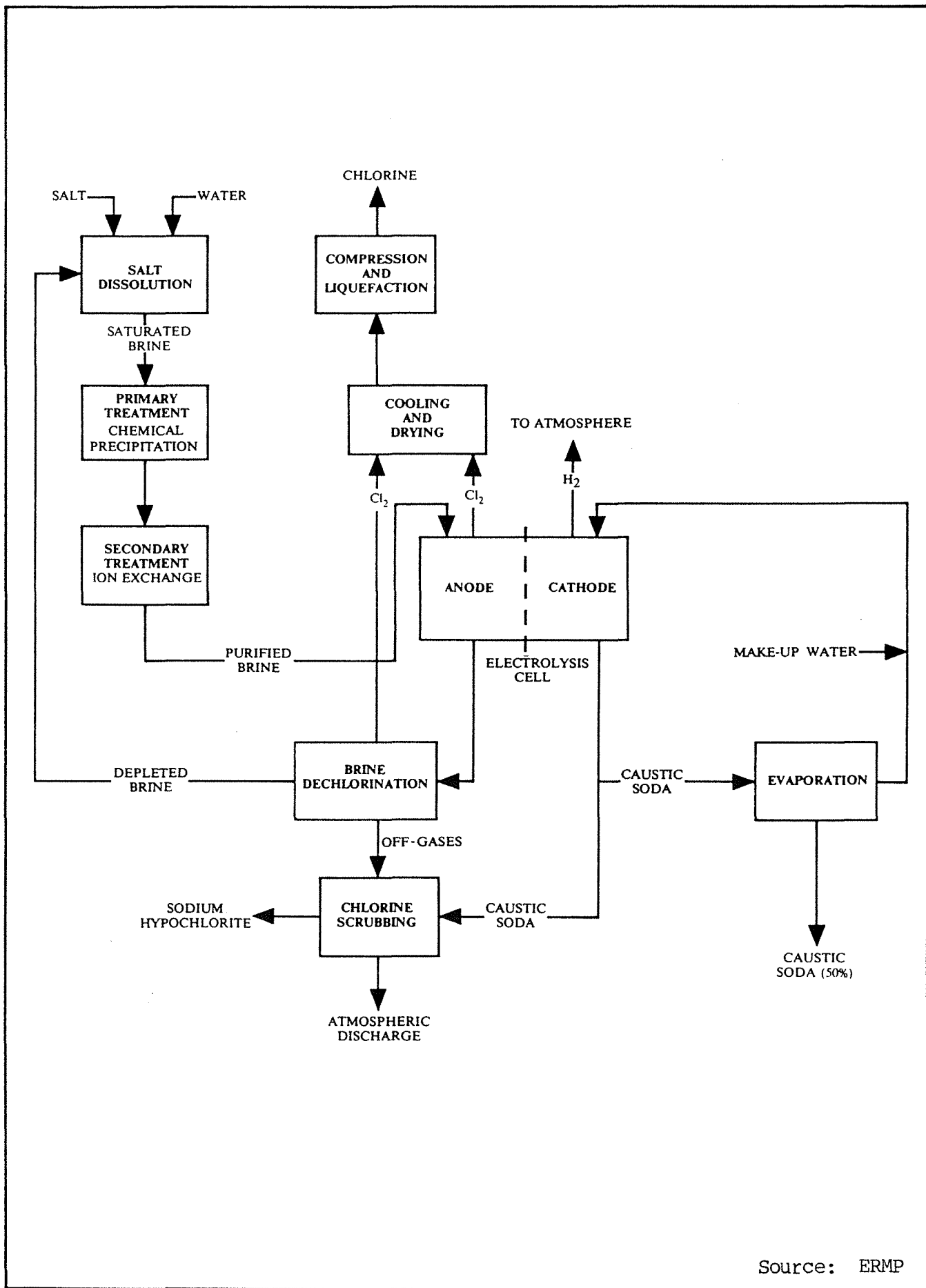


Figure 5 Chlor-Alkali plant process.

4.4.2 Wastewater Products and Disposal

4.4.2.1 Wastewater Products

The ERMP (p36) states that liquid wastes produced by the plant would be:

- . 2 520 kL of process water/day from the processing plant of the titanium dioxide pigment plant, which would contain chlorides of iron, manganese and vanadium, unreacted ore, unreacted coke and sodium salts;
- . 2 220 kL/day of groundwater from the contaminant recovery programme and various blow-down and cooling waters;
- . 60 kL/day of acidic and alkaline liquors produced during the regeneration of ion exchange columns in the brine purification section of the chlor-alkali plant; and
- . sulphuric acid, which would be bled from the chlorine drying tower and re-used.

4.4.2.2 Wastewater Treatment and Disposal System

The modified wastewater treatment system is shown schematically in Figure 3. This consists of collection, lime-dosing for precipitation, and neutralisation through clarification.

Initially the clarifier was to produce two wastewater streams, one (4 500 kL/day) discharging into the Collie River and the other (300 kL/day) disposed through ground infiltration. However, this was modified during the EIA process.

The temperature of the wastewater stream would be up to 35°C. The composition of the overflow would now be significantly improved (in terms of heavy metals and suspended solids) to that shown in Table 5.2 of the ERMP, and reproduced as Table 9 below.

The clarifier overflow is proposed to be discharged by gravity pipeline into the Collie River. The outfall would consist of a 200 mm nominal diameter discharge pipe located at an elevation of 0.44 m below Australian Height Datum (AHD).

4.4.3 Solid Wastes

The modified proposal would now produce the following solid wastes:

- . 60 tonne/day of filtered sludge from the underflow of the clarifier;
- . a small quantity of mildly radioactive waste; and
- . domestic solid waste from the plant.

The ERMP does not provide the details of how and where the solid waste from the plant would be disposed.

TABLE 9 COMPOSITION OF CLARIFIER OVERFLOW

ION		CONCENTRATION (parts per million)
Chloride	(Cl ⁻)	5 791
Sodium	(Na ⁺)	2 405
Calcium	(Ca ⁺⁺)	2 570
Sulphate	(SO ₄ ⁻)	1 760
Magnesium	(Mg ⁺⁺)	190
Manganese	(Mn ⁺⁺)	84
Aluminium	(Al ⁺⁺⁺)	10
Chromium	(Cr ⁺⁺⁺)	0.5
Iron	(Fe ⁺⁺⁺)	0.5

Source: ERMP

4.4.4 Noise Emissions

The ERMP (p39) states that the proponent would restrict the maximum noise level from any item of equipment in the plant to 85 decibels (A-weighted) at a distance of one metre.

The major noise sources estimated for the chlor-alkali plant presented in the ERMP are as shown in Table 10.

4.5 OTHER RELEVANT INFORMATION ON THE PROPOSAL

The plant would employ a permanent workforce of approximately 292 persons. The plant would be operated on a continuous basis.

If approval is given then the plant would be constructed in approximately two years and would be commissioned in late 1988.

If the proposal proceeds then the State has given approval for the Company to operate concurrently the existing sulphate-process plant and the proposed chloride-process plant until 31 December 1989 or at an extension of time determined under Section 8 of the Pigment Factory (Australind) Agreement 1986. This would mean that the pumping of sulphate effluent on the Peninsula could be terminated at the end of the concurrent period.

TABLE 10 ESTIMATED MAJOR NOISE SOURCES WITHIN THE CHLOR-ALKALI PLANT

SOURCE	NOISE LEVEL (decibels [A-weighted] at 1 metre)
Chlorine compressor	80-85
Instrument air compressors	83 (two)
Refrigerator compressor	80-85
Transformer rectifier	Less than 75
Evaporator ejector	85

Source: ERMP

5. DESCRIPTION OF THE EXISTING ENVIRONMENT

A detailed description of the environment as it pertains to the proposal is presented in the ERMP (pp43-64). This Chapter summarises the relevant information applicable to the assessment of the project.

5.1 SITE LOCATION

The proposed location of the plant is at Australind (see Figure 1). The site is approximately 5 km north-east of Bunbury and 160 km south of Perth.

5.2 LOCAL LAND USES

Generalised zoning in the proximity of the site is shown in Figure 6. Neighbouring land uses to the proposed plant site are shown in Figure 7. The site is bordered to the south by a golf course which stretches from the Leschenault Inlet to the Collie River, and to the north by uncleared bushland.

The land on the eastern side of the Collie River from the site is cleared grazing land.

5.3 LOCAL POPULATION

The nearest population centres to the proposed plant site are Australind to the north and Clifton Park and Eaton on the south. The nearest residence in Australind is approximately 625 metres north-west of the proposed plant.

The nearest eastern residence is a farmhouse approximately 500 metres east-south-east of the proposed plant.

On the south the nearest residential development is approximately 650 metres at Clifton Park.

There are approximately 3 900 people living within 3.5 km to the north of the proposed site and approximately 5 300 people living within 3.5 km to the south and south-west of the site. (Source ERMP Volume 2)

5.4 METEOROLOGY

The Cremer & Warner Report (ERMP Volume 2) states that data used in the risk analysis was from the Glen Iris meteorological monitoring station. This data was then modified to take into account the low level wind conditions relevant to the analysis.

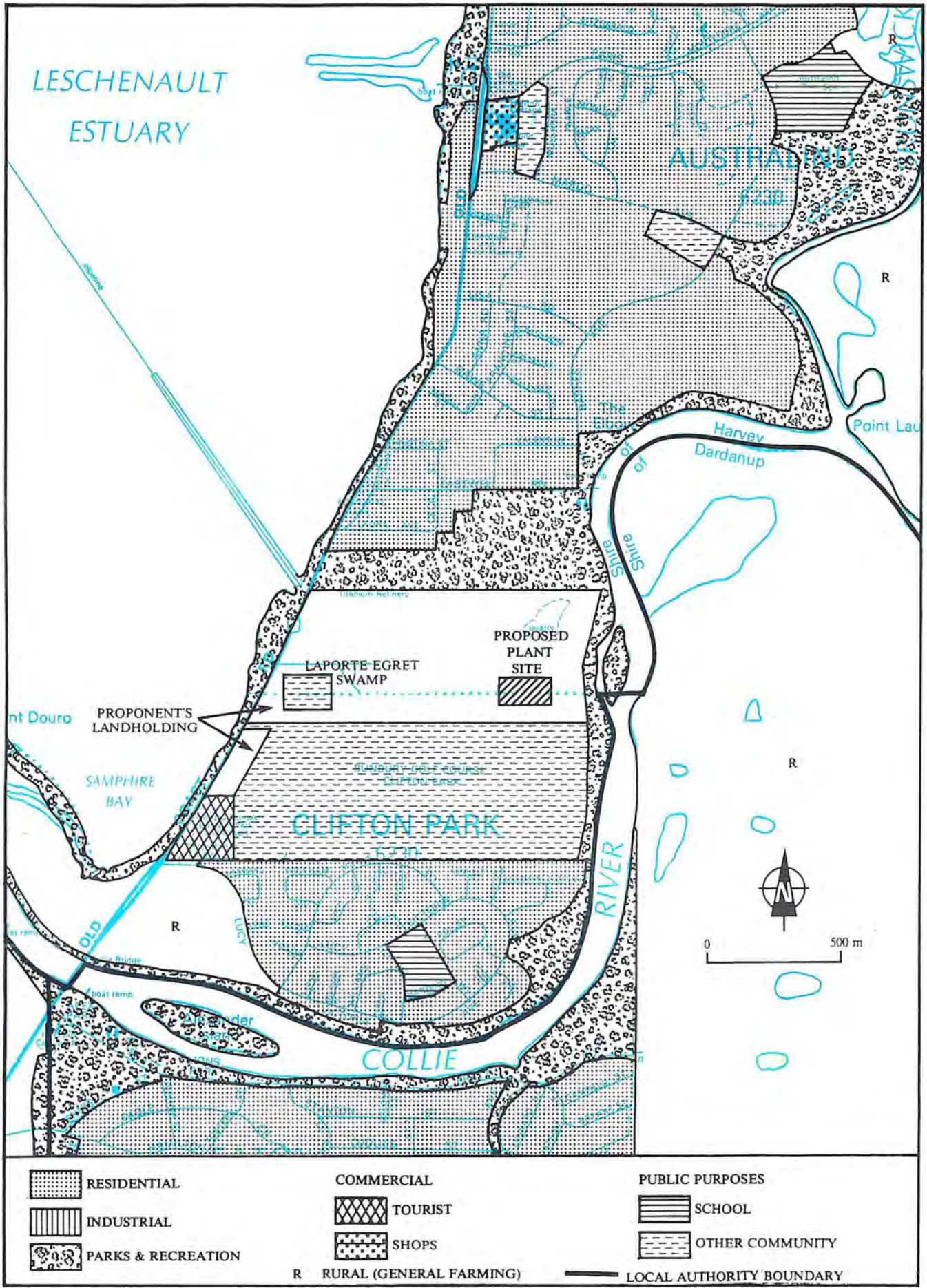


Figure 6 Generalized zoning.

Source: ERMP

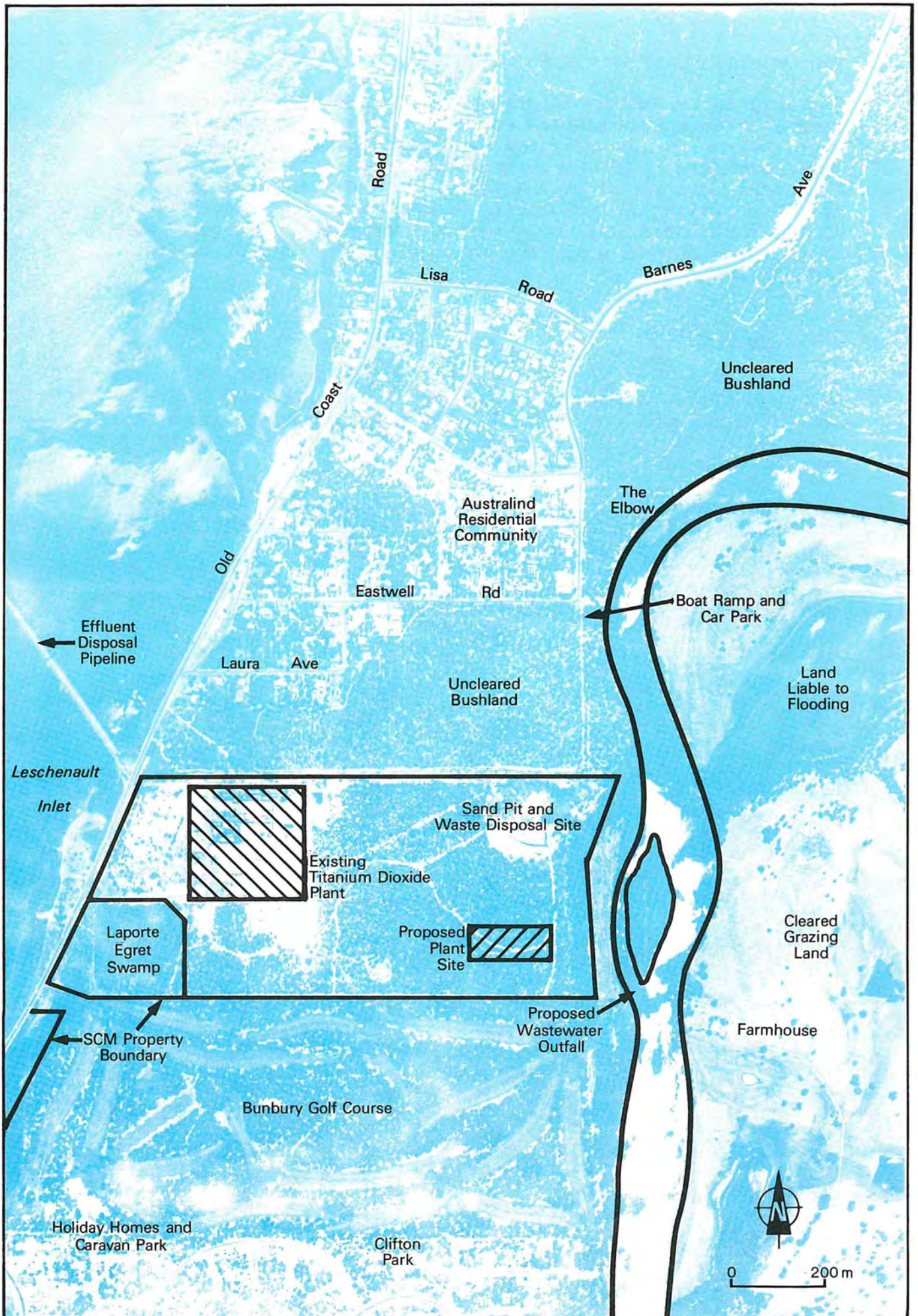


Figure 7 Neighbouring land uses

Source: ERMP

This meteorological data shows that:

"The area around Bunbury is strongly influenced by the diurnal land breeze/sea breeze phenomenon, especially during the summer months. This pattern is characterised by light night-time and morning south-easterlies (offshore breeze) changing to stronger onshore south-westerlies during the afternoon. In winter this phenomenon is much less influential and general weather conditions more directly dictate the climate, relatively stronger north-westerlies being more frequent and onshore winds varying more in direction of origin." (ERMP Volume 2 p3.3)

5.5 COLLIE RIVER

The Collie River in the vicinity of the proposed outfall is a salt wedge estuary having a high degree of vertical density stratification with sharp halocline separating the upper (fresh) and lower (salty) layer. There is also a strong tidal influence in the river at this point.

The water temperature of the river near the plant site varies between approximately 26°C during summer (low flow conditions) and 14°C in winter (high flow conditions).

The river contains a number of fish species and is used by some species as a nursery area during the summer months.

6. REVIEW OF SUBMISSIONS

The ERMP Stage 2 documents were released to the public and Government departments for comment on 24 November 1986 for a 10 week public review period, which ended on 30 January 1987.

A total of 51 submissions were received on the proposed chloride-process titanium dioxide plant at Australind; 11 from Government agencies and 40 public submissions. Three public submissions were accompanied by petitions containing a total of 1 128 signatures opposing the establishment of the new plant at Australind.

In addition, the EPA taped the proceedings of the public meeting of the 30th March and used the transcripts as oral submissions to further determine the concerns of the local residents.

All of the submissions have been analysed and the main issues summarised in Table 11. A detailed review of issues including a list of comments can be found in Appendix 3 of this Assessment Report, which also includes the list of people and Government departments making submissions.

The issues that received most frequent comment related to the following concerns:

6.1 RISK AND HAZARDS

- 6.1.1 Opposition to the proposal irrespective of risk involved (did not want the plant at Australind).
- 6.1.2 Disagree with risk analysis results including difference between CSBP's Kwinana and SCM's risk contours.
- 6.1.3 Record of Company, ie: lack of credibility due to past experience.
- 6.1.4 Disagreement with methodology and results of risk analysis, ie: no site visit by analyst, risk contours do not take account of topography, etc.
- 6.1.5 Emergency plan and services, eg: local roadwork may not accommodate evacuation, sirens, etc.
- 6.1.6 Plant safety, ie: possibility of human error or error due to intoxication, mismanagement, etc.

6.2 LIQUID WASTE DISCHARGE TO COLLIE RIVER

- 6.2.1 Opposed to discharge by infiltration.

TABLE 11 LIST OF ISSUES IDENTIFIED IN THE SUBMISSIONS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51					
1. <u>RISKS AND HAZARDS</u>																																																								
. <u>OPPOSITION</u>	*			*	*		*	*	*		*	*						*			*	*	*		*	*		*	*																	*	*		*	*						
. <u>RISK ANALYSIS FINDINGS</u>							*	*	*		*	*						*			*				*	*		*	*																											
. <u>RECORD OF COMPANY</u>			*			*	*	*						*					*				*		*	*		*	*																	*	*									
. <u>METHODOLOGY & RESULTS OF RISK ANALYSIS</u>						*	*	*					*			*			*			*	*		*	*		*	*																											
. <u>EMERGENCY PLANS & SERVICES</u>					*				*			*	*						*			*			*	*		*	*																											
. <u>PLANT SAFETY</u>				*			*				*	*							*			*			*	*		*	*								*	*		*	*		*	*		*	*		*	*						
2. <u>LIQUID WASTE DISCHARGE TO COLLIE RIVER</u>																																																								
. <u>DISCHARGE BY INFILTRATION</u>	*		*	*														*			*		*																	*	*		*	*		*	*		*	*						
. <u>DISCHARGE TO COLLIE RIVER</u>	*	*	*	*					*									*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
. <u>ALTERNATIVE EFFLUENT DISPOSAL</u>	*								*									*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
3. <u>AIR EMISSIONS</u>			*	*								*																																												
4. <u>RADIOLOGICAL ASPECTS</u>																			*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
. <u>FEEDSTOCK & PLANT WASTES</u>																		*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
. <u>RADIOACTIVITY IN THE PLANT</u>																		*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
5. <u>OCCUPATIONAL HEALTH & SAFETY ISSUES</u>																																																								
. <u>GENERAL</u>																																																								
. <u>WORKER SAFETY</u>																																																								
. <u>MEDICAL HEALTH OF EMPLOYEES</u>													*																																											
. <u>RISK ANALYSIS REPORT</u>																																																								
6. <u>SOLID WASTE DISPOSAL</u>																																																								
. <u>60 tonnes/day</u>			*																																																					
7. <u>SITE SELECTION</u>																																																								
. <u>PLANNING PHILOSOPHY</u>														*																																										
. <u>TOWN PLANNING (Zoning)</u>					*													*																																						
. <u>PROX OF SCHOOLS & CAMPSITE</u>	*							*	*	*								*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
. <u>SITE SELECTION</u>			*		*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
. <u>BUFFER ZONE</u>				*					*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
8. <u>OTHER</u>																																																								
. <u>ACID PLANT</u>		*																																																						
. <u>PLANT CAPACITY & SIZE</u>		*						*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
. <u>PROPERTY VALUES</u>		*		*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
. <u>MONITORING</u>		*		*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
. <u>ERMP</u>	*	*		*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
. <u>NOISE</u>							*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
. <u>IMPACT ON ADJACENT SITES</u>								*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
. <u>TOURISM & POPULATION GROWTH</u>		*		*				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
. <u>NO COMMENT</u>																																																								

Note: See Appendix 3 of this Assessment Report for details

6.2.2 Opposed to discharge of plant effluent into Collie River (concern about temperature, salinity, radioactivity and heavy metals).

6.2.3 Concern about treatment and discharge of contaminated groundwater.

6.3 AIR EMISSIONS

6.3.1 Concern about air emissions under normal conditions.

6.3.2 Concern about fugitive emissions and nuisance odours.

6.4 RADIOLOGICAL ASPECTS

6.4.1 Feedstock and plant waters.

6.4.2 Radioactivity in the plant.

6.4.3 Concern regarding discharge of radioactivity in the Collie River.

6.5 OCCUPATIONAL HEALTH AND SAFETY

6.5.1 Concern about worker safety.

6.5.2 Medical health of employee.

6.5.3 Risk analysis report does not discuss worker safety.

6.6 SOLID WASTE DISPOSAL

6.6.1 Solid waste disposal site for 60 tonne per day of waste not adequately discussed.

6.6.2 Disposal methodology, safeguards and potential impacts.

6.6.3 Disposal of mildly radioactive solid waste.

6.7 SITE SELECTION AND PLANNING IMPLICATIONS

6.7.1 Question of planning philosophy, ie: incompatibility with Draft Bunbury Regional Plan: 2 km buffer zone for plants having over one tonne storage of chlorine.

6.7.2 Town planning zoning, ie: incompatible with Draft Bunbury Regional Plan regarding focus of residential development.

- 6.7.3 Proximity of schools and campsite.
- 6.7.4 Proponent's site selection inappropriate. Alternative site should have been chosen.
- 6.7.5 Inadequacy of 600 metre buffer zone at Australind site.

6.8 OTHER ISSUES

- 6.8.1 Acid plant, concern that the acid plant would continue.
- 6.8.2 Property values declining.
- 6.8.3 Monitoring proposed in ERMP inadequate, more monitoring needed.
- 6.8.4 ERMP documentation inadequate.
- 6.8.5 Noise, concern to golf club and residents of adjacent areas.
- 6.8.6 Visual impact on adjacent sites and surrounding area.
- 6.8.7 Concern that proposal will restrict tourism and population growth in Australind area.

7. ASSESSMENT OF ENVIRONMENTAL IMPACTS

7.1 INTRODUCTION

In Section 3.2 the EPA's three stage environmental assessment strategy was discussed. In Section 3.3 the Authority concluded that the Australind site is an acceptable site to locate a chloride-process plant. This assessment is based on the following:

- . one of the key issues associated with this project concerns risk and hazards. The Authority examined the risk levels generated by the proposed plant and finds that these levels can be made, through conditions, to be so small as to be acceptable to the Authority.
- . The other key issue concerning this project involves wastewater disposal. The Authority believes that with appropriate conditions, wastewater discharge from the plant can be managed.
- . Section 3.3 stated that the Authority's investigations have not identified any major environmental constraints which could prevent the proposal proceeding.

Given the above, the Authority believes that a properly managed chloride-process titanium dioxide plant would be acceptable at the Australind site.

However, the development of a chloride-process plant at the Australind site will generate environmental impacts which include:

- . construction phase impacts;
- . impacts of risk and hazards;
- . other environmental impacts due to the emissions of wastes; and
- . occupational health, amenity and social impacts.

The Company, having been made cognisant of the EPA's (and the community's) need to have in place the highest levels of management controls and safeguards and to generate a minimum impact in the Australind area, has made a number of commitments to ensure that these objectives would be met (see Appendix 4 of this Assessment Report for a list of the proponent's management commitments). Under the Environmental Protection Act (1986), these will become part of legally binding consent conditions if the proposal proceeds.

The environmental impacts of the concurrent operation period is discussed in Chapter 8 of this Assessment Report.

7.2 CONSTRUCTION STAGE IMPACTS

The construction of the project, over an approximately two year period, would have the following impacts:

- . the generation of dust;
- . discharge of contaminated stormwater (especially grease and oils from construction equipment);
- . noise; and
- . may have impacts due to the loss of vegetation caused by excessive site clearance.

The Authority believes that the proponent needs to liaise closely with the relevant control agencies, including the Harvey Shire Council and the Leschenault Inlet Management Authority (LIMA), during the construction phase to ensure that no issues arise during that period which could adversely affect the environment or inconvenience the local population. In particular the proponent needs to ensure that:

- . stormwater runoff is properly filtered for grease and oil before discharge to the Collie River;
- . dust generation will be suppressed by sprinkler water practices;
- . noise generated during construction will not exceed those levels deemed acceptable by the Environmental Protection Act (1986);
- . traffic generation is kept to a minimum;
- . site clearance is kept to the minimum; and
- . appropriate landscaping and tree planting is undertaken at an early stage to minimise visual impact of the plant. This tree planting could also help to act as a noise barrier in the future.

7.3 RISK AND HAZARD IMPACTS

7.3.1 Introduction

The manufacture of titanium dioxide generates risk and hazards. The major hazard identified for the proposal relates to the loss of containment of toxic gases, namely chlorine and titanium tetrachloride.

The Authority has discussed its position on the issues of risk and hazards from industrial projects previously (see DCE Bulletin 257; and EPA Risk and Hazard Statement of 14 November 1986).

The Authority believes that the quantitative assessment of risks to the community is an important part of the environmental evaluation of such proposals. Historical records show that industrial accidents occur, and that technical safeguards have their limitations. However, with proper planning, review and controls during the plant design, commissioning and operational stages, these risks and hazards can, in most cases, be minimised, managed and made acceptable in the sense that they can be reduced to a level that the community is prepared to tolerate.

The term 'hazard' is used to describe a set of conditions that could lead to a harmful accident. 'Risk' is defined in terms of both the likelihood of a hazard, and the consequences of that hazard, ie: "the probability that a hazard, in terms of a specific level of loss or injury to people or property, will occur in a specific period of time" (Pomeroy 1982).

Risk assessment methodology consists of the following elements:

- . HAZARD IDENTIFICATION OR DEFINITION: ie: identification of potential hazards of hazard events;
- . RISK ESTIMATION: ie: determination of the likely severity of consequences of the event and its products with the likely frequency of the event; and
- . EVALUATION OF RISK AND HAZARDS: ie: guidelines or standards of assessment and an evaluation of the risk.

There has been a quantitative assessment of risk of the proposed titanium dioxide plant's raw material inputs and processes, including chlorine process, operation and storage by Cremer & Warner Ltd (ERMP Volume 2). The Authority has been advised by Cremer & Warner Ltd that the Company had undertaken its analysis impartially and completed its assessment independently (see Appendix 5). The Authority has reviewed the Cremer & Warner document and on the basis of that Company's credentials and after seeking further independent expert advice from the NSW Department of Environment and Planning, accepts the preliminary analysis as an acceptable and appropriate assessment of the risks and hazards associated with the proposal on the proponent's preferred site.

7.3.2 Hazard Identification

The ERMP Volume 2 identifies the major hazards associated with chloride-process plant, including the associated chlor-alkali plant, to be those which arise if there were loss of containment of chlorine or titanium tetrachloride.

Chlorine is a yellow-greenish, non-flammable gas that is 2.5 times heavier than air and hence hugs the ground in the form of a dense vapour cloud if released. At atmospheric pressure, chlorine boils at -34°C and needs to be cooled at -35°C if storage at atmospheric pressure is desired.

The toxic effects of chlorine are summarised in Table 12.

TABLE 12 TOXIC EFFECTS OF CHLORINE

EFFECT	CONCENTRATION IN AIR (parts per million)	DURATION
Odour detectable by most people	1.0	Any
Threshold limit value*	1.0	8 hours
Negligible effects, mild irritation	3.0	Any
Strong irritation, serious distress	5-20	Any
Lethal	35-50	60-90 minutes
	40-60	30-69 minutes
	75	15 minutes
	1,000	A few breaths

* Threshold limit value is the average concentration to which nearly all workers might be repeatedly exposed for a normal eight-hour work day, every day, without adverse effect.

Source: ERMP

On the other hand, titanium tetrachloride is a liquid at atmospheric temperature and pressure. Once spilled, in moist air, titanium tetrachloride would hydrolyse rapidly forming a dense, yellow-white cloud containing amongst others, hydrochloric acid. Hydrochloric acid is toxic and irritant to the eyes and skin.

7.3.3 Risk Estimation

Risk estimation seeks to measure the likelihood of an event (of some stated magnitude) occurring and the likelihood and nature of the consequences that follow. In essence, risk estimation consists of multiplying the failure frequency by the severity, ie: calculation of consequences, of an event or incident. An event (or an unwanted event) is defined as an action or accident leading to fatalities.

7.3.3.1 Identification of Unwanted Events and Their Likelihood of Failure

The Cremer & Warner Report (ERMP Volume 2) identified a number of possible unwanted events through information and experience previously obtained from other studies, and from design data provided by SCM Chemicals Ltd for their plants at both Stallingborough, UK, and Baltimore, USA. These release events, their rates, and the frequency of their failure have been provided to the Authority. Failure frequencies of plant components are shown in Table 13.

The Cremer & Warner Report notes that probability factors are involved in the assessment of the final outcome of a release or event. These factors include:

- . wind direction and stability;
- . the duration of a release;
- . whether persons are indoor or outdoor; or
- . whether they can escape from a chlorine or titanium tetrachloride cloud.

7.3.3.2 Calculation of Severity of Consequences

The Cremer & Warner Report (ERMP Volume 2) discusses the methodology by which accident consequences analysis was undertaken. By using passive dispersion and dense vapour cloud models, downwind concentrations of the loss of containment of chlorine and titanium tetrachloride were calculated for various meteorological conditions.

The toxic gas concentrations were then converted into a toxic dose (based on the time an individual may be exposed) and this in turn was used to calculate the likelihood of an individual being killed at any point downwind. The data used in the study for individual fatalities due to chlorine were those of the Cremer & Warner toxic model.

A similar approach was undertaken by the consultants for the titanium tetrachloride case.

7.3.4 Risk Estimation Results

Using the abovementioned methodology, and taking into consideration the safeguards proposed by the proponent to prevent the likelihood of the occurrence of unwanted events leading to the loss of containment of toxic gases, the Cremer & Warner Report (ERMP Volume 2 pp6-5) calculates the risk levels that would be generated by the proposal for the Australind site. These risk levels for 100% outdoor are shown in Figure 8. The document concludes that:

TABLE 13 FAILURE FREQUENCIES OF PLANT COMPONENTS

a)	<u>Storage Vessel</u>	
	Catastrophic failure and instantaneous loss of contents	1 to 3 x 10 ⁻⁶ /yr
	Disruptive (partial) failure	10 - 30 x 10 ⁻⁶ /yr
b)	<u>Pipework and Valves</u>	
	Catastrophic failure (1 to 3") (depends on degree of support/protection)	0.3 to 1.0 x 10 ⁻⁶ /yr per metre per year
	Partial failure	1 to 10 times catastrophic failure rate depending on circumstances
c)	<u>Gaskets</u>	
	Typically	3 x 10 ⁻⁶ per gasket per year
d)	Failure of remote operated valve to close on demand	0.05/demand
e)	Failure of general instrument trip system	0.02/demand

Source: Cremer & Warner Report 86157

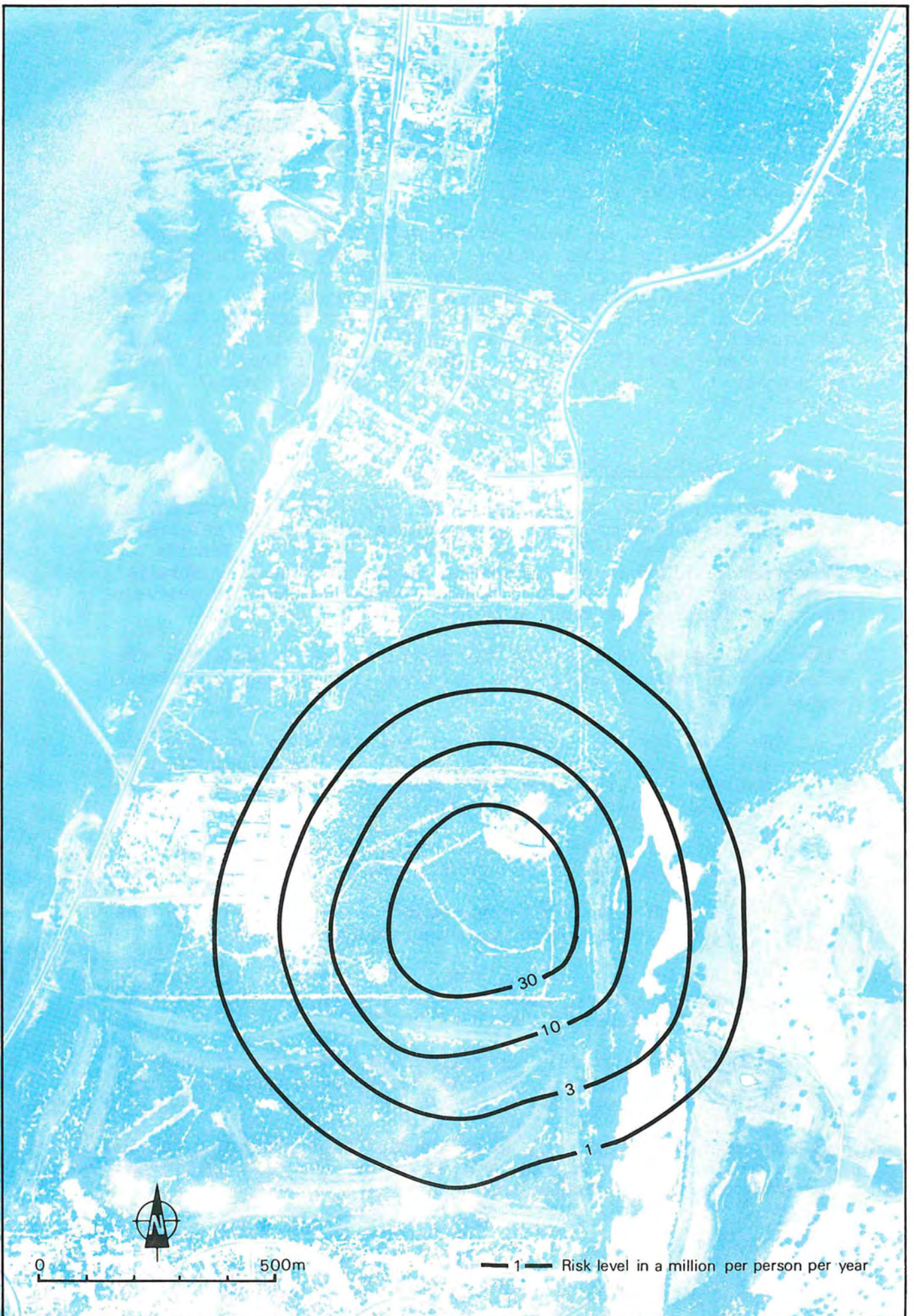


Figure 8 Resultant risk contour as presented in the ERMP

Source: ERMP

"the residential area at Australind is subject at the most affected point to a risk of fatality level of less than 1.5×10^{-6} (100% outdoor risk) per year. The 1×10^{-6} per year risk contour extends only 50 or 60 metres into the Australind residential area and so includes only one or two homes".? (ERMP Volume 2 p6-5)

The document further states that:

"The maximum risk at any point on the golf course is approximately 25×10^{-6} per year (100% outdoor risk) but only one fairway and hole is subject to a risk of over 10×10^{-6} per year. Therefore for an individual playing one round per day, every day of the week, his risk of fatality from playing at the most affected hole is approximately 0.2×10^{-6} per year and for the whole course would be less than 0.4×10^{-6} per year. The majority of the golf course is subject to a risk of less than 1×10^{-6} per year." (ERMP Volume 2 p6)

7.3.5 Evaluation of Risk and Hazards

Given that the EPA had a number of new industrial plants to evaluate, the Authority sought expert advice and recently released a set of guidelines on the "Evaluation of Risks and Hazards of Industrial Development on Residential Areas in Western Australia" (EPA November 1986). For new industrial installations, the relevant guidelines for assessment are as below:

"The following are proposed by the Authority, as a guide for the assessment of the fatality risk acceptability of new industrial installations:

- . The Authority has taken note of how decisions on risks are taken in other parts of the world. In the light of that knowledge the Authority will classify decisions into three categories. These are as follows:
 - A small level of risk which is acceptable to the Environmental Protection Authority;
 - A high level of risk which is unacceptable to the Authority and which warrants rejection; and
 - A middle level of risk, which subject to further evaluation and appropriate actions may be considered to be acceptable to the Authority.
- . An individual risk level in residential zones of less than one in a million a year is so small as to be acceptable to the Environmental Protection Authority.
- . An individual risk level in residential zones exceeding ten in a million a year is so high as to be unacceptable to the Environmental Protection Authority.

- . Where the preliminary risk level in residential zones has been calculated to be in the range one in a million to ten in a million a year, the Authority will call for further evaluation of the risks associated with the project. The Authority may then be prepared to recommend that the project be acceptable subject to certain planning and technical requirements.
- . A major technical requirement will be the commissioning of a Hazard and Operability Study (HAZOP) at the detailed design stage of the project. Such a study is an effective technique for discovering potential hazards and operating difficulties at the design stage. Significant reductions of hazards, and in the number of problems encountered in operations, as a result of such studies are possible. The Hazard and Operability Study should be undertaken by the proponent with a qualified person, approved by the Authority, who has to certify to the Authority that the study was carried out in a proper manner. This study should explore all feasible ways of reducing risks. The proponent may be required to update the risk analysis, and make the results public." (EPA November 1986)

7.3.6 Risk Assessment

The Authority has found the risk assessment of this proposal to be a difficult task due to the fact that the ERMP documentation, including the Cremer & Warner Report (ERMP Volume 2), was deficient in providing adequate information on which to base an assessment. This resulted in the Authority requiring a large quantity of additional technical information which has now been provided to the EPA.

7.3.6.1 Verification of Risk Results

Given the extreme technical nature of the risk analysis discipline requiring computer modelling and lengthy calculations, the Authority sought the advice of the Risk Assessment Section of the NSW Department of Environment and Planning (DEP). This organisation has had the most extensive experience in Australia in modelling the hazards of industrial installations.

DEP has advised the EPA that their calculations show Cremer & Warner Ltd's methodology and analysis undertaken on the likely generation of risk from the proposed plant at the Australind site, to be appropriate and reasonable. DEP has further advised the Authority that likely risk levels to be experienced from the plant would be as presented in the ERMP. This analysis agrees with the risk results shown in Figure 8.

7.3.6.2 Assessment of Risk Levels in Complying with EPA Guidelines

The Authority believes that the outdoor risk levels for this plant which, subject to further appropriate action, including adequate safeguards and conditions, can be made acceptable to the EPA.

However, the Authority is aware that even with safeguards described in the ERMP, residual risk from the plant remains and needs to be properly managed by the Company. This is due to the fact that there are limitations in technology, and accidental failures of material and components will occur, however infrequently. In addition, human error is possible.

7.3.6.3 Further Risk-Related Issues Arising from This Proposal

While the Authority believes that the likely risk from the proposed plant is acceptable, the proposal still raises a number of risk-related issues identified in submissions to the Authority. These are:

- A) Concerns have been raised on the adequacy of Cremer & Warner modelling. These concerns are:
- . no site visits by the consultant while undertaking the risk study;
 - . appropriateness of meteorology used in the gas dispersion calculations; and
 - . sensitivity of the Cremer & Warner model to toxic gas doses given the difference between the consultant's and alternative toxic dosages.

The Authority's assessment of the above matters is discussed in Section 7.3.6.4.

B) Buffer zones

Concern has been expressed regarding the following:

- . the apparent difference in "buffer zone" between CSBP's 10 000 tpa chlor-alkali plant at Kwinana and the proposed 12 000 tpa chlor-alkali plant for the Australind site; and
- . the question of 2 km buffer zone suggested for 1 tonne storage of chlorine listed in the Draft Bunbury Regional Plan.

The Authority's assessment of the above matters is discussed in Section 7.3.6.5.

C) Risk management strategy

An appropriate risk management strategy needs to be developed to manage the following:

- . design construction and commissioning of the plant;
- . a clear line of responsibility for the ongoing management of risks and hazards within the Company's management structure;
- . appropriate training of plant operators and strategy by which human error due to inadequate training, irresponsibility due to intoxication etc, are prevented or managed; and
- . methods for ensuring that the plant is appropriately maintained and that risks do not increase due to the ageing of the plant.

The Authority's assessment of the above matters is discussed in Section 7.3.6.6.

D) Chlorine storage

The main concern at the plant is the 50 tonne refrigerated storage of chlorine. Suggestions have been made in submission that:

- . this quantity of chlorine storage should be reduced;
- . extra safeguards need to be imposed on the chlorine storage system.

The Authority's assessment of the above matters is discussed in Section 7.3.6.7.

E) Management of plant operations

This critical issue concerns the following:

- . the chlor-alkali plant operator chosen by SCM needs to be experienced in the management of such plants; and
- . the Company's ongoing management of the operations needs to be supervised. Many submissions have strongly suggested that EPA should have a major ongoing involvement in this part of the project should it proceed.

The Authority's assessment on the above matters is discussed in Section 7.3.6.8.

F) Emergency planning

It has been commented that:

- . the Company needs to prepare a plan in the event of fire;
- . the Company needs to develop an emergency plan for all contingencies especially those involving a loss of containment of toxic gases; and
- . the Company's plan should be integrated with a Bunbury Regional Counter Disaster Plan.

The Authority's assessment of the above matters is discussed in Section 7.3.6.9.

7.3.6.4 Assessment on the Adequacy of Risk Analysis Undertaken

The following comments are relevant on this issue:

- . the Authority believes that a site visit is desirable in undertaking risk analysis but is not necessary in carrying out the analysis if all the adequate information, including local population, meteorological and topography data are available to the consultant. In this particular case, the Authority does not believe that the analysis carried out is inadequate or should be rejected due to the lack of site visit at Australind;
- . the Authority has reviewed the matter of meteorological data used for the gas dispersion calculations and believes that the data used was the most appropriate available and its usage was undertaken in an acceptable manner; and
- . the Authority sought further information on the sensitivity of the Cremer & Warner model not only to the chlorine toxicity data but to a large number of other modelling parameters including variations in the following:
 - release frequency;
 - release duration;
 - vaporation characteristics;
 - meteorology data;
 - toxicity data;
 - outdoor/indoor ratio and escape model;
 - ventilation rate; and
 - the surface roughness factor

The Cremer & Warner response to the EPA on these issues is summarised in Appendix 6 of this Assessment Report. The Authority has reviewed this information and finds it acceptable.

7.3.6.5 Assessment of Appropriate 'Buffer Zone' Required

One issue regarding this matter is the question of the difference between the CSBP's Kwinana chlor-alkali plant (DCE Bulletin No 216) and the proposed plant at Australind. Given that Cremer & Warner Ltd undertook the preliminary risk analysis for both of these projects, the Authority sought an explanation from the consultants. The critical differences between the two proposals from a risk generation point of view is as presented in Table 14. Full details of the Cremer & Warner explanation is presented as Appendix 7 of this Assessment Report.

The Authority has reviewed the information provided by Cremer & Warner on the differences between the two proposals and finds the consultant's explanation to be appropriate and acceptable.

Another issue concerned the whole question of having fixed 'Buffer Zones' rather than undertaking Quantifiable Risk Analysis. A number of submissions pointed out that the Draft Bunbury Regional Plan suggests a 2 000 metre buffer zone around installations storing more than 1 tonne of chlorine.

The EPA has reviewed in detail the matter of fixed 'Buffer Zones' vs. Quantifiable Risk Analysis in the past and decided on the Quantifiable Risk Analysis approach for assessing major hazardous installations in Western Australia. The rationale for adopting this approach (as it applies to this proposal) is as follows:

- . a 'Buffer Zone' approach does not differentiate between the quantities of chlorine stored, eg storage of 1 tonne and 10 000 tonnes of chlorine as each would require the same 2 km buffer zone;
- . the 'Buffer Zone' approach does not take into account the degree of technical controls and safeguards which can be applied to an installation; and
- . historically, the buffer zones were the earliest approach to pollution control and hazard management. However recently, especially over the last 10-15 years, technology has now reached a stage where each individual project can be evaluated in terms of hazards present, and likely risk generated after taking into consideration the safeguards proposed or imposed.

Given the above, the EPA chooses the quantitative assessment of risk from hazardous installations as the approach applicable to Western Australia and adopted certain requirements for environmental assessment of such proposals. In its statement on the "Evaluation of Risks and Hazards of Industrial Developments on Residential Areas in Western Australia" the Authority listed these requirements as below:

- ". Where the Authority is of the opinion that a project involves a significant element of risk it will require a quantitative risk assessment at an early stage of the environmental impact assessment process. The need for such an assessment will be determined on a case by case basis.

TABLE 14 THE MAIN DIFFERENCES IN THE PROPOSED SCM PLANT AND THE CSBP KWINANA PLANT REGARDING RISK RESULTS

RISK-PRODUCING UNITS	SCM	CSBP
Storage	2 x 25 tonne tanks + one spare	2 x 25 tonne tanks + one spare + cylinders (4 x 50 tonne tanks originally + one spare)
	Refrigerated storage	Pressurised storage
Export	No export	Exported in 1 tonne 70 kg and 33 kg cylinders
Loading requirements	None	Cylinder loading (+ road tanker loading originally)
Liquefaction of chlorine	Partial + revaporisation most chlorine direct to titanium dioxide process in gas phase	Full-direct to storage
Hypochlorite unit	46 m stack assumed	10 m stack assumed

Note 1 The major influences on the differences in the risk around the two plants concern the storage and loading facilities in conjunction with the pressurised system used at Kwinana and not the small difference in plant production rates. Other major differences concern differing topography and metrology for the site.

(Source: Cremer & Warner 1987)

A full explanation of the above differences is presented in Appendix 8 of this Assessment Report.

- . The quantitative risk assessment should be undertaken and certified to the Authority's satisfaction by a qualified, independent and reputable analyst, approved by the Authority, and at the proponent's expense. This process requires the risk analyst to certify to the Authority that the assessment was done independently.
- . In most circumstances the Authority would not seek or undertake a separate verification of the independent risk assessment but could do so if it considered exceptional circumstances so justified.
- . The scope and extent of the assessment will vary from project to project, and the Authority will provide specific advice to each proponent. However, in general, assessment will include an identification of all relevant hazards, a quantification of their consequences and the likelihood of their occurrence, and estimations of outdoor risk levels. The assessment is to address specifically proposed safeguards and their effectiveness in reducing and managing risk."
(EPA 1986)

7.3.6.6 Assessment of the Proposed Risk Management Strategy

A risk management strategy consists of a detailed approach on how the risks and hazards from an industrial installation are to be managed. The proponent's risk management strategy consists of the following:

- . making commitments on a range of risk reducing safeguards that would be undertaken. (These safeguards are listed in Appendix 4 of this Assessment Report);
- . making a commitment to undertake a Hazard and Operability (HAZOP) study for the plant;
- . training of all personnel in safe work practices and emergency procedures; and
- . a commitment to undertake another risk assessment at the completion of the final design to confirm or improve upon the results presented by the Cremer & Warner Preliminary Risk Analysis Report (1986).

The Authority believes that the risks and hazards from the proposed plant can be managed and made especially safe if appropriate action steps are taken. The proponent has already made commitments to undertake some of the risk management steps required. The Authority believes the following are also necessary:

- . an assurance from the proponent that most appropriate and reliable equipment will be used in the construction of the plant. (This matter needs to be addressed in the HAZOP for the plant);

- . adequate supervision is undertaken during the construction stage. (The Authority would refer this matter to the appropriate regulatory agencies if the proposal proceeds);
- . a hazard analysis update including a fire safety study, study detailing the management of commissioning stage and study of emergency procedures to be completed before plant commissioning (the proponent has made commitments to undertake some of these studies); and
- . a regular auditing of risk and hazards after commissioning.

Accordingly, the Environmental Protection Authority recommends as follows:

RECOMMENDATION 5

The Authority has undertaken a thorough evaluation of the preliminary risk analysis undertaken by the proponent and described in the ERMP, together with the additional information and commitments made by the proponent to further reduce risks and hazards. The Authority accepts the certification by the proponent's consultants, Cremer & Warner Ltd, that the preliminary risk analysis is reasonable and was undertaken independently..

The Authority has concluded that the project can satisfy the EPA's published guidelines for the evaluation of the risk and hazards of new industrial installations on people living in residential areas.

The EPA acknowledges that the proponent has given a commitment to undertake a Hazard and Operability Study (HAZOP) and to prepare a hazard and risk management strategy.

The Environmental Protection Authority recommends that a condition of approval should be the preparation in stages of a comprehensive and integrated hazard and risk management strategy, to the Authority's satisfaction.

This should consist of the following with the results being forwarded to the Environmental Protection Authority:

- . the HAZOP study to be completed and submitted before construction commences and to be conducted in a manner approved by the EPA;
- . a final risk analysis report incorporating the plant design after HAZOP (and taking into consideration any additional safeguards/modifications proposed by the EPA) to be submitted soon after construction;
- . a hazard analysis update (including fire safety study, study detailing the management of commissioning stage and study of emergency procedures) to be submitted before plant commissioning; and
- . an audit of risk and hazards to be submitted to the EPA upon request.

Another issue regarding the risk management strategy concerns the on-line responsibility for environmental and risk management within the Company's management structure. The proponent has provided the management structure for the proposed plant (see Figure 9). This includes a hazard and risk manager having responsibility for the safety of the plant.

The Authority believes that the approach to safety management taken by the Company should be appropriate. However, the Authority is of the opinion that the ultimate responsibility to ensure plant safety rests with the management of the SCM Chemicals Ltd (see Section 7.3.6.8).

7.3.6.7 Assessment of Chlorine Storage and Proposed Safety Features

The proposal calls for the refrigerated storage of 50 tonne of chlorine in 3 x 25 tonne tanks (one tank would be on standby and would normally be kept empty). The Authority believes that this storage should be reduced. The Authority notes that the Cremer & Warner risk analysis was undertaken assuming 25 tonne storage. Given this fact, the Authority believes that the proposed plant can be operated with an average of 25 tonne of chlorine being stored.

RECOMMENDATION 6

The Environmental Protection Authority recommends that no more than 25 tonnes of chlorine should be stored at the Australind site.

The Authority is concerned about the transport of chlorine into and from the Australind site. This, the Authority believes, would be unacceptable. However, the EPA is aware that the Company would require a small quantity of chlorine during the start-up and commissioning period. The Authority believes that the transport of this small quantity of chlorine over a very short-term period can be managed.

RECOMMENDATION 7

The Environmental Protection Authority recommends that a condition of approval should be that there be no sale of chlorine from the Australind site and that there be no transport of chlorine to and from the site except during the commissioning stage.

The management of the transport of chlorine for commissioning should be discussed with the relevant Government agencies prior to commissioning.

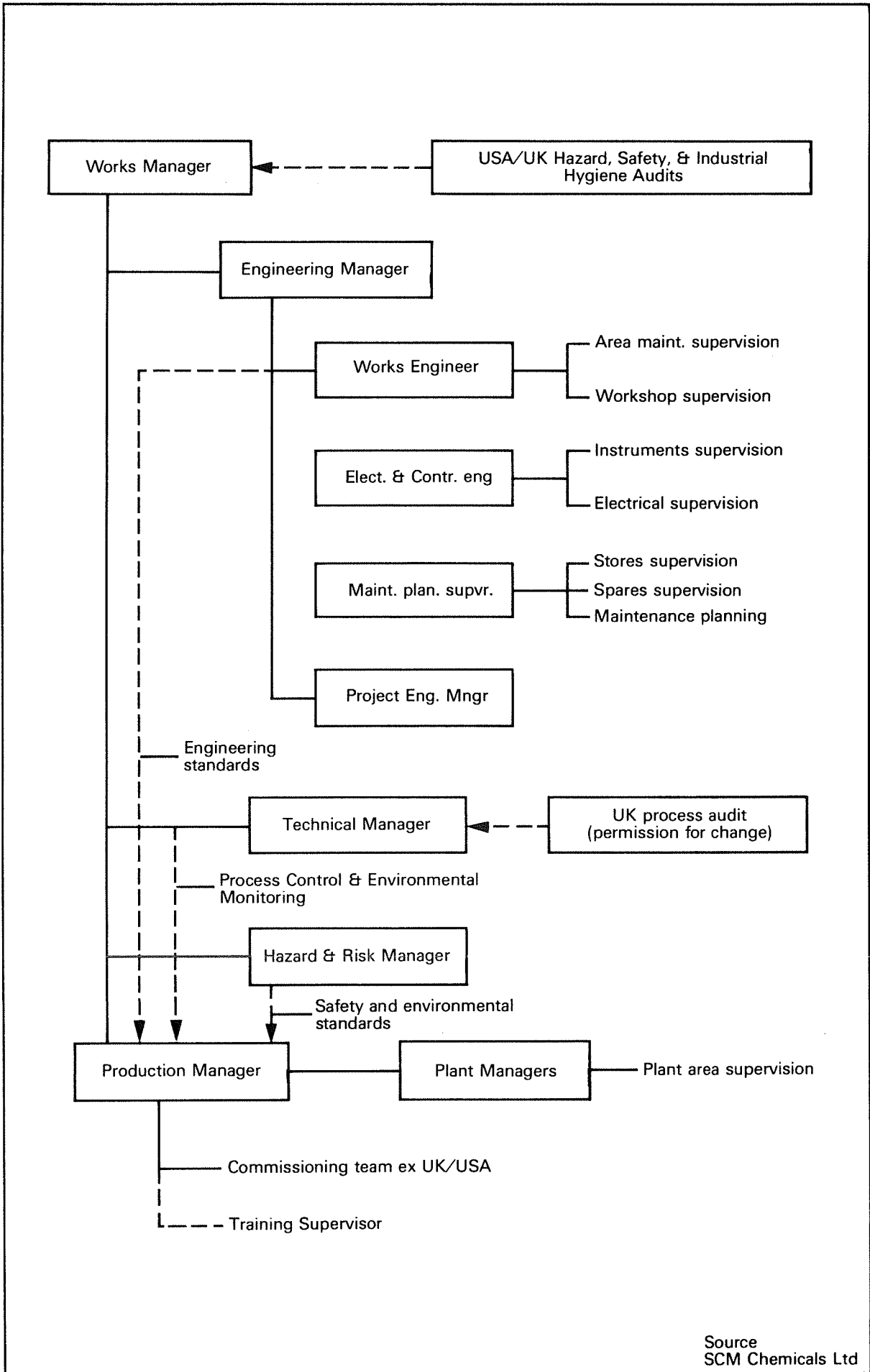


Figure 9 Simplified management structure of the proposed plant.

The Authority has also investigated the safeguards required for the storage of chlorine at Australind, to make the proposal especially safe. The Authority believes that the following additional chlorine storage safeguards are required to those proposed in the ERMP and notes that the proponent has modified the proposal to include these safeguards (see Section 4.2). These are:

- . full height bunding - concrete bunding to the full height of the storage tanks;
- . insulating tiles - the bund should be lined with insulating tiles to prevent rapid heat transfer from the bund to the liquid chlorine and so reduce the rate of vaporisation of the liquid;
- . foam suppression - the foam generators would provide a stable insulating barrier on top of the chlorine to minimise heat extraction from the atmosphere, and suppress gas evolution; and
- . isolating valves around pumps - the chlorine pumps should have double remote acting block valves to allow complete remote isolation of the pump should it develop a leak.

The Authority has been informed by DEP that other safety features should also include the following:

- . monitoring of air moisture levels in the titanium tetrachloride building and alarm if moisture content is high; and
- . if water (or steam condensate) is used in the vaporiser heating system, monitoring is required to give immediate warning if failure of vaporiser occurs.

RECOMMENDATION 8

The Environmental Protection Authority recommends that a condition of approval should be the implementation of the following safeguards on the chlorine storage units:

- . full height concrete bunding;
- . insulation tiles in the bunds;
- . a foam suppression system; and
- . isolating valves on main storage tanks and process items. Storage tank isolation valves require two actuation points.

Other safety features should include the following:

- . a monitoring alarm system for air moisture levels in the titanium tetrachloride building; and
- . if water (or steam condensate) is used in the vaporiser heating system, monitoring is required to give immediate warning if failure of vaporiser occurs.

7.3.6.8 Assessment of the Management of Plant Operations

The proposal calls for the construction of a 12 000 tonne per annum chlor-alkali plant. It is critical that this plant be operated and managed in an acceptable manner.

SCM Chemicals Ltd has not yet chosen the Company which would be operating this plant. The Company is currently investigating the proposal to sub-contract the chlor-alkali plant to an experienced operator. The Authority concurs with the proponent's view which it believes is appropriate. However, the proponent should retain the responsibility for the environmental management performance of the plant.

RECOMMENDATION 9

The Environmental Protection Authority notes that the proponent is investigating sub-contracting the chlor-alkali plant. While the Authority approves of this procedure, it recommends that the proponent be held responsible for the environmental performance of the chlor-alkali plant, regardless of the operating company.

A number of submissions have strongly suggested that the EPA should have a major involvement in this project. The Authority concurs with this suggestion.

The EPA will have an ongoing involvement in this project in the following manner:

- . the HAZOP analysis for this project will be concluded in a manner approved by the EPA;
- . EPA will be involved in the supervision of the construction stage;
- . EPA will be reviewing the commissioning details;
- . under the Environmental Protection Act (1986), the Authority's Pollution Control Division will set licence conditions at the operation stage of the proposal; and
- . the Authority will undertake a regular review of the site and will assess the required auditing of risk and hazards for the plant.

7.3.6.9 Assessment of Emergency Planning

The Authority believes that the proponent needs to prepare:

- . an emergency plan to prevent and manage any fire on site; and
- . an emergency plan for all other contingencies especially those involving a loss of containment of toxic gas.

The Authority has already recommended that the proponent should prepare such plans if the proposal proceeds (see Recommendation 5).

The Authority is aware that the State Emergency Service is preparing a regional counter disaster plan for the Bunbury Region, particularly for the surrounds of Australind, for a number of emergencies including fire, floods, toxic gas release etc. The Authority believes that the Company's emergency plan should be integrated with the regional counter disaster plan for the Bunbury area.

RECOMMENDATION 10

The Environmental Protection Authority recommends that the proponent's emergency plan and procedures be integrated with the proposed State Emergency Services' Bunbury Regional Counter Disaster Plan.

It is understood that the Regional Centre Disaster Plan will cover contingencies for chemical release emergencies as well as natural emergencies such as floods and fire.

7.3.6.10 Conclusion on the Assessment of Risk and Hazards

The EPA concludes that if the following are implemented

- . the proponent's proposed safeguards; and
- . the Authority's recommendations on the risk and hazard assessment

and the plant is operated in a responsible manner, then the likely risks generated from the plant would be low enough to be acceptable to the Environmental Protection Authority.

While the Authority believes that the risk level from the proposed plant is low enough to be acceptable, the Authority would be concerned if this risk level from the site was to increase for any reason.

RECOMMENDATION 11

The Environmental Protection Authority recommends that the likely risk generated from all operations on the Australind site including the proposed plant should never exceed the risk levels presented in the ERMP and shown in Figure 8 of this Assessment Report.

The Authority believes that future residential development should be confined to beyond the one in a million per person per year risk contour.

RECOMMENDATION 12

The Environmental Protection Authority recommends that no residential development should occur within the one in a million per person per year risk contour as shown in Figure 8 of this Assessment Report. The Authority further recommends that this be implemented through appropriate statutory planning mechanisms.

The Authority is aware that the above recommendation could generate constraints in landuse rezonings for the surrounds of the SCM Australind site. The Authority has received submissions from several local residents including the Hough family regarding the matter of being disadvantaged if the proposal proceeds.

RECOMMENDATION 13

Almost all of the houses in the Australind area fall outside the one-in-a-million risk contour for the proposed plant. This means that these houses are in such a low zone of risk that, according to EPA guidelines, they are classified as "acceptable". No house is inside the contour of risk greater than ten-in-a-million and therefore, according to EPA guidelines, none are classified as "not acceptable".

Three houses lie in the zone between the one-in-a-million contour and the ten-in-a-million contour (all three are located close to a risk of two-in-a-million).

The Environmental Protection Authority recommends that the Government enter into discussion with the owners of these three residences with the objective of determining if further action is necessary to ensure that the owners would not be unreasonably disadvantaged by the proposed proceeding. Such further action should include the examination of additional requirements which could be placed on the proponent by the Government.

7.4 ENVIRONMENTAL IMPACTS FROM THE EMISSIONS OF WASTES

The ERMP identified a number of waste products being generated from the plant which would require treatment and/or disposal. These include:

- . liquid wastes;
- . atmospheric emissions;
- . solid wastes; and
- . radioactive wastes.

7.4.1 Liquid Waste Impacts

7.4.1.1 Liquid Waste Treatment and Disposal Discussed in the ERMP

The proposed liquid waste treatment and disposal for this project, outlined in the ERMP, has been presented in Chapter 4 of this Assessment Report. In summary this proposal consists of:

- . collecting 2 520 kilolitres per day of process water, 2 220 kilolitres per day of recovered contaminated groundwater, 60 kilolitres per day of acidic and alkaline liquors, and a quantity of bleed-off sulphuric acid;
- . treatment of the above wastewater by sedimentation through a clarifier followed by neutralisation through lime dosing;
- . disposal of 4 500 kilolitres of heated (35°C) clarified overflow through a gravity pipeline to the Collie River; and
- . disposal of 300 kilolitres of clarified underflow, containing a large quantity of suspended solids through infiltration ponds to groundwater.

7.4.1.2 Environmental Impacts of Wastewater Discharge Outlined in the ERMP

The proponent has argued in the ERMP (pp65-69) that environmental impacts associated with the liquid wastewater treatment and disposal would be minimal and should be considered acceptable because:

- . the treated wastewater being discharged into the Collie River is very similar to diluted seawater, except for higher concentrations of calcium and manganese;
- . the discharged wastewater would only contain small amounts of non-settleable or marginally settleable suspended solids (however the ERMP does not provide quantification of the final discharge concentrations of particular materials);
- . the proponent's wastewater disposal strategy for Collie River consists of achieving adequate mixing and dilution of the discharge with river water;
- . to achieve this strategy, the proponent's consultant (Dr John Hunter of the Centre of Marine Science and Technology, Curtin University) has undertaken modelling which simulated the likely dilution and flow of the wastewater after discharge into Collie River (for both low and high flow conditions) using different discharge depths;
- . Table 15 shows the consultant's findings on the minimum dilution factors calculated for 100 metres from the proposed outfall to the surface water layer;

TABLE 15 MINIMUM DILUTION FACTORS CALCULATED FOR 100 METRES FROM THE PROPOSED OUTFALL TO THE SURFACE WATER LAYER

LAYER	DILUTION FACTOR	
	HIGH RIVER FLOW	LOW RIVER FLOW
Upper water layer	52	20
Lower water layer	223	320

Source: ERMP

- . in the summer conditions, due to this dilution, the mean surface water salinity regime near the discharge point would decrease from 20.4 parts per thousand to 19.9 parts per thousand;
- . in the winter conditions, due to this dilution, the mean surface water salinity would increase from the present mean of 1.4 parts per thousand to 1.6 parts per thousand;
- . the maximum induced increase in the surface temperature, calculated by the consultant, 100 metres downstream of the outfall would be approximately 0.5°C;
- . the above differences are well within the temporal and spatial variability of the salinity and temperature regimes for the river; and
- . the consultant's modelling also shows that a discharge within the surface water layer would maximise the dilution and minimise the residence time for the wastewater.

The ERMP concludes (p68) that the wastewater discharge into the Collie River would have negligible effect because:

- ". During high winter river flows:
 - the volume of wastewater would be only a small proportion of river flow (approximately 0.3%) and would be rapidly diluted;

- the maximum anticipated increase in salinity or temperature due to the discharge would be very small, and would be confined to the surface water; and
 - fish inhabiting the estuarine reaches of the river during winter do not frequent the upper fresh water layer.
- . During low river flow in summer:
- the salinity of the wastewater would not appreciably affect the surface salinity of the receiving environment; and
 - the thermal plume from the discharge would be confined to the surface water and would rapidly diffuse. Le Provost, Semeniuk and Chalmer (1983) investigated the effect of heated water upon the fish in the Leschenault Inlet and concluded that all major commercial species actively avoided water temperatures above 27°C. Under the conditions proposed, fish would be able to successfully avoid any heated water that was encountered in the Collie River during summer by either lateral or vertical migration."

The ERMP (p69) makes a similar conclusion regarding the acceptability of the discharge of clarifier underflow into groundwater through infiltration lagoons. The Company's modelling shows that the impact of the discharged wastewater would be as follows:

- . the water level under the infiltration site within 1 000 days would rise 5 metres; the infiltration cone would extend westward under the factory site and east toward the Collie River;
- . groundwater seepage might occur within this period where the ground level was less than 3 metres AHD, but would be more likely at 1.0 metre AHD; and
- . the calculated rise in salinity is from 1 400 to 1 750 milligrams per litre over the 1 000 day period, rising to 2 900 milligrams per litre after 3 650 days, assuming no dilution from the percolating rainfall. Allowance for percolating rainfall reduces this calculated salinity to 2 700 milligrams per litre.

The document then states that:

"the Melaleuca raphiophylla (swamp paperbark), which inhabit the Collie River foreshore adjacent to the site, have a salt tolerance of approximately 3 000 milligrams per litre. Allowing for percolating rainfall, the gradual rise in salinity to 2 700 milligrams per litre over a ten-year period should not cause any deleterious effects on the existing natural vegetation." (ERMP p69)

7.4.1.3 EPA Comments on Wastewater Disposal Outlined in the ERMP

As stated in Section 4.2, the discharge of clarifier underflow into groundwater through infiltration lagoons was found to be unacceptable during the EIA process and hence the proponent has modified this aspect of the proposal so that the underflow is filtered and the wastewater treated in the clarifier before final disposal either into the Collie River or elsewhere.

7.4.1.4 Wastewater Issues Raised in Submissions

The Authority has received a number of submissions expressing concerns regarding the wastewater treatment and disposal outlined in the ERMP. The issues raised (see Appendix 3 for details) were as follows:

- . total opposition to discharge of underflow into the groundwater (and hence into the Collie River) via the infiltration ponds;
- . concerns about modelling data used to estimate aspects of the discharge such as mixing zones, flow rates and depth discharge data;
- . concern about rise in salinity and temperature in the Collie River due to the discharge;
- . concern about heavy metals discharge and build-up, especially of manganese;
- . concern about radio-nuclides being discharged into the river and accumulating over time;
- . need for a further detailed study;
- . inadequacy of monitoring proposed in the ERMP; and
- . alternative disposal options should have been investigated and discussed in the ERMP.

7.4.1.5 EPA Assessment of Wastewater Treatment and Disposal Outlined in the ERMP

As was mentioned in Section 4.2, the proponent's proposal has been modified during the EIA process so that discharge of underflow into the infiltration pond would not be occurring if the proposal proceeds. Instead, the proponent has redesigned the clarifier to accommodate all of the wastewater from the site, including extracted contaminated groundwater, for treatment and disposal (see Figure 3).

RECOMMENDATION 14

The Environmental Protection Authority recommends that the wastewater treatment clarifier accommodates all wastewater requiring disposal including extracted contaminated groundwater.

The Authority believes that there are two options for wastewater disposal from the plant. These are:

- . discharge of treated wastewater into the Collie River; and
- . discharge of treated wastewater into the ocean, perhaps eventually through the existing pipeline over the Leschenault Inlet.

In order to determine the merit (or otherwise) of the above two options, the Authority has undertaken extensive investigations into the proponent's proposal to discharge into the Collie River.

7.4.1.6 EPA Assessment on Wastewater Modelling

The Authority has reviewed the modelling study undertaken by Dr J.R. Hunter of Curtin University. This study examined the limited salinity/temperature data available for the lower reaches of the Collie River, and concluded in ERMP, Appendix B, that over a wide range of river flow rates, from typical summer to typical winter flows, the estuary could best be characterised and modelled in terms of two superimposed layers of different salinity (and therefore density), the upper layer having a net down-river movement, and the lower layer having a net up-river movement (there being also vertical mixing and entrainment of water between the layers).

Pritchard's two-layer box model was therefore used to estimate the total resident mass of a conservative pollutant and its broad longitudinal distribution, in both the upper and lower layers of the lower Collie estuary, that would occur for a given discharge rate of the pollutant in a chosen reach of the estuary. This model requires concomitant salinity and riverflow data inputs, and cannot be used to estimate pollutant distributions for conditions under which these data are not available.

The consultant has selected and averaged available salinity and streamflow data to obtain inputs which enable the model to work for typical winter and summer conditions. The Authority concludes that the results obtained in the ERMP for these two cases, which simulate conditions for most of the year, ie: 10 months, appear to have been properly derived in terms of what this model sets out to do.

The Pritchard model however has little relevance for the near-field dilution achieved very close to the pipe exit nozzle, nor for the rate of spreading of the effluent discharge in the mid and far-field as it is advected downstream and influenced by ambient mixing.

Two separate, but complementary models are used by the consultant to examine these questions. The study used the 'spreading disc' model to show that an effluent plume in the upper layer from a discharge point on the river bank will not generally mix across the whole width of the river. Since the two-layer model did not resolve the

lateral distribution of pollutant, the concentrations or dilution factors predicted by that model require the application of a correction factor as discussed by the consultant in ERMP, Appendix B. Use of a second near-field model which allows for momentum and buoyancy effects of the discharge, shows that, for an effluent of the stated composition, and at 35°C, the near-field dilution will result in this diluted effluent remaining in the upper layer. The effluent will also be jetted away from the bank as it is carried down-river, thus the virtual source of the effluent is more favourably placed for ambient dispersion than assumed by the spreading disc model.

The Authority concludes that the dilution factors predicted for wastewater discharge into the Collie River and shown in Table 15, have been satisfactorily derived and the methodology undertaken for the modelling is acceptable to the Authority.

The ERMP states that the maximum temperature of the effluent being discharged into the Collie River would be 35°C. Modelling undertaken by the consultant shows that the maximum temperature rise above ambient for typical summer or winter conditions in the Collie River should not then exceed about 2°C at a distance of 100 m away from the outfall. The Authority finds the methodology undertaken for this prediction to be acceptable. The Authority additionally notes that no allowance has been made in these calculations for heat loss to the atmosphere, and in this sense the consultant's calculations may be conservative.

As stated earlier, a number of submissions raised concerns about the basic data used in the consultant's modelling and the sensitivity of this data in predicting results. The Water Authority of Western Australia in its submission on this matter raised the issue of periods of flow much lower than the agreed typical summer rate, due to periods of low irrigation flows. The Water Authority of Western Australia however had little or no data to indicate the likely levels of these low flows nor of their duration. Under such low-flow conditions, it is possible that elevated temperatures could be more widespread. The Water Authority of Western Australia have suggested that the river and estuary flow, temperature and density should be measured as soon as possible to determine the river profile for the 1987 end of summer low flow situation. These data could then be used to undertake final EPA assessment and verify the validity of assumptions used by the consultant in the modelling presented in the ERMP.

The EPA agreed with the Water Authority's concerns and initiated a short-term monitoring programme involving the Waterways Commission and the Water Authority of Western Australia. The results of this extensive short-term monitoring programme are shown in Table 16.

Table 16 shows that during the low-flow conditions at the end of summer, the Collie River flow in general exceeds the 1 m³/sec critical figure. This means that the assumptions used in the consultant's modelling exercise have been appropriate.

TABLE 16 COLLIE RIVER ESTUARINE INFLOWS - PARAMETER DISCHARGE IN m³/S

* Estimated only

Date	23/3/87	1/4/87	8/4/87	15/4/87	23/4/87	29/4/87
MOORES FARM Collie River Q 612 1107	0.1114	0.2730	0.3615	0.1424	0.172	0.3020
CROSS FARM Brunswick River Q 612 1108	0.5459	0.7734	2.3660	0.3836	0.550	0.6142
TREENDALE Treendale Gallg Q 612 1128	0.0944	0.020*	0.3399	0.001*	0.068*	0.003*
MILLARS Millars Ck Q 612 1129	0.1321	0.1662	0.3115	0.0337*	0.147	0.0905*
Victory Drain	0.0	0.0231*	0.087*	0.0	0.0	0.001
TOTAL m ³ /S	0.8838	1.2526	3.4659	0.5640	0.9365	1.01

Source:

- . Waterways Commission
- . Water Authority of
Western Australia

However, the Authority notes that Collie River flow can be lower than 1 m³/sec and that the proponent needs to take this fact into consideration while designing the wastewater treatment and disposal system.

7.4.1.7 EPA Assessment of Wastewater Quality being Discharged into the Collie River

The Collie River is an estuary in its lower reaches, and forms part of the estuarine environment of Leschenault Inlet.

The river has high value, both as a habitat for fish and other biological components of the estuary, and as an aesthetic and recreational resource for the local and regional community. The Authority considers that these beneficial uses must be protected.

The proponent wishes to discharge treated wastewater containing mostly the ions which comprise the dominant components of seawater - sodium, chloride, magnesium, calcium and sulphate in a ratio not very different from that of seawater itself. Other metals will be present in trace quantities. However the proponent has not provided details on the final quality of wastewater being discharged into the Collie River.

The Authority believes that the wastewater discharge to the Collie River from the Australind site should conform with schedule 7(2) of the Department of Conservation and Environment Bulletin 103, 1981, Marine and Estuarine Water Quality Criteria for the Maintenance and Preservation of Aquatic Ecosystems. The details of beneficial use No.7 and the quality criteria for schedule 7(2) is included as Appendix 8 of this Assessment Report.

RECOMMENDATION 15

The Environmental Protection Authority recommends that the wastewater discharge to the Collie River from the Australind site conforms with the marine and estuarine water quality criteria in 7(2) of the DCE Bulletin 103 (1981) for the maintenance and preservation of aquatic ecosystems.

7.4.1.8 EPA Assessment of Wastewater Quantity being Discharged into the Collie River

Initially, the proposal consisted of discharging 4 500 kilolitres per day of wastewater into the Collie River. However, the proposal as modified would now mean that approximately 5 000 kilolitres of wastewater could be disposed into the river. While the Authority considers that up to 10% increase in water quantity entering would not likely be significant, the Authority notes that the proponent needs to re-run the dilution model to determine the likely impact of this increase discharge and would be providing these results to the relevant agencies for review.

The Authority believes that this remodelling should take into consideration the results of monitoring initiated by the EPA. The results of the remodelling should also be submitted to LIMA and WAWA.

7.4.1.9 EPA Assessment on Radioactive Waste Discharge in the Wastewater

The matter of radioactive waste discharges and their impacts is discussed in Section 7.4.4 of this Assessment Report.

7.4.1.10 EPA Assessment on the Temperature of Wastewater and its Likely Effect on the Collie River

In Section 7.4.1.6 the adequacy of proponent's modelling, as submitted in the ERMP, was discussed. The critical issue identified was the possible effect of wastewater's elevated temperature on the Collie River.

The Authority believes that the proponent needs to control the wastewater temperature through technical means to ensure that the ecology of the river is not affected through an increase in receiving water temperature. In Recommendation 15 of this Assessment Report, the Authority has stipulated that wastewater discharge into the Collie River should meet Schedule 7(2) of DCE Bulletin 103 (1981). This schedule limits the receiving water temperature increase to 2° above the normal ambient temperature of the surface water (see Appendix 8).

7.4.1.11 EPA Assessment on the Wastewater Monitoring Proposed in the ERMP

The ERMP proposes the following monitoring of wastewater discharge:

- . all wastes to be regularly monitored for radio-nuclides; and
- . regular monitoring of the discharge to the Collie River would be implemented to ensure that the system operated as predicted.

The Authority believes that additional monitoring of the discharged effluent and its effects should be discussed by the proponent with and agreed to by LIMA, and should include at least the following components:

- . temperature of the wastewater discharge and of the surface waters of the Collie River upstream and 10 metres downstream from the point of discharge;
- . pH, total dissolved solids, level of radioactivity, levels of chromium and manganese and total suspended solids;
- . baseline (that is pre-discharge) and post-discharge characterisation of the benthos of the Collie River in the vicinity of the outfall; and
- . volume and velocity of flow of the Collie River under low flow conditions.

RECOMMENDATION 16

The Environmental Protection Authority recommends that the proponent undertakes ongoing wastewater monitoring including:

- . temperature of the wastewater discharge and of the surface waters of the Collie River 10 metres upstream and downstream from the point of discharge;
- . pH, total dissolved solids, level of radioactivity, levels of chromium and manganese, and total suspended solids of the effluent;
- . baseline (that is pre-discharge) and post-discharge characterisation of the benthos of the Collie River in the vicinity of the outfall; and
- . volume and velocity of flow of the Collie River under low flow conditions.

The proponent should develop a monitoring programme for approval by the EPA and Leschenault Inlet Management Authority which includes proposals for timing of sampling and for the reporting of results.

7.4.1.12 EPA Assessment on the Need for a Wastewater Contingency Plan

The Authority has reviewed the wastewater treatment and disposal strategy presented by the proponent and as modified by the EPA. The Authority believes that with the additional safeguards proposed, such a strategy would be acceptable and would not cause a detrimental impact on the Collie River environment.

However, as mentioned in Section 7.3.6.2, there are limitations in technology and accidental failures of material and components will occur, however infrequently.

The Authority believes the proponent needs to develop a contingency plan to accommodate any likely failures of part of the effluent management or chemical containment and handling system of the proposed plant.

RECOMMENDATION 17

The Environmental Protection Authority recommends that the proponent prepare a contingency plan to the satisfaction of the Authority and the Leschenault Inlet Management Authority, which addresses the management actions to be taken in the event of failure of any part of the effluent management or chemical containment and handling systems of the proposed plant as they may impact upon the Collie River or the Leschenault Inlet.

7.4.1.13 EPA Assessment on Alternative Wastewater Disposal Options

The EPA does not believe that the disposal of wastewater in the Leschenault Inlet is appropriate. However, as mentioned in Section 7.4.1.5, the Authority believes that ocean discharge using the existing pipeline should initially remain as an option.

The Authority has undertaken an extensive review of the proponent's proposal to discharge into the Collie River. The Authority concludes that this discharge strategy appears to be appropriate and if managed properly should not cause any adverse impact on the Collie River.

The Authority, after undertaking its assessment, believes that the discharge into the Collie River should be environmentally acceptable. The Authority has recommended a monitoring programme which would be verified by additional monitoring undertaken by LIMA. However, if these monitoring results over the first year of operation show that adverse environmental impacts are being experienced in the Collie River, then the Authority will review an alternative wastewater disposal option, ie: through the existing pipeline, into the ocean.

RECOMMENDATION 18

The Environmental Protection Authority recommends that the pipeline across Leschenault Peninsula be maintained until monitoring results of wastewater effluent discharge to the Collie River demonstrate to the Authority's satisfaction that unacceptable environmental impacts have not occurred.

7.4.2 Atmospheric Emissions and Their Impacts

7.4.2.1 Atmospheric Emissions Discussed in the ERMP

In Section 4.4.1 the proposed discharges of air emissions from the plant were listed as below:

- . 34 000 tonne per annum of carbon monoxide and carbon dioxide from the purification section;
- . one to five (1-5) parts per million (ppm) of chlorine from the discharge of the chlor-alkali single scrubber system; and
- . atmospheric gas emission from the air separation plant.

In addition, a number of submissions to the Authority have expressed concern about the generation of chlorine odours due to fugitive emissions from the plant.

7.4.2.2 EPA Assessment on Normal Atmospheric Emissions

The Authority is aware that the normal atmospheric emissions from the proposed plant would be a very significant improvement on the discharge of current atmospheric emissions. In fact this is one of the major benefits that the local Australind community will experience if the proposal proceeds.

The proponent states in the ERMP (p35) that the tail gases from the chlor-alkali plant scrubber would be between 1-5 ppm. The Authority believes that further pollution control equipment is required to reduce these emissions to less than one part per million and to increase the reliability and hence the safety of the pollution control systems.

RECOMMENDATION 19

The Environmental Protection Authority recommends that the proponent should install a chlorine scrubbing system on the chlor-alkali plant with sufficient back-up capacity to be able to absorb all of the chlorine produced at the full production rate for one hour.

The Authority notes that appropriate air emission standards will be set under the Works Approval and licensing processes of the Environmental Protection Act (1986).

7.4.2.3 EPA Assessment on the Generation of Odours and Fugitive Emissions

The Authority believes that there should be no odours or fugitive emissions from the plant during normal operations. The proponent needs to have an objective to minimise the likelihood of fugitive emissions, from atypical conditions, to a frequency low enough to be acceptable to the Authority. In order to achieve this objective, the proponent needs to seriously consider the matter of preventing fugitive emissions from the plant during the design stage of HAZOP analysis (see Recommendation 5).

7.4.2.4 Monitoring of Atmospheric Emissions

Monitoring of atmospheric emissions would be specified in the licence conditions under the provisions of the Environmental Protection Act (1986).

7.4.3 Solid Waste Disposal

As discussed in Section 4.4.3, the modified proposal would produce the following solid wastes:

- . 60 tonne per day of filtered sludge from the underflow of the clarifier;
- . a quantity of mildly radioactive waste; and
- . domestic solid waste from the plant.

The ERMP does not provide the details of how and exactly where the solid waste from the plant would be disposed. However, the document does state that this would be done off-site and most likely at Capel.

7.4.3.1 EPA Assessment of Non-Radioactive Solid Waste Disposal

The Authority has investigated the solid waste to be produced by the proposal and believes that this waste disposal can be managed. The proponent needs to resolve the matter of solid waste disposal to the satisfaction of the EPA.

7.4.3.2 EPA Assessment of Mildly Radioactive Solid Waste Disposal

The Authority believes that the disposal site(s) for mildly radioactive solid waste should be approved by the Radiological Council.

RECOMMENDATION 20

The Environmental Protection Authority recommends that the disposal site(s) for solid waste, including that generated during concurrent operation of both plants, should be approved by appropriate Government agencies including the Radiological Council.

7.4.4 Radioactive Waste Impacts

The ERMP (pp33-35) states that due to the inefficiency of the mineral sand sorting operation, small quantities of radioactive mineral monazite associated with the feedstock typically display low levels of radioactivity. The document cites the following radioactive levels for ilmenite being processed by the sulphate-process:

- | | | |
|-----------|------|--------------------------|
| . Thorium | -228 | 0.40 becquerels per gram |
| . Radium | -228 | 0.39 becquerels per gram |
| . Radium | -226 | 0.07 becquerels per gram |

The ERMP further states that:

"Experience indicates that the only areas where the (radioactive) activity is concentrated above the level of the feedstock are in the chlorinator brickwork and bed, and isolated sections in the process equipment; the resultant typical activity levels are an order of magnitude greater than the feedstock." (ERMP p33)

The document then goes on to say that:

"The potential for environmental impact from the activity entering the waste products can be assessed by considering two unlikely and hypothetical scenarios, where all the activity entering the plant reported to a particular waste product. These are discussed as follows:

- . **Scenario 1 - all radiation to solid wastes:** Neutralization of the wastewater produced by the plant would result in 60 tonnes per day of a neutral solid waste, which would be recovered, following drying in infiltration ponds, for disposal by burial. If all the radiation in the feedstock entered this waste, the activity of the waste would only be two and a half times the activity of the feedstock. Even at these hypothetical levels, this material would not present any significant disposal problems, and a suitable disposal system based upon burial could easily be developed in association with the relevant authorities."
- ". **Scenario 2 - all radiation to wastewater:** All the wastewater produced by the plant and the water from the contaminant recovery programme would be combined into one stream prior to neutralization and disposal. The total quantity of wastewater would be 4 800 kilolitres per day.

If all the radiation in the feedstock entered the wastewater stream, the resultant radioactivity concentrations would be:

- . Thorium -232 12 500 becquerels per kilolitre
- . Radium -228 12 188 becquerels per kilolitre
- . Radium -226 2 188 becquerels per kilolitre

To ascertain the significance of these levels in this hypothetical case, reference can be made to the concentrations of each radio-nuclide and published standards for drinking water quality, even though this is not normally a criterion used to assess wastewaters." (ERMP p34)

The document then concludes that:

"At the concentrations predicted for the hypothetical scenario, this water would be comparable to water considered safe on the basis of exposure of slightly less than forty hours per week for the radium isotopes and of continuous exposure for the other radio-nuclides." (ERMP p35)

The Authority sought the advice of the Radiological Council of Western Australia on this matter. The Council has informed the Authority that the paucity of information provided in the ERMP makes the assessment of the document's conclusions very difficult. However the Council is satisfied that the radiological discharges from the plant can be managed if the Company prepares a radiation management programme to the satisfaction of the Radiological Council.

RECOMMENDATION 21

The Environmental Protection Authority recommends that a radiation management programme should be developed by the proponent for the commissioning and operation of the proposed plant to the satisfaction of the Radiological Council.

The Authority's comments and recommendation regarding the radiological management of solid waste are discussed in Section 7.4.3.2 of this Assessment Report.

7.5 Occupational Health, Amenity and Social Impacts

7.5.1 Introduction

The following matters are identified for discussion in this section:

- . matters which could affect the health or safety of personnel in the proposed SCM plant;
- . the matter of noise impact, from the plant, to the surrounding area;
- . the potential of visual impact, due to the proposed plant; and
- . traffic impacts.

7.5.2 Occupational Health and Safety

The EPA acknowledges that the responsibility for assessing the acceptability of risk levels within the proposed plant rests with the Commissioner for Occupational Health, Safety and Welfare (DOHSW). Accordingly, the Authority notes that the proponent needs to liaise with DOHSW.

7.5.3 Noise Impact

7.5.3.1 Introduction

The SCM's existing sulphate-process complex has been the subject of a number of complaints in the past, to various authorities, from residents in both the Australind town site area and Clifton Park (see Section 2.7). As discussed in Section 2.7, investigation of

these complaints also included measurements of background noise levels. Levels recorded were in the order of 30 dB(A) and on occasions less. Intruding noise levels from the existing plant have been measured at up to 47 dB(A) in Australind and up to 44 dB(A) in Clifton Park. These noise levels are further adjusted by +5 dB(A) for their tonal nature.

The difference between ambient levels and measured noise levels indicates that a considerable level of intrusion by the existing plant can occur.

The proposed location of the chloride-process plant is closer to some residences than the existing plant and the residences from which complaints were received. Given this fact, the Authority believes that the proponent needs to take considerable care in the design, construction and operation stages of the plant to ensure that the noise impact is kept to the minimum.

7.5.3.2 Design Phase

The ERMP states that the plant layout will not be finalised until detailed design work is completed. However a general statement appears in the ERMP (p39) claiming that all equipment would be limited to a maximum emission limit of 85 dB(A) at 1 metre. The Authority believes that during the design stage the proponent needs to recognise that adjacent noise sources can combine to produce levels in excess of 85 dB(A). Likewise reverberant build-up can occur within enclosed or partially enclosed structures and give rise to noise levels at points in excess of 85 dB(A).

During the design stage, the proponent should also consider the possibility of utilising the plant structure itself to provide barriers in the transmission path to the areas that may potentially suffer degradation of their acoustic environment. Of particular concern is the golf course and the surrounding residential areas to the north-west.

Ideally, the objective in the design phase should be the design of a plant which prevents the introduction of any audible noise to potential areas of complaint.

7.5.3.3 Construction Phase

The ERMP makes no mention of the likely impact of noise associated with the construction phase of the plant. Impact of noise during this phase of the operation may be limited through restrictions on working hours and through off-site construction where possible. The scheduling of work to utilise any barrier effects from previously completed portions of the plant structure may also provide assistance at this stage. The matter of noise from construction stage has already been discussed (see Section 7.2).

7.5.3.4 Operational Phase

The ERMP concentrates mainly on noise from the operational phase and the likely impact is based on the assumption that all equipment will meet a design criteria of 85 dB(A) at 1 metre.

The ERMP tabulates noise sources (unidentified) within the plant, giving octave band data from 31.5 hertz to 8 kilohertz. A number of sources have been "assigned" 85 dB(A) as a noise level in one or more octave bands; actual values should have been utilised particularly as these data require modification by applying the A-weighting corrections before summation to arrive at the overall A-weighted noise level.

As the operation phase will extend over a number of years this phase of the project represents the phase in which the greatest scope for creating annoyance due to noise arises. Therefore more definite noise data is required.

7.5.3.5 EPA Assessment of Likely Noise Impacts from the Plant

The ERMP (p83) states that:

"the nearest residential locations are situated just over 600 metres north west of the proposed plant along Laura Avenue, Cecil Street and Eastwell Road. To the south, the nearest residences are approximately 780 metres distant in Ganfield Place, Burton Close and Whatman Way."

Using a 'simple' noise analysis, the document concludes that:

"even under adverse conditions, the highest noise level received by nearest residents would be 38.8 decibels, resulting in a perceived noise level, due to the plant and background noise under adverse conditions, of 42.5 decibels. This is less than 5 decibels higher than the appropriate assigned neighbourhood noise level of 40 dB(A) and hence is considered acceptable." (ERMP p83)

The Authority has discussed above the methods by which the noise from the plant can and should be reduced. Given the fact that the background levels of the surrounding area are approximately 30 decibels, the proponent needs to design the plant so that the noise levels generated should not significantly exceed the background noise level.

The Authority believes that the proponent needs to predict the likely noise emissions from the plant via acoustic modelling. This would also allow for differing atmospheric conditions to be taken into account. The results of this acoustic modelling should be discussed with the Pollution Control Division of the EPA prior to the setting of the licence conditions.

When commissioning of the plant is completed, noise levels within the plant should be measured as should noise levels in Australind

and Clifton Park (under various weather conditions) to assess impact and identify, if necessary, any items of plant requiring further noise control.

7.5.4 Visual Impacts

The visual impact of any industrial project is determined by a range of factors including:

- . size, shape and texture;
- . background from viewpoint;
- . colour relative to surroundings;
- . distance between object and viewpoint; and
- . intervening obstructions.

Also of importance is the level of viewer familiarity with the existing landscape, which is dependent on accessibility and surrounding landuse.

The ERMP (pp83-87) discusses the matter of visual impact in terms of:

- . existing and zoned landuse; and
- . long-term landuse and cumulative landscape impact.

7.5.4.1 EPA Assessment of Visual Impact

The ERMP concludes that "the combined effects of topography, surrounding tree cover and the type and distribution of surrounding land uses would keep the (new) plant well screened from the Old Coast Road, the Australind residential area and from most of Clifton park and Eaton." (ERMP p84)

The document admits that "due to the height of the new plant in relation to the low elevation ... the plant would be visible from ... Leschenault Peninsula & Inlet, (and) the Australind Bypass". (p84)

The Authority considers that the visual impact from the Australind bypass can be managed by undertaking appropriate landscaping along the proposed route.

The Authority notes the proponent's commitment to undertake appropriate landscaping to minimise the visual impact of the existing plant.

The ERMP states that there is a likelihood of cumulative visual impact in the long-term future if residential development proceeds on the eastern side of the Collie River. The Authority suggests that this matter be addressed by the Bunbury Regional Plan during its finalisation process.

7.5.5 Traffic Impacts

The ERMP states that "in the long-term, there would be a small increase in the number of truck movements associated with the plant and negligible change in the number of passenger vehicle movements." (ERMP p87)

The Authority is aware that the increase in plant production from the current 36 000 tonne per annum to the proposed 51 000 tonne per annum could increase the current heavy traffic from and to the plant by 30%. While this is a significant increase, the Authority is aware that the existing major roadwork in the proximity of the plant can accommodate the likely traffic increase.

8. ENVIRONMENTAL IMPACTS OF CONCURRENT OPERATIONS

As mentioned in Chapter 4, if the proposal proceeds, then the existing sulphate-process plant would continue to be maintained and operated concurrently with the proposed chloride-process plant while approximately 90 000 tonne of titanium dioxide is produced until 31 December 1989 (unless varied under the Agreement). This would entail for that year:

- . the discharge of 5 000 kilolitres per day of treated wastewater from the chloride-process plant into the Collie River and 6 700 kilolitres per day of sulphate-process acidic wastewater on the Leschenault Peninsula;
- . a minimum air emission from the chloride-process plant and the existing air emissions of SO₂, NOX etc from the sulphate-process plant;
- . an increase in total noise levels generated from the SCM site;
- . additional solid waste (mildly radioactive) needing disposal; and
- . more than doubling of the existing heavy truck movement during that year.

The Authority believes that some of these impacts particularly noise and traffic, need close management during the concurrent operation year. These would be controlled under pollution control licence conditions under the Environmental Protection Act 1986.

RECOMMENDATION 22

The Environmental Protection Authority recommends that the proponent be subject to the provisions of the Environment Protection Act 1986 during the period of the concurrent operation.

9. ENVIRONMENTAL MANAGEMENT AND MONITORING

The environmental assessment process in Western Australia places a high priority on the management of environmental impacts and the monitoring of both the management programme and the impacts to ensure that appropriate steps are taken to ameliorate and minimise impacts.

9.1 ENVIRONMENTAL MANAGEMENT OUTLINED IN THE ERMP

The environmental management commitments made in the ERMP are listed in Appendix 4 of this Assessment Report. The Company's key commitments to environmentally manage the proposal are:

- . dust and noise during construction would be controlled, in consultation with the local authorities;
- . noise would be maintained at levels that would not create a nuisance to surrounding residential areas;
- . the plant would be aesthetically designed and the site landscaped;
- . all waste products would be safely disposed of;
- . all practicable safety features would be incorporated into the plant design;
- . a hazards and operability (HAZOP) study would be undertaken for the plant, and all personnel would be trained in safe work practices and emergency procedures;
- . the proponent would undertake another risk assessment at the completion of the final design in order to confirm or improve upon the results presented by Cremer & Warner (1986); and
- . the effectiveness of these measures to protect the environment would be regularly monitored and, should unforeseen problems eventuate, these would be rectified in consultation with the responsible authorities.

9.2 ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAMME

At the time that the ERMP was released, no decision had been made by the Company as to final plant design or details of treatment and disposal of wastes. Details of a monitoring programme were not provided although the proponent has made commitments to undertake management and monitoring of the project (see Appendix 4). Other matters needing consideration have been identified in this Assessment Report with recommendations that, as appropriate, the proponent submits regular reports to the Authority on environmental performance.

RECOMMENDATION 23

The Environmental Protection Authority recommends that the monitoring commitments made by the proponent and requirements of the Authority be set as part of the works approval and licensing process under the Environmental Protection Act 1986.

The EPA has recommended in this Assessment Report that it closely monitors the construction and operation of this proposal. Such close monitoring carries a cost. The EPA considers it reasonable that the licence fees payable by the proponent should help to meet these costs.

RECOMMENDATION 24

The Environmental Protection Authority recommends that this proposal be re-scheduled under the definition of 'prescribed premises' in Regulations under the Environmental Protection Act 1986 for the purpose of setting fees on licenses issued under the Act to more closely cover the costs by the EPA of monitoring.

10. CONCLUSION

This Assessment Report is submitted to provide an environmental input to decision making on the proposed chloride-process titanium dioxide plant at Australind. In preparing this report, the Authority has considered a range of documentation and technical information and has been assisted by contributions from the public and other government agencies.

While the Authority believed that from an environmental viewpoint, it was inappropriate to initially locate the 'Laporte' plant at Australind and that it would be preferred to have the existing and the proposed plant located elsewhere, the Authority in its investigations has concluded that if a chloride-process plant is designed, commissioned and managed properly, then it could meet the EPA's expectations of environmental performance.

The Authority has recommended in this Assessment Report that if the proposal proceeds, then the existing sulphuric acid plant and the redundant sulphate-process equipment should cease production at the Australind site.

The Authority has also commented on the management of the waste disposal on the Peninsula until the end of 1989.

The Authority identified the following two key issues regarding the proposal which required detailed assessment:

1. The first key issue associated with this project concerns risk and hazards. The proponent had commissioned a preliminary risk analysis study by the UK based consultants Cremer & Warner Ltd and presented this study (ERMP Volume 2) as part of the public review documents for the proposal. The Authority examined in detail the Cremer & Warner findings regarding the risk levels generated by the proposed plant, and received specialised advice from the NSW Department of Environment and Planning, and found the risk levels presented in the ERMP to be of the right magnitude (see Section 7.3 for details). These risk levels comply with the EPA guidelines on risk and hazards as set out in the document "Evaluation of Risks and Hazards of Industrial Development on Residential Areas in Western Australia" (EPA November 1986) and are so small as to be acceptable to the Authority.
2. The second key issue concerning this project involves wastewater disposal. The Company commissioned an appraisal study of proposed discharge of the plant's treated wastewater into the Collie River by the consultant Dr John Hunter from the Centre for Marine Science and Technology, Curtin University. The Authority has examined this study in detail and finds its findings to be acceptable. The Authority believes that with appropriate conditions, wastewater discharge from the plant can be managed in an environmentally acceptable manner (see Section 7.4.1 for details).

There are a number of other issues which have been assessed and discussed in this Assessment Report. The general conclusion is that these can be managed and the proposal made environmentally acceptable.

The Authority would require regular reporting from the proponent on the Company's management and monitoring programme and would review and assess these reports in consultation with relevant interested bodies.

The Authority concludes that the proposed chloride-process plant is acceptable on environmental grounds subject to compliance by the proponent with commitments given (as listed in Appendix 4 of this Assessment Report) and subject to the adoption and implementation of the Authority's recommendations.

11. REFERENCES

- Australian Environment Council/National Health and Medical Research Council of Australia. 1985. National guidelines for the control of emission of air pollutants from new stationary sources. Recommended methods for monitoring air pollutants in the environment. Canberra: Australian Government Publishing Service.
- Bunbury Region Plan Steering Committee. 1981. The Bunbury Region Plan summary. Based upon a report prepared by Taylor and Burrell, Town Planning Consultants, for the Bunbury and Districts Regional Planning Committee - June 1980.
- Cremer & Warner. 1986. Report on risk assessment for a proposed titanium dioxide plant at Bunbury, Western Australia. Report No. 86149. Prepared for SCM Chemicals Limited.
- Dames & Moore, 1985. Evaluation of options and recommendations for a long term strategy for disposal of Laporte effluent. Stage I ERMP for the Laporte Steering Group.
- Department of Conservation and Environment. 1981. Water quality criteria for marine and estuarine waters of Western Australia. Bulletin 103. Perth: Department of Conservation and Environment.
- Department of Conservation and Environment. 1983. The Darling System - System 6. Conservation reserves for Western Australia as recommended by the Environmental Protection Authority - 1983. Report 13.
- Department of Conservation and Environment. 1985. Proposed chlor-alkali plant - CSBP & Farmers Pty Ltd - Report and recommendations by the Environmental Protection Authority. Bulletin 216. Perth: Department of Conservation and Environment.
- Department of Conservation and Environment. 1983. Evaluation of disposal options for effluent from Laporte titanium dioxide manufacturing plant. Report and recommendations by the Environmental Protection Authority. Bulletin 137. Perth: Department of Conservation and Environment.
- Groundwater Resource Consultants. 1985. Groundwater contamination study, Australind, for SCM Chemicals Ltd. Report on Stage I - Exploration. March 1985.

Groundwater Resource Consultants. 1986. Feasibility study of process water infiltration scheme. Unpublished report prepared for SCM Chemicals Ltd, October 1986.

Kinhill Stearns. 1986. Proposed Chloride Process Titanium Dioxide Plant, Stage II, Environmental Review and Management Programme, Perth, Western Australia.

Laporte Steering Group. 1986. Effluent disposal on the Leschenault Peninsula 1986-1989. Perth: Department of Resources Development.

Le Provost, Semeniuk & Chalmer. 1983. Effects on Discharges of Acid-Iron Effluent from Production of Titanium Dioxide on the Abundance of Benthic Biota of Leschenault Inlet, Waterways Commission, Perth, Western Australia.

Pomeroy, R.V. 1982. Reliability and Risk Assessment, Presentation at Technical Committee Meeting, Lloyds Register of Shipping, London.

Report of the Working Group established by the Environmental Protection Authority. 1981. Water Quality Criteria for Marine and Estuarine Waters of Western Australia, Department of Conservation and Environment, Perth, Western Australia.

Western Australia, Environmental Protection Authority. 1986. Proposed Liquefied Petroleum Gas (LPG) Extraction Plant, Wesfarmers Kleenheat Gas Pty Ltd, Report and Recommendations by the EPA, Perth, Western Australia.

Western Australia, Environmental Protection Authority. 1986. Statement on the Evaluation of the Risk and Hazards of Industrial Developments on Residential Areas in Western Australia, EPA, Perth, Western Australia.

APPENDICES

- Appendix 1 Proponent's Response to Issues Raised in Submissions
- Appendix 2 Proponent's Response to Issues Raised by the EPA
- Appendix 3 Review of Submissions by the EPA
- Appendix 4 Management Commitments made in the ERMP by the Proponent
- Appendix 5 Extract from a Cremer & Warner Telex to the EPA Regarding Independence of Risk Analysis
- Appendix 6 Cremer & Warner Ltd's comments to the EPA regarding the sensitivity of the Consultant's model to differing input parameters.
- Appendix 7 The explanation, given by Cremer & Warner Ltd, to the Environmental Protection Authority, in a telex dated 16 November 1986 on the difference in risk levels between the CSBP's chlor-alkali plant at Kwinana and the proposed SCM plant at Australind.
- Appendix 8 Water Quality Criteria for Marine and Estuarine Waters of Western Australia. Beneficial use No.7. Maintenance and Preservation of Aquatic Ecosystems. Schedule 7(2).

APPENDIX 1

PROPONENT'S RESPONSE TO ISSUES RAISED IN SUBMISSIONS

SCM CHEMICALS LTD
PROPOSED CHLORIDE PROCESS
TITANIUM DIOXIDE PLANT
STAGE II
ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME
RESPONSE TO SUBMISSIONS

- Prepared by -

Kinhill Engineers Pty Ltd
47 Burswood Road
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Tel. (09)362.5900
Ref. P86050/305:C

March 1987

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1 INTRODUCTION

The Environmental Protection Authority (EPA) received a total of forty-one submissions from both the public and government departments in response to an Environmental Review and Management Programme (ERMP) published by SCM Chemicals Ltd (SCM, the proponent) for its proposed chloride process titanium dioxide pigment plant to be located at Australind. A copy of these submissions, suitably censored to provide anonymity to public respondents, was provided to the proponent for comment. This report contains comments relating to issues perceived by the proponent as being significant. Further information on the risk analysis and design details proposed is contained in a separate submission to the EPA (submitted 18 March 1987). The latter submission concludes that the results of the risk analysis presented in the ERMP were calculated in a conservative manner.

Appendix contains a summary of the comments made in each of the submissions. These have been further summarized into the main issues outlined as follows.

The proposal

Some respondents believed that additional information should have been presented on:

- . possible alternative sites
- . alternative waste disposal options
- . past accident histories of chloride plants
- . intended production capacity
- . components of discharges.

Most respondents accepted the proposal to change from the sulphate process to the chloride process.

The biological environment

The issues raised by respondents in regard to the effects of effluent, atmospheric and solid waste disposal from the plant on the biological environment include:

- . ecology of the Collie River and Leschenault Estuary
- . groundwater quality
- . atmospheric quality.

The social environment

The issues raised by respondents in regard to the effects of the plant on the social environment include:

- . health and safety/buffer zone areas
- . real estate values
- . aesthetics/noise/odour
- . tourism industry
- . planning/zoning aspects

. emergency contingency plans.

The proponent's comments relating to the above issues in the context of commitments given in the ERMP and subsequent changes to the proposal are contained within the following sections. A summary of changes to the proposal subsequent to publication of the ERMP is contained in Appendix B.

2 THE PROPOSAL

2.1 POSSIBLE ALTERNATIVE SITES

A number of submissions raised the question as to why an alternative site more appropriate to land use and planning could not be used for the proposed plant. The ERMP argues that the overriding consideration regarding site selection is based on economic reasons, with the proposed plant not being viable unless it is associated with the existing finishing plant. It is stressed that the stimulus for the proposal is the government's desire to cease effluent disposal on the peninsula, and to achieve this, a capital contribution has already been required from the government towards the proposal.

2.2 ALTERNATIVE WASTE DISPOSAL OPTIONS

A detailed proposal for the disposal of solid waste was not presented in the ERMP. Instead, it was indicated that a suitable landfill site would be developed with the approval of the relevant government authorities.

Alternatives for wastewater disposal have been discussed at a meeting arranged by the Department of Resources Development (DRD). At this meeting, the following were discussed:

- . disposal into the Leschenault Inlet - known water movement patterns in the inlet do not encourage dispersion, particularly during summer when evaporation causes a net movement of water towards the shallow margins;
- . disposal into a lagoon on the Leschenault Peninsula - this option would require the continued operation of the pipeline across the inlet and would prevent sections of the peninsula from being developed for other beneficial uses;
- . disposal into the ocean - this has similar emotive problems to disposal on the peninsula.

2.3 INTENDED PRODUCTION CAPACITY

The production capacity of chloride plants is primarily governed by the size and availability (production time) of the titanium tetrachloride oxidizer. The latter varies from plant to plant and the production rate in the ERMP is based upon a standard SCM oxidizer, with the best available estimates for availability.

2.4 COMPONENTS OF DISCHARGES

The components of discharges given in the EMRP have been deduced from measurements of existing plants and from material balances and are, therefore, the best available.

3 THE BIOLOGICAL ENVIRONMENT

3.1 ECOLOGY OF THE COLLIE RIVER

The proposal to dispose of wastewater into the Collie River was based upon the following two principles:

- . removal from the wastewater of any components that could be considered to cause a future problem to the ecology of the river;
- . dispersion and removal from the discharge location by flow in the upper layers of the river in order to avoid accumulation of wastewater or its components.

With reference to the first principle, concern has been expressed at the levels of manganese in the wastewater stream. As a consequence of this concern, the proponent gave a commitment at the DRD meeting to alter the wastewater treatment process to reduce manganese levels to concentration of the order of parts per million. This will be achieved by raising the alkalinity of the wastewater to about pH 9.0, thereby causing the manganese (and heavy metals, although they are not expected to be present) to be precipitated. The pH of the wastewater would then be adjusted to a neutral level prior to discharge.

Section 5.6 of the ERMP discussed the radiation balance for the proposed plant, based upon the best information available to the proponent at the time of publication. Subsequent to publication, a review of other plants operated by the proponent has not yielded any useful data due to variations in feedstocks and operating practices. Radiation discharge to the Collie River is discussed in the ERMP in terms of an unlikely and hypothetical scenario of all the radiation in the feedstock reporting to the wastewater stream. This is unlikely as lime treatment used to neutralize the wastewater is known to cause effective precipitation of the radionuclides under consideration. The modified wastewater treatment process to remove manganese will further remove radionuclides to levels much less than those discussed in the ERMP. As a further safeguard, the proponent will regularly monitor the wastewater for radionuclides, as well as the bed sediments in the Collie River, to assure the relevant authorities that the proposed disposal practice does not cause an unacceptable accumulation of radionuclides. Commitments have been given to further modify the wastewater treatment should problems be detected. This monitoring will include analysis for heavy metals, even though these are not expected to be present in significant quantities.

The other issue concerning wastewater discharge to the Collie River is the effect of temperature. The rise in temperature of receiving waters is not immediately obvious from the modelling results, which are expressed in terms of dilution factor, defined by equation (4) on page B-14 of the ERMP. A reasonably accurate assessment of the dilution factor required to restrict the temperature rise to +2°C above ambient level is as follows:

- . low flow conditions (26°C ambient), dilution factor required = 4.5
- . high flow conditions (15°C ambient), dilution factor required = 10.0.

Some comments received from local residents queried how physical features in the river (islands, etc.) had been accounted for in the modelling work undertaken by Dr Hunter. The information presented in the ERMP is a combination of two dispersion models:

- . an integral jet-plume model that evaluated the dispersion in the vicinity of the outfall, based upon the momentum of the discharge and the streamflow in the river;
- . a two-layered interconnected box model that evaluated the dispersion into the estuarine system.

The latter model used the best available salinity profile and temperature data to calibrate the model prior to introducing the wastewater discharge and, therefore, effectively accounted for local physical features.

The proponent has recently commissioned Dr Hunter to re-evaluate his modelling to take into account revised discharge quantities arising from the changed discharge strategy and possible variations that may arise during detailed plant design, and to assess the impact of extremely low river flows. This work is progressing and will be made available to the EPA, together with a monitoring strategy, early in April 1987. Special consideration will be given to controlling the impact of temperature upon marine organisms.

3.2 GROUNDWATER QUALITY

The wastewater disposal proposal outlined in the ERMP involved 300 kL/d of wastewater being infiltrated into the groundwater. At the DRD meeting, the proponent gave a commitment to change the wastewater treatment strategy by introducing filtering of the thickener underflow and thereby removing the need to infiltrate the wastewater. Filtering of the thickener underflow will require the filtrate to be discharged into the Collie River, thus increasing the discharge to the river.

3.3 ATMOSPHERIC QUALITY

Some of the public submissions expressed concern about a possible deterioration of air quality surrounding the plant. These comments appear to be based upon a perception of the proposal being a scaling up of the existing operations. However, as clearly stated in the ERMP, all atmospheric discharges will be scrubbed and this, together with the decommissioning of the existing plant, will ultimately result in an improvement in air quality.

4 SOCIAL ENVIRONMENT

4.1 HEALTH AND SAFETY/BUFFER ZONE AREAS

Some of the submissions discussed the adequacy of the buffer zones with respect to those adopted in some overseas countries and from accounts of toxic chemical releases overseas. The proponent believes that the approach adopted by government in setting the statutory buffer zone, evaluating risks and hazards against EPA guidelines, comparing additional noise impacts with statutory requirements and incorporating regional constraints (such as flood plains) is appropriate for this proposal.

4.2 REAL ESTATE VALUES

Some of the submissions expressed concern at the potential for depressed real estate values. In this context, it must be remembered that, of the existing residents, only a handful would have been residents at the time of the establishment of the original plant in 1964. Therefore, the majority of residents would have established their homes with full knowledge of an existing and adjacent major industry. The proponent considers that variations in real estate values are in the main a function of supply and demand and macro-economic factors.

4.3 AESTHETICS/NOISE/ODOUR

Comments relating to these issues have been addressed elsewhere in this response. Commitments to the management of these potential impacts are given in the ERMP.

4.4 TOURISM INDUSTRY

Some submissions claimed that tourism would be a more appropriate industry for the Australind area. This relates to the discussion on alternative sites in Section 2.1. The tourism potential of the region will be improved with the cessation of effluent disposal on the Leschenault Peninsula.

4.5 PLANNING/ZONING ASPECTS

Advice obtained from the Crown Law Department via the DRD confirms the interpretation to zoning given in the ERMP. Therefore, the site will not require rezoning under the Town Planning Act.

4.6 EMERGENCY CONTINGENCY PLANS

Some submissions requested that emergency plans be prepared for the surrounding residential areas. The proponent, while concurring with this viewpoint, cannot be held responsible for public emergency and contingency plans, the formulation of which should be the responsibility of appropriate government agencies. The proponent will afford all practical co-operation in the formulation of such plans.

4.7 SAFETY RECORDS AT OTHER PLANTS

Some submissions requested details of accidents associated with chloride process plants and plants handling chlorine generally. Appendix C contains data pertaining to the above, which were obtained by the proponent's Stalinborough personnel.

APPENDIX B
SUMMARY OF CHANGES TO THE PROPOSAL SINCE THE ERMP

Natural progression of the design phase and commitments given by the proponent in response to specific issues have resulted in the following changes to the proposal since publication of the ERMP:

- . no wastewater will be infiltrated at the site. The proponent will be filtering the thickener underflow to reduce its water content and disposing of the filtrate with the balance of the wastewater;
- . the alkalinity of the wastewater will be raised to about pH 9.0 in order to precipitate manganese and heavy metals, although the latter are not expected to be present in significant quantities. The pH of the wastewater would then be adjusted to neutral level prior to disposal;
- . the proponent will regularly monitor the wastewater discharge and bed sediments in the Collie River for radionuclides;
- . additional safety features currently anticipated in the design, including the following:
 - full height concrete bunding of storage tanks;
 - bunds to be lined with insulating tiles;
 - provision of foam suppressors to chlorine storage;
 - provision of double remote acting block valves to isolate all chlorine pumps;
 - elimination of the possibility of hydrogen/chlorine explosions in chlorine storage tanks by appropriate design of the membrane cell plant;
 - liquid chlorine will be pumped to the storage tank at -34°C and maintained at that temperature by withdrawing vapour to the hypo scrubber, thereby making storage temperature maintenance independent of refrigeration plant failure.

APPENDIX C
DATA ON OBSERVED RISKS FROM CHLORINE INSTALLATIONS

To: P. Bibby
c.c. V.J. Mazza

From: P.J. Lynskey
PJL/JP
22nd January, 1987

RISKS FROM CHLORINE INSTALLATIONS

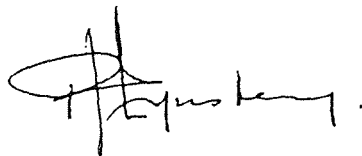
Your Fax. of 7th January 1987 requests information on Fatal Accident Risks for Chloride and Chloralkali plants.

There have been no incidents involving fatalities or injury to members of the public connected with either SCM's (in the past Laporte's) various $TiCl_4$ or Chloride plants, or connected with Tioxide's (and Titanium Intermediate Ltd) $TiCl_4$ and Chloride plant.

We are not aware of any incident in Europe causing death or serious injury to the public from the Thann, Bayer or Kronos plants.

There have been no deaths among the public in the U.K. caused by an incident in a chemical works, which includes chlorine manufacture, storage and use.

Statistics have been gathered for worldwide chlorine incidents but lack of knowledge of the total population at risk prevents this data being presented as an individual risk number.



P.J. Lynskey

FATAL ACCIDENT RISK FOR CHLORINE

In the U.K. the chemical industry record is that no member of the public has been killed as a result of an accident in a chemical plant. Clearly this includes chlorine manufacture, storage and use.

The risk to employees of the U.K. chemical manufacturers who are CIA members can be taken from the CIA annual accident statistics and are reproduced as Table 1. The Fatal Accident Risk (FAR) expressed as deaths per 10^8 working hours is about $1\frac{1}{2}$. This number is comparable with that for U.K. industry as a whole and in fact causes of death tend to relate to general industrial risks rather than to specific chemical risks. It is not possible to separate out the chlorine sector of the industry but there is no reason to believe significantly different statistics would apply.

Accidents related to chlorine storage, pipelines and rail transport worldwide, are listed in Table 2. Marshall (1) has suggested the derivation of a simple mortality index, numbers killed per tonne released, from these statistics, giving for Table 2, for fixed installations, 0.48 deaths per tonne released. Derivation of a risk number from the data would require combining the 129 deaths from fixed installations with an estimate of the total population at risk (i.e. within range) of all chlorine installations over the approximately 60 years covered.

Some of the failure causes no longer apply; rivetted tanks are not used; overfilling is prevented by the use of internal dip pipes. There is also more knowledge of some failure causes, e.g. NCl_3 concentration.

There is some data on chlorine cylinder accidents but it is most unlikely that information on cylinder leaks which caused no casualties will be reported, giving a high mortality index for those that are reported because a serious casualty resulted.

(1) How Lethal are explosions and toxic escapes? V.C. Marshall
The Chemical Engineer, August 1977 - P573-577

TABLE 1

ACCIDENT RECORD OF CIA MEMBERS

<u>Year</u>	<u>Fatalities</u>	<u>Total Man Hours (Thousands)</u>	<u>FAR*</u>
1985	4	266447	1.50
1984	4	278968	1.43
1983	4	256445	1.56
1982	1	248412	0.40
1981	4	308779	1.30
1980	6	338674	1.77
1979	8	403887	1.98
1978	8	344058	2.33
1977	11	359631	3.06
		Overall	1.78

*FAR = Fatalities per 10^8 worked hours.

PJL/JP
22nd January, 1987

TABLE 2

<u>Location</u>	<u>Date</u>	<u>Released From</u>	<u>Tonnes Released</u>	<u>Fata- lities</u>	<u>Mortality Index</u>	<u>Notes</u>
Wyandotte, Mi	1917	Storage Tank	13.6	1	0.073	
St. Auban, France	13th December 1926	" "	25	40	1.60	
Syracuse, N.Y.	10th May, 1929	" "	22.5	1	0.044	H ₂ + Cl ₂ explosion
Zarnesti, Roumania	24th December 1939	" "	25	ca 60	ca 2.40	
Rauma, Finland	5th November, 1947	" "	30	19	0.63	Tank overfilled, too great a fitting ratio
Walsum, Germany	4th April, 1952	" "	15	7	0.46	Converted boiler, rivetted
Lake Charles, La	10th March, 1956	" "	2.7	0	0	
Baton Rouge, La	10th December, 1976	" "	90 - 100	0	0	Explosion by natural gas contamination. Tank jumped and punctured by load cell support point
Cleveland, Ohio	5th August, 1969	2 1-ton containers	1	1	1	Contaminated by NCl ₃
Malaga, Spain	27th December, 1974	One-ton container	1	4	4	Connection knocked off while loading in ship
Johnsonburg, Pa	11th December, 1936	Pipeline	3	1	0.33	Transfer line broken by housing
Freeport, Texas	9th January 1949	" "	5	0	0	Line burnt in attempted welding
Billingham, U.K.	23rd February, 1961	" "	12	0	0	
Dominquez, Ca	12th September, 1966	" "	0.25	0	0	Accidentally cut by welder
Dominquez, Ca	21st February, 1967	" "	0.25	0	0	Pipe dug up accidentally
Dominquez, Ca	22nd February, 1967	" "	0.25	0	0	Pipe dug up accidentally
Javle, Sweden	19th October, 1970	" "	2	0	0	
Tavaux, France	8th December, 1974	" "	20	0	0	Line to tank car broke during emptying.
Chrome, NJ	1914	Rail Tank Car	7	0	0	
Asbotan, N.Y.	7 & 13th July, 1928	" " "	2	0	0	
Niagara Falls, N.Y.	28th February 1934	" " "	14.5	0	0	Anchor failure
Griffith, Ind	13th March, 1935	" " "	27.5	0	0	Anchor failure
Mjodalen, Norway	26th January, 1940	" " "	8	3	0.375	
Chicago, Ill	4th February, 1947	" " "	16.3	0	0	Caused by heat from a fire
Billingham, U.K.	20th July, 1950	" " "	0.5	0	0	
Runcorn, U.K.	19th October, 1957	" " "	2 - 3	0	0	
La Barre, La	31st January, 1961	" " "	27.5	1	0.036	Train wreck
Cornwall, Ont	30th November, 1962	" " "	27.5	0	0	Anchor failure
Brandtsville, Pa	28th April, 1963	" " "	8	0	0	Valves sheared in wreck
Philadelphia, Pa	9th August, 1963	" " "	?	0	0	Loading line broken when rammed
La Spezia, Italy	14th June, 1966	" " "	7	0	0	
Newton, Al	18th November, 1967	" " "	50	0	0	Tank punctured in a wreck
Loos, BC	5th March, 1973	" " "	15.5	0	0	
Youngstown, Fa	26th February, 1978	" " "	50	8	0.16	Train containing 6 tanks crashed, 2 tankers leaked
Mississauga, Canada	10th November, 1979	" " "	70	0	0	Train crash and propane fire, ruptured chlorine tank
Montana, Mexico	1st August, 1981	" " "	100 initial 300 total	17	0.17	Train wreck of 32 chloride tanks, 13 dead due to chlorine 4 to collision.
		Total, fixed installations	266.55	129	0.48	
		Total, all cases	701.85	163	0.23	

LIST OF INCIDENTS FROM JANUARY 1981
Cl2, TiCl4, AlCl3

SOURCE	DATE	COMPANY	LOCATION	DETAILS OF INCIDENT	DEATHS, INJURIES, COSTS
Job Safety & Health Report 11 (5) 10.3.81.	Feb 1981	Hooker Chemical & Plastic's Corp.	Tacoma Washington USA	Approximately 10,000 cubic feet of chlorine gas leaked from the plant, injuring 13 workers employed at an adjacent company. Also 3 Hooker employees were treated with oxygen. The accident was allegedly caused by a power failure which caused loss of control of seals in a gas line.	0, 16, -
Hazardous Materials Intelligence Report 5.6.81.	19.5.81.	Puerto Rico Aquaduct & Sewer Authority (PRASA)	San Juan Puerto Rico	Chlorine corroded the main valve at the water filtration plant owned by P.R.A.S.A. and the resulting rupture allowed most of the chlorine in the two 1-ton tanks to leak into the atmosphere. 2,000 inhabitants were evacuated.	0, 2000 , - people were treated for chlorine exposure,
Hazardous Materials Intelligence Report 12.6.81.	1.6.81.	BASF Wyandotte Corp	Geismar Louisiana	An undetermined quantity of chlorine gas leaked at the BASF plant. Construction workers, who were building an addition to the plant, were treated at hospital for chlorine exposure. The chlorine emission was caused by a mechanical malfunction.	0, 141 treated for chlorine expo- sure, 10 hospita- lized overnight, -
Lloyd's List 5.8.81. Times 5.8.81.	1.8.81.	-	Potosi Mexico	A goods train derailed causing 27 tank cars to leave the rails. 4,000 Gallons of chlorine gas was spilt from the tank cars and 5,000 people fled the area. The cause of the derailment was a brake failure.	29, 1000, -
The Standard 13.8.81. The Times 13.8.81.	12.8.81.	Nor-Cal Swimming Pool Supplies	Wallington Surrey	A fire at a warehouse caused the release of a cloud of chlorine gas. Containers of hydrochloric acid, minuric acid, glycerine and chlorine exploded to create the toxic gas cloud. 500 people were evacuated from their homes.	0, 25 people treated for expo- sure to chlorine, £500,000
Hazardous Materials Intelligence Report 1.1.82. Chem. Marketing Reporter 4.1.82	26.12.81	Imtoe Industries	Fraser Michigan	A cloud of chlorine was released from a parked trailer containing dry chlorine bleach. Eight of the sixty six barrels stored on the trailer were consumed in a fire. 6000 Residents were evacuated for 3 hrs. The pellets which became contaminated with water were being processed in violation of a city ordinance.	0, several \$2,400 minor

SOURCE	DATE OF INCIDENT	COMPANY	LOCATION	DETAILS OF INCIDENT	DEATH AND INJURIES	COST OF DAMAGE	CHEMICAL INVOLVED	EQUIPMENT INVOLVED
	1982							
Hazardous Materials Intelligence Report 16 Apr 1982	10th April 1982	Diamond Shamrock	West Virginia USA	Pipeline ruptured releasing 29 tons chlorine before leak stopped.	-/15	-	Chlorine	Pipeline
Hazardous Materials Intelligence Report 17 Dec 1982	15th December 1982	-	Israel	4 tons "Alchloride" solidified in reactor due to human error	-	US\$ 42,000	Aluminium chloride	Reactor

SOURCE	DATE OF INCIDENT	COMPANY	LOCATION	DETAILS OF INCIDENT	DEATH AND INJURIES	COST OF DAMAGE (,000s)	CHEMICAL INVOLVED	EQUIPMENT INVOLVED
	1983							
Chemical Week 16.3.83	February 1983	Ford Motor Corp.	South Charleston USA	Explosion in the chlorine unit at Ford Motor Corp's plant.	1/-	-	Chlorine	-
Essen newspaper	15th May '83		Essen W. Germany	Leak of chlorine gas at the Baldeney Lake swimming pool	1/27	-	Chlorine	-
HMIR 19.9.83.	8th August '83	Borden Chemical Co.	Geismar Louisiana, USA	1000 lbs of chlorine leaked from ruptured valve of a road transport tanker	0/7	-	Chlorine	Road transport
Daily Telegraph 16.8.83.	15th August 1983	Bryers	Swardeston Norfolk UK	Spillage from tank caused release of chlorine	-	-	Chlorine	Tank
Times 9.12.83.	18th December 1983	La Porte	Stalling borough UK	Fire caused by ignition of titanium tetrachloride Fume escape	0/1* *employee	-	Titanium tetrachloride	-
HMIR 30.12.83	23rd December 83	Stauffer	Louisiana USA	Valve failure caused leak of 3000 lbs of chlorine	0/12	-	Chlorine	Valve

LIST OF MAJOR INCIDENTS FOR 1984

SOURCE	DATE OF INCIDENT	COMPANY	LOCATION	DETAILS OF INCIDENT	DEATH AND INJURIES	COST OF DAMAGE (,000s)	CHEMICAL INVOLVED	EQUIPMENT INVOLVED
BBC News 6.9.84	6th September 1984	-	Hinkley, Leicester UK	Chlorine leak at swimming pool.	0/40	-	Chlorine	-
Toronto Globe and Mail	15th November 1984	Boise Cascade Canada Ltd	Ontario, Canada	Overheated chlorine pipe caused the steel to burn and rupture with the release of chlorine from a pulp mill. The entire town of 9000 people was evacuated.	-	-	Chlorine	Pipe
Times 21.11.84 and 23.1.85 Guardian 23.1.85	20th November 1984	-	Slaithwaite, Yorkshire, USA	Road tanker of ferric chloride incorrectly labelled as sodium hypochlorite was offloaded into a tank of sodium hypochlorite causing the release of chlorine.	0/16	-	Ferric chloride Sodium hypo- chlorite	Road transport
BBC News	28th December 1984	ICI	Thornton, Lancs, UK	Explosion resulted in the release of chlorine		-	Chlorine	-

LIST OF MAJOR INCIDENTS FOR 1985

SOURCE	DATE OF INCIDENT	COMPANY	LOCATION	DETAILS OF INCIDENT	DEATH AND INJURIES	COST OF DAMAGE (,000s)	CHEMICAL INVOLVED	EQUIPMENT INVOLVED
Times 7.1.85	4.1.85	Madurai Coats	Kerala, INDIA	Chlorine gas release.	0/45	-	Chlorine	-
HMIR 22.2.85	12.2.85	Pennsylvania Electric Co.	Homer City, Pennsylvania, USA	Chlorine gas released when sodium hypochlorite mixed with sulphuric acid in a drain pipe.	-	-	Chlorine Sodium hypochlorite Sulphuric acid	-
Gazet van Antwerpen	28.2.85	Loda	Westmalle, BELGIUM	A road transport tanker of hydrochloric acid was delivered by mistake for sodium hypochlorite and offloaded into a hypochlorite tank. Chlorine gas was released.	0/28	-	Sodium hypochlorite Hydrochloric acid	Road transport
Financial Times 3.4.85	2.4.85	Union Carbide	Bhopal, INDIA	Chlorine release while being transferred from plant to road tanker.	-	-	Chlorine	-
Los Angeles Times 30.9.85	11.4.85	Int. Flavors & Fragrances	Union Beach, N.J., USA	Release of chlorine.	0/1	-	Chlorine	-
Lloyd's List 19.7.85	10.7.85	-	Toledo, Ohio, USA	Fire in warehouse containing chemicals. 600 people evacuated.	-	-	Chlorine Ammonia Detergents	Warehouse
Lloyd's List 2.9.85	30.8.85	Calico Mills	Bombay, INDIA	Rupture of pipe carrying chlorine from a 37 ton tank caused release.	1/150	-	Chlorine	Pipe
The Guardian 5.9.85	4.9.85	H.R.Howard	Middleton, Manchester, UK	Two chemicals accidentally mixed causing the release of chlorine and people evacuated.	0/89	-	Chlorine	-

APPENDIX 2

PROPONENT'S RESPONSE TO ISSUES RAISED BY THE EPA

Your Ref:

Our Ref: JL:JMR:GMMY87

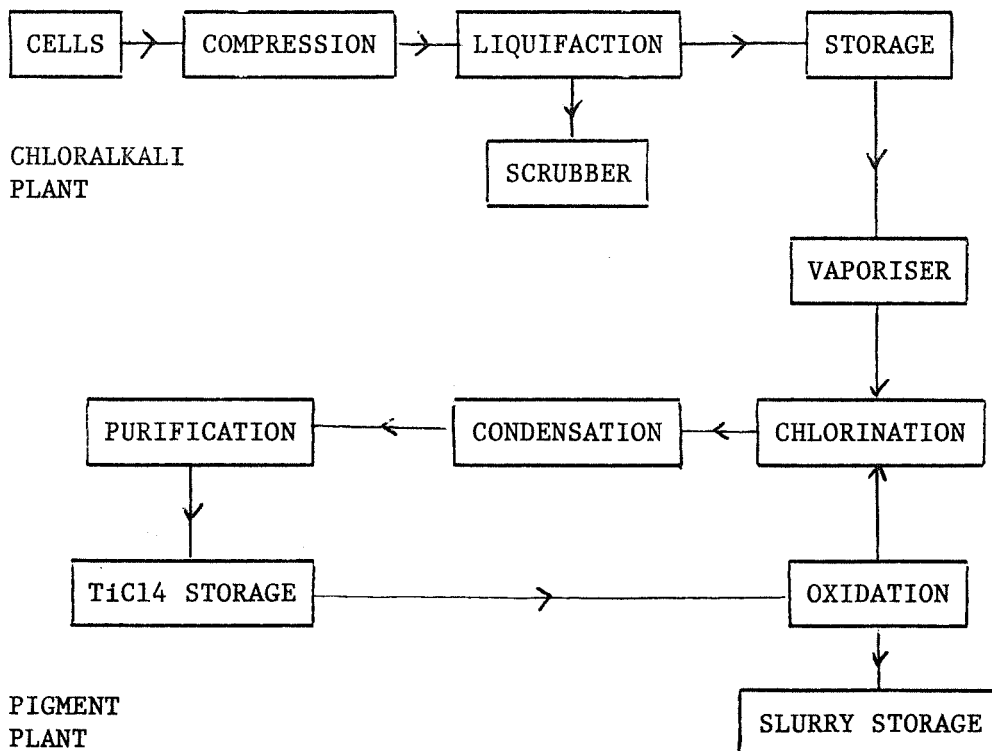
Mr R.A. Field,
 Director - Evaluation Division,
 Environmental Protection Authority,
 1 Mount Street,
 PERTH, W.A. 6000

Dear Ross,

The following information is supplied in answer to the questions and queries raised on our chloride conversion project.

FLOW DIAGRAM

The relationship between the process stages in the chloralkali plant and our proposed chloride pigment producing unit is shown in the block flow diagram below.



CHLORINE STORAGE

Justification

(a) Economic Reasons

The reasonable expectation of availability of a chloralkali plant at Australind is 95%. Total plant downtime is therefore 18 days. Five of these days are associated with annual scheduled maintenance which could coincide with the pigment plant annual maintenance period. This leaves 13 days (312 hours) of downtime. The great majority of outages are in the 8 - 12 hour range giving an expected 30 times a year shut down averaging 10 hours.

If there were no buffer storage between the two plants then this would result in a loss of pigment output. Loss of revenue associated with this production loss at current average export price would be in excess of \$5 million.

In addition, each shut down produces several tonnes of off specification material which is not saleable. Up to a certain limit, this can be blended back into good base, but with an overall reduction in product quality. The blend rate is determined by what mix can be attained whilst retaining market acceptability. The worst scenario is that none can be blended, leading to a further annualised loss of revenue of over \$5 million.

(b) Operational Reasons

To avoid the above losses it is necessary to have some liquid chlorine storage between the two plants. The 8 - 12 hour chloralkali plant outages require a storage of 14 - 21 tonnes of chlorine at the normal usage rate.

It was on this basis that 25 tonnes of storage was chosen (this gives a small margin of safety for a 12 hour shut down).

Normal industrial practice is to use two tanks for this type of duty to enable accurate production and usage numbers to be obtained. On this basis 2 x 25 tonne tanks give an average storage of 25 tonnes. One filling and the other emptying at all times. The third tank has been included as a spare to allow maintenance on the other two and to provide a place to pump out a tank should a problem develop.

(c) Added Risk

The imposition of extra shut downs on the titanium dioxide plant would increase the risk of gaseous release. This risk has not been quantified for this particular plant. Qualitatively, the least stable operating conditions are experienced on start up or shut down. It is during these periods that the likelihood of equipment or human failure is highest.

We believe from discussions with Cremer and Warner that experience in North Seas Gas pipeline operations suggest that some 90% of pipeline failures occurred at start up. Our own experience on effluent pipelines supports this.

CHLORALKALI PLANT AVAILABILITY

Plant availability has been assessed at a nominal 95% on the following basis.

One chloralkali contractor quotes 15 days total downtime as representative. In our situation the operating restrictions will be tighter than most plants, leading to a more frequent downtime. For example, operation could not continue with a minor chlorine leak on a compressor. The use of 18 days is considered by them to be reasonable.

A second contractor in their sales presentation described a situation of 98% availability outside of major shut downs. Marketing presentation figures are notoriously optimistic and SCM believe a further 2% discount on this figure would be more representative.

A plant visited by SCM in the USA had been operating for 18 months and had had an availability of 60% in the first year of operation. After this first year, on stream factor has increased to the mid nineties.

On this basis, SCM considers that a planned availability of 95% on the chloralkali plan is reasonable, but there will be a normal variation around this figure.

Plant reliability can certainly be increased by the expenditure of capital funds. In general the functional relationship between reliability and capital expenditure is exponential. At the margin, each extra percentage point of plant reliability requires a disproportionate amount of capital expenditure.

To improve reliability to such a high level as to allow a low quantity of storage would require significant capital equipment and systems duplication. The complete brine treatment section of the plant would require duplication, as would the chlorine compression and liquefaction sections. These are conservatively estimated to add several millions of dollars to the cost of the plant.

INCREASING SAFETY OF STORAGE VESSELS

Additional features currently anticipated in the design but not allowed for in the original risk analysis are as follows:-

- Full height Bunding - Concrete bunding to the full height of the storage tanks.
- Insulating Tiles - The bund would be lined with insulating tiles to prevent rapid heat transfer from the bund to the liquid chlorine and so reduce the rate of vapourisation of the liquid.
- Foam Suppression - The foam generators would provide a stable insulating barrier on top of the chlorine to minimise heat extraction from the atmosphere, and suppress gas evolution.
- Isolating Valves Around Pumps - The chlorine pumps would have double remote acting block valves to allow remote complete isolation of the pump should it develop a leak.

- Hydrogen/Chlorine Explosion in Storage Tanks - The major risk of hydrogen/chlorine explosion in chloralkali plants has been associated with the non condensible gas line to the scrubber in mercury cell plants. In modern membrane cell plants, the chlorine produced by the membrane cell is of a relatively high purity. The hydrogen content of the chlorine gas from the cells is below detectable limits, with membrane cell producers specifying 0%. (See attached excerpts from contractor literature.)

The average quantity of chlorine will be less than twenty-five tonnes. The tanks are of nominal 25 tonne capacity. With some allowance for head space, actual maximum storage in a tank may be 24 tonne. The operating procedure is to have one tank filling whilst the other is emptying. As these cycle, the average inventory at any time will be between 24 and 25 tonnes. The average contents of a single tank at any time will be some 12 tonne, with a range of < 1 tonne to 24 tonne.

The use of full height bunds, insulation tiles and foam suppressent will significantly reduce the rate at which chlorine will be vapourised should a major spillage occur.

CHLORALKALI PLANT START UP

The initial start-up of the chloralkali plant will require the import of liquid chlorine in 1 tonne cylinders. This will be a once-off requirement.

DIFFERENCES IN RISK SCM VS CSBP

A certain amount of information has already been provided to the EPA by Cremer and Warner. We have been advised that for ethical reasons they are unable to disclose any more details of their other client's proposal. Cremer and Warner have indicated that the individual risks associated with the SCM proposal, at the 10^{-6} level, would extend to some 2 km should we not include the engineering design concepts intended.

SENSITIVITY OF THE MODEL USED BY CREMER AND WARNER

We have been told by Cremer and Warner that their model has the following sensitivities pertinent to our project and we quote their comments.

"Sensitivity Analysis

Cremer and Warner had many years experience in both developing and using models for risk analysis of installations handling toxic materials. The model used in the present project was developed in 1982 following identification of deficiencies in earlier models. At this time a thorough sensitivity analysis was undertaken in addition to the validation procedure. Relevant sensitivities are discussed below. Note, although numbers quoted are not directly for the proposed SCM development, it is expected that similar numbers would be produced if an equivalent sensitivity analysis is run for it.

Sensitivity to Release Frequency

The largest source of uncertainty in a risk analysis is the estimation of release frequencies. Since the overall frequency of risk whether societal or individual is directly proportional to the release frequency no further discussion is given.

Sensitivity to Release Duration

If the release durations are increased, i.e. if no allowance is made for automatic shutdown of equipment the risk contours will move outwards, increasing typically 10 per cent at the 400 m distance and nearly 20 per cent at 600 m.

Sensitivity to Vaporisation Characteristics

A realistic model has been used to calculate the vaporisation rates from liquid pools, both chlorine and titanium tetrachloride. However, if the vapour generation rate is doubled the individual risk levels at any distance from the site will vary by 30 to 50 per cent.

Note, that in the particular case of the SCM plant at Bunbury, many of the cases which have the highest contributions to individual risk are gaseous releases and so the analysis would be less sensitive to this particular parameter.

Sensitivity to Meteorology Data

The selection of four typical weather cases to represent the full spectrum of weather cases is a coarse approximation. However, the uncertainties associated with the release frequency data mean that a more rigorous analysis cannot be justified. Moreover, the meteorology data from Glen Iris is only available for a short period, therefore, there is no guarantee that it is representative of average conditions.

Typically, doubling the number of weather categories can vary the calculated individual risks by about ten per cent at maximum.

Sensitivity to Toxicity Data

There are a large number of toxic models for chlorine which have been published. The one used in this study is that developed by Cremer and Warner. This is a mid range model. Other models are considerably more pessimistic, e.g. US Coast Guard model (Reference 2). The US Coast Guard model is now generally acknowledged to be inappropriate for risk analysis (Reference 3), whilst the Akzo model contains no allowance for the high variability in chlorine resistance found in the general population and so is representative only of healthy adults not the very young or very old, asthmatics, etc.

The overall results of the risk analysis are more sensitive to this choice of toxicity model than to any other parameter. If the Akzo model is used the individual risk at the 400 m level decreased by a factor of about 50. Further from the plant the decrease in risk is even more dramatic. If, however, the US Coast Guard model is used the risks increase by a factor of 4 at 400 m. Again, the difference increases at greater distances.

Sensitivity to Fraction of People Outdoors and Escape Model

For many releases the effects can be mitigated by potentially exposed people escaping indoors. In this study individual risk has been calculated based on 100% outdoors and societal risk on 20% of people outdoors at all times. No allowance has been made for people initially outdoors escaping indoors.

The risk analysis program has been tested with an escape model based on that in Reference 4. The difference the inclusion of this model makes is small (<10%) when only a relatively small fraction of people outdoors is assumed.

If a large number of people are assumed to be outdoors then the number of fatalities that can be expected from a large event will increase. This effect is greatest for those releases which only cause a few fatalities. The increase in the number of fatalities caused by a large release to changes in this assumption are small.

If the number of people present in the area during the 'day' is reduced to fifty per cent in order to allow for people going to work, etc. then the effect on the societal risk is small because the greatest risk occurs during stable conditions which tend to occur only at night or in the early morning.

Sensitivity to Ventilation Rate

Variations in the value assumed for the ventilation rate have only a small effect on both individual and societal risk in the case of chlorine. This is because the majority of the risk is posed to people outdoors rather than indoors.

Sensitivity to Surface Roughness

The dispersion models used are quite sensitive to the surface roughness length assumed, particularly in F stability conditions. If the roughness length is reduced from 0.36 m to 0.1 m, a considerable reduction, it is anticipated that the risk contours would move out by up to thirty per cent.

Other

In terms of individual risk the most important control measure by far is placing the $TiCl_4$ process in a building. This reduces the frequency of releases which could affect people outside the SCM site by a factor of fifty when considering those items of equipment which have been placed in the building."

PROPOSED MANAGEMENT STRUCTURE

A simplified management structure for the SCM Chemicals Ltd plant is presented diagrammatically in Figure 1. It is essentially based upon our existing management system with increased emphasis on the role of Hazard and Risk management as befits the introduction of chlorine and titanium tetrachloride to the site.

Because of the long established organisation on the Bunbury site, there is already a comprehensive management system in place appropriate to the safe handling of hazardous chemicals, such as sulphuric and hydrochloric acids, caustic soda, and gaseous oxides of sulphur.

Whilst the manufacture of titanium dioxide by the Chloride route represents new technology for the Bunbury site, extensive safe operating experience is available from four other SCM sites, where Chloride technology has been developing and improving over 20 to 30 years (depending upon the site). This experience is being utilised to the fullest extent during plant design, and for training of management and workforce, development of standard operating, process control and maintenance procedures, emergency response planning, hazard and risk management programmes and for plant commissioning.

Overseas training will take place at all levels down to, and including, Supervisor/Foreman. This programme is in progress already, with the proposed Chloride Plant Manager having spent two years in the USA to date and the Production Manager having joined the Chloride Project Design Team as from September 1986. The proposed Assistant Chloride Plant Manager is currently at our Stallingborough plant undertaking an eight month training period, and the Works Engineer is on an extended visit to all operating areas.

Senior operator and Shift Supervisor training has commenced locally, utilising 27 and 18 week courses specifically designed in conjunction with Bunbury TAFE.

Standard operating, process control, maintenance and safety procedures are being developed in conjunction with our Stallingborough and Baltimore site personnel. Full procedure manuals are available from all existing sites and a set of Bunbury specific manuals will be developed well prior to start up, to facilitate training.

Hazard and risk management programmes are in place at all sites and are monitored and auditted currently by the Manager - Loss Prevention in Baltimore. A similar comprehensive programme is being developed for Bunbury, modelled substantially on the well proven Stallingborough system, with modifications essentially to take account of more restricted availability of local emergency services. Significant interchange of appropriate personnel will be required during development of the programmes. Performance thereafter will be auditted by Baltimore on a regular basis for hazard, safety and industrial hygiene management standards, as for existing sites (as indicated in Figure 1).

A further external audit on operations will take place via a system of "Permission for Change" which operates already on our existing plant, whereby all significant process changes are notified formally to Stallingborough, prior to implementation, for technical and hazard review. No changes are implemented without formal approval from the Hazard and Risk Manager at Stallingborough.

OPERATION OF THE CHLORALKALI PLANT

We will advise you of our decision of a chloralkali plant operator as soon as this is decided.

OTHER INFORMATION:

Site Selection. The essential factor leading to the selection of Australind as the preferred site is that of extra cost. This extra cost has been identified to the Department of Resource Development as being in excess of \$15 million.

In the Company's negotiations with the State Government, much financial information was provided on a confidential basis. This information demonstrated that the return on investment was unsatisfactory for SCM without a contribution by the Government. This contribution will be a payment to relieve the Government of WA of its obligation to dispose of the sulphate plant effluent. It can be seen from this that a further \$15 + million would render the return on investment such that the conversion would not take place and the effluent disposal problem would remain.

All alternate sites would suffer this added capital constraint, as well as significant additional ongoing operating costs over \$1 million per year. Thus all alternate sites were considered unsuitable. Without an additional \$15 million contribution from the Government, they would remain unsuitable as an alternative investment for the Company.

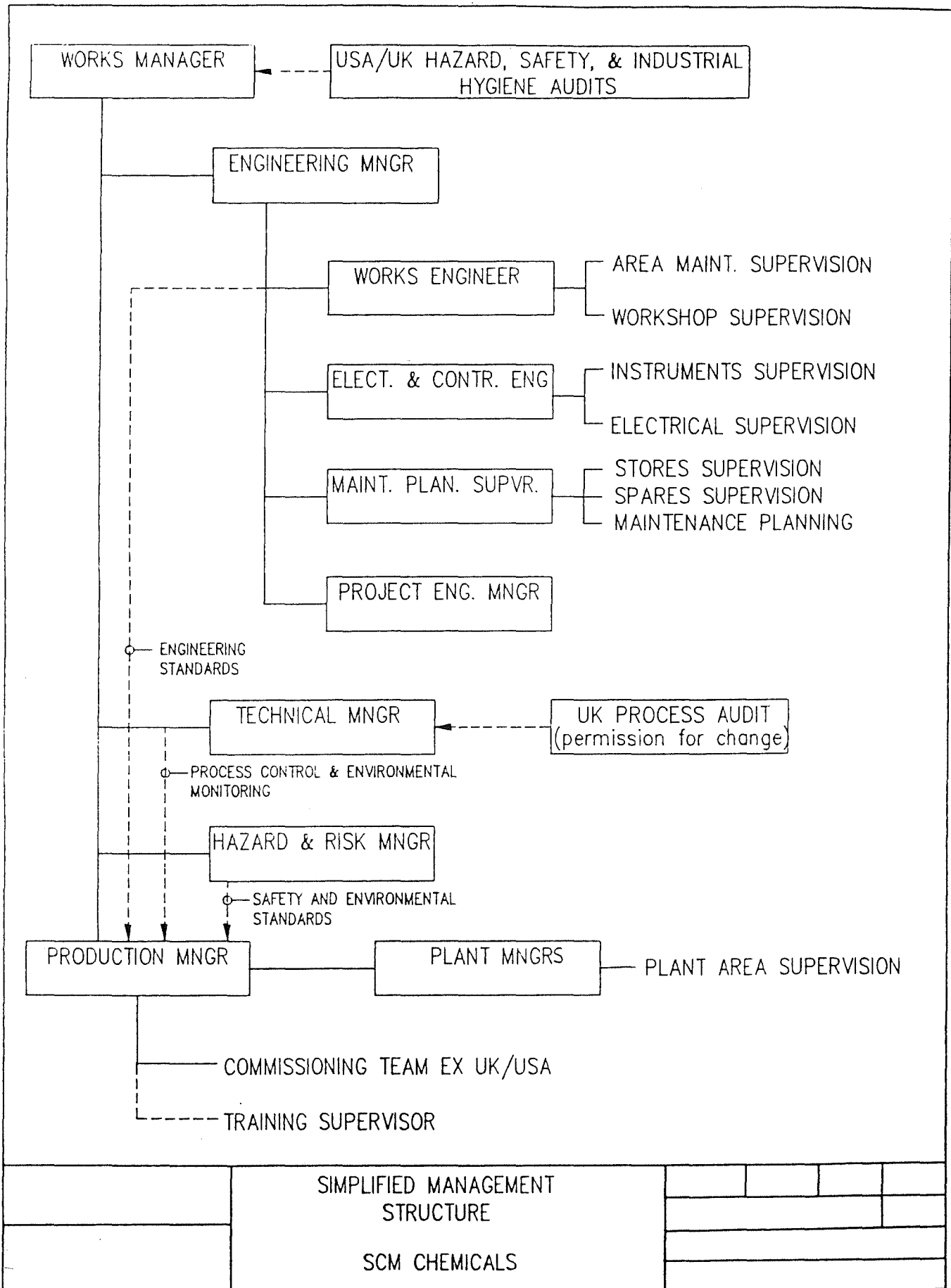
The extra \$15 + million is associated with duplication of infrastructure, effluent pipeline to a suitable discharge point including the costs of easements, land purchase and preparation and contingency. A detailed breakdown of the cost estimates has been provided to the Department of Resource Development.

It is our understanding that you may wish to publish the information contained in this letter as a part of your assessment report and we confirm that we have no objection to this.

Yours sincerely
SCM Chemicals Ltd



.....
J. Leach
General Manager



SIMPLIFIED MANAGEMENT STRUCTURE

SCM CHEMICALS

1ST CONTRACTOR

Chlorine Gas ex Cells (dry basis)

Cl₂ = 97 - 99 Vol.-%

O₂ = 1 - 3 Vol.-%

H₂ = Nil

Liquid Chlorine/Gaseous Chlorine

Cl₂ = 99.5% w/w

2ND CONTRACTOR

Chlorine ex Cells

(a) With alkaline brine feed:

Chlorine (v/v) 97.1%

Oxygen (v/v) 1.9%

Carbon Dioxide (v/v) 1.0%

(b) With acidic brine feed:

Chlorine (v/v) 98.4%

Oxygen (v/v) 1.5%

Carbon Dioxide (v/v) 0.1%

APPENDIX 3

REVIEW OF SUBMISSIONS BY THE EPA

SUBMISSIONS FROM THE PUBLIC AND GOVERNMENT DEPARTMENTS

A total of 51 submissions were received on the proposed chloride process titanium dioxide plant at Australind; 11 from Government agencies and 40 public submissions. Three public submissions in the form of petitions containing a total of 1 128 signatures protesting the establishment of the new plant at Australind.

The issues that received most frequent comment in the submissions related to the following categories:

- (1) Risks and Hazards
- (2) Liquid Waste Discharge to Collie River
- (3) Air Emissions
- (4) Radiological Aspects
- (5) Occupational Health and Safety Issues
- (6) Solid Waste Disposal
- (7) Site Selection
- (8) Other

The list of persons and government agencies making submissions is attached at the end of this appendix. The order in which that list is presented does not correspond to the numbering in Table 11 of those making submissions.

1. RISKS AND HAZARDS

1.1 OPPOSITION

Eighteen submissions objected to the construction of the plant at the suggested location. The main reason given was that it would be impinging on the lifestyle of the people of the surrounding area. Some perceived that there would be emissions from the plant which would cause health problems to residents and affect people involved in recreational activities such as users of the golf course, Collie River and Leschenault Inlet and surrounds. Some had the view that marine and bird life in and around Collie River and Leschenault Inlet could be contaminated by wastes from the plant. Some said that it was a high risk industry and they were anxious about the safety of the surrounding community. Some objected on the grounds of the worst possible scenario, ie a catastrophic event as a result of an accident at the plant with subsequent horrific consequences.

1.2 RISK FINDINGS

A few submissions said that despite the risk analysis findings they were not prepared to accept the proposed location because the overriding concern was that an accident could have disastrous consequences.

1.3 RECORD OF COMPANY

Some submissions made the point that they were concerned about the company's ability to operate and maintain the proposed chloride process plant safely based on the company's past performance on the sulphide process.

1.4 METHODOLOGY AND RESULTS OF RISK ANALYSIS

One submission questioned the credibility of the results of the risk analysis on the basis of discrepancies noted in the data.

Some submissions expressed that additional information should have been used in the risk analysis and that some technical points were inaccurate.

A few submissions were concerned that no staff had been sent to the site prior to publication of the risk analysis report.

1.5 EMERGENCY PLANS AND SERVICES

A number of submissions stated that an emergency plan should be developed for the workforce and community prior to any construction commencing.

A few submissions pointed out that there would be difficulties with an emergency evacuation plan because of a problem of few access roads to residential areas near the plant from the arterial road.

There was also concern about the adequacy of emergency services in terms of availability and where they were located.

1.6 PLANT SAFETY

Some aspects of this issue were concerns about safety of chemical storage, supply equipment for safety needs, risks to safe operations through human error.

Some submissions pointed out that details about accidents associated with chloride process plants had not been mentioned.

2. LIQUID WASTE DISCHARGE TO THE COLLIE RIVER/GROUNDWATER

Comments were made in relation to various aspects of the discharge - discharge processes, wastes composition, environmental effects, groundwater recovery plan.

2.1 DISCHARGE BY INFILTRATION

Some submissions were of the opinion that large quantities of saline water with significant amounts of heavy metals and radionuclides would be discharged into the Collie River (and groundwater) via the infiltration ponds.

There was concern that the salinity would significantly alter the salinity of both the river and groundwater, affect the flora of the riverbank and the Egret Swamp which could in turn affect the egret colony and fish breeding in the Collie River. Some submissions expressed that heavy metals could enter the food chain and contaminate fisheries of the Inlet similar to Geographe Bay. Two submissions mentioned that Collie River and Leschenault Inlet are

the subject of a System 6 recommendation and one also said that they are part of a Regional Park proposal, and as such, wastes should not be entering these areas.

One submission said that more detailed plans for the infiltration method should be submitted.

One submission was concerned about the groundwater contaminant recovery programme and said that more detail was required describing the recovery programme and method of disposal of contaminants. It was thought that the best method of disposal would be to filter the waste to remove solids and dispose of the liquid with the other liquid waste.

2.2 DISCHARGE TO COLLIE RIVER

Seventeen submissions raised issues and technical points regarding this procedure. Eight submissions specifically expressed concern regarding the temperature of the waste water which would be discharged, saying that the 35°C mentioned in the report was too high and should be lowered to river temperature (which one submission indicated as averaging 22°C).

One submission mentioned that the discharge location was one of the best breeding areas for some fish species in the south-west of the State.

Submissions expressed concern about modelling data used to estimate aspects of the discharge such as mixing zones, flow rates and depth discharge data. The general view was that further study was needed.

Some submissions were concerned about heavy metals which could be discharged in the waste water. One submission identified that aquatic fauna toxicity of vanadium and manganese was not addressed. It was mentioned that the amount of manganese to be discharged was high compared to the guidance limit for industrial discharges and aquatic life sub-lethal effects data. Two submissions were concerned about manganese becoming oxidized to form manganese oxide, a black precipitate. The suggested solution was to remove the manganese via pH alteration prior to disposal.

2.3 ALTERNATIVE EFFLUENT DISPOSAL

A few submissions mentioned waste treatment options other than the proposed discharge to Collie River and infiltration to groundwater including pumping across the inlet and disposal in a settling pond on the peninsula, effluent pumped over the peninsula to the sea, effluent pumped into deep estuary water.

3. AIR

Concern was expressed that the toxic gas (phosgene) could be inadvertently produced on-site where carbon monoxide could be in contact with chlorine gas in sunlight.

Three submissions expressed concern about the emissions of chlorine from the plant in that they felt that the odour could cause health problems. There was also concern that carbon monoxide and carbon dioxide which are plant emissions, could have toxic effects on plant staff and the nearby community during an atmospheric inversion.

One submission said that burning off hydrogen gas in a suitable stack was safer than venting the gas to the atmosphere.

4. **RADIOLOGICAL ASPECTS**

Two submissions expressed the view that the report had not adequately assessed radiological issues.

4.1 FEEDSTOCK AND PLANT WASTES

One submission expressed concern that insufficient detail had been given regarding radioactive material entering the plant and radioactivity in the wastes. It was mentioned that a new assessment of solid waste disposal options would be required as the method mentioned in the report was likely to be inappropriate in view of the nature of the wastes. The impact of release of waste water containing radionuclides into Collie River and Leschenault Inlet was also mentioned as requiring assessment.

4.2 RADIOACTIVITY IN THE PLANT

The chlorinator brickwork which accumulates radionuclides was of concern in a few submissions. It was mentioned that monitoring of actual radiation levels of the brickwork would be necessary in order to ensure safe handling and disposal methods.

5. **OCCUPATIONAL HEALTH AND SAFETY ISSUES**

5.1 GENERAL

One submission expressed that many occupational health and safety issues relating to the type of plant had not been addressed in the report such as exposure of employees to toxic chemicals, hazards and risks to employees from the possible explosion in the membrane cell room and emergency procedures for employees to adopt in a wide range of situations.

5.2 WORKER SAFETY

It was recommended that aspects relating to worker safety should be incorporated at the design stage.

5.3 MEDICAL HEALTH OF EMPLOYEES

One submission said that medical checks should be made to ensure that people with respiratory problems are not placed in the chlorine plant. It also mentioned that details of medical monitoring of employees should have been included in the report.

Two submissions were concerned that people with drug and alcohol problems could be working in the plant and this would affect the safe operation of the plant.

5.4 RISK ANALYSIS REPORT

Concern was expressed that the risk analysis focussed on toxic effects of chemicals beyond the plant boundary in the event of leakage and/or loss of containment. It was mentioned that risk to employees from most of the possible events within the plant boundary should have been considered as the

fact that measures designed to protect employees would ensure greater protection for the public and the environment. It recommended that a comparative study on toxic emissions to the environment from chlor alkali process and sulphate should be made and comparisons on matters of employee and public safety.

6. SOLID WASTE DISPOSAL (60 TONNES/DAY)

Five submissions expressed the view that more detail was required with regard to the solid wastes disposal method. Of these, two submissions recommended that the material should be discharged where any leachate could not be expected to impact on groundwater. One submission mentioned that as the amount overall to be disposed (220 000 tonnes approximately) could not be regarded as a small task, the issue should have been addressed in the report.

7. SITE SELECTION

7.1 PLANNING PHILOSOPHY

Two submissions were concerned that urban uses are in close proximity to the plant. It was mentioned that several major future residential areas are proposed within a 2 kilometre radius of the new plant with a population increase from 2 000 current estimate to approximately 5 000 in the future. It was also mentioned that the proposal is incompatible with the Bunbury Region Plan which classifies the Industry as Class 1 industry with a suggested minimum buffer zone of 2 kilometres.

7.2 TOWN PLANNING ZONING

Two submissions identified that the proposed plant was on a site zoned General Farming. It was indicated that the Shire of Harvey Town Planning Scheme No 10 would have to be amended to rezone the land to permit the proposed use.

7.3 PROXIMITY OF SCHOOLS AND CAMPSITE

A few submissions were of the opinion that school sites both existing and proposed, are in too close proximity to the plant (between 1.5 to 2.5 kilometres) and that this was an undesirable situation.

Two submissions were concerned about the safety of occupants of the scout campsite immediately south-east of the plant.

7.4 SITE SELECTION

Several submissions expressed the view that the site chosen for the plant was inappropriate as the surroundings were primarily residential and recreational. Many were of the opinion that the plant should be relocated and a few suggested to a site near Capel, Picton and Dardanup and an area near Minninup were also mentioned as suitable locations.

7.5 BUFFER ZONE

Some submissions were concerned that Glen Huon farm and the golf course would be gazetted as buffer zone if the new plant was established.

Two submissions said that the zoning would result in devaluation of these properties.

8. OTHER

8.1 ACID PLANT

There was some concern as to whether the existing acid plant would be continuing. One submission indicated that they had been given to understand previously that this operation would be closed down but that the report does not guarantee that this will occur.

8.2 NEW PLANT CAPACITY AND SIZE

Some concern was expressed that the plant capacity would in fact be above 51 000 tonnes per annum (value on which the risk analysis was based). They mentioned that if this were the case, it would invalidate the ERMP and risk analysis report and a new assessment would have to be compiled.

A few submissions expressed the opinion that the plant would be much larger than mentioned in the report and as a consequence it would have much greater impacts including risks and visual impact.

8.3 PROPERTY VALUES

Several submissions were of the opinion that the value of land in the area would be diminished as a consequence of the establishment of a new plant.

8.4 MONITORING

Some submissions expressed that independent monitoring should be carried out to ensure that emissions/effluent from the site are of acceptable levels and that maintenance is attended to when required. One submission had the view that all monitoring should be made public immediately.

8.5 ERMP

A few submissions commented that the ERMP covered some issues with insufficient technical detail to enable thorough assessment, that there were a number of inconsistencies and some inaccuracies and incomplete descriptions.

8.6 NOISE

One submission was of the opinion that noise from the new plant would disturb residential areas during certain favourable conditions.

One submission noted that some items at the plant had noise levels in excess of the stated maximum noise limit for any item and indicated that additional work would be required to minimise noise levels on those items.

One submission said that noise would carry with the new plant sited on the crest of a hill and would increase when the sulphate plant is recommissioned for other use.

8.7 IMPACT ON ADJACENT SITES

Submissions expressed concerns about the impacts of the new plant on sites adjacent to the plant - the golf club and Glen Huon area. Two submissions expressed that there should be further consideration of impacts of the proposal on the golf club and proposed Glen Huon residential site.

8.8 POPULATION AND TOURISM GROWTH

There was some concern that population growth would diminish because of the new plant and established community facilities wasted as a result.

A few submissions said that tourism prospects for the area would be diminished if the new plant was built. Some submissions said that the locality was more suited to tourist activities than a chemical industry.

LIST OF PERSONS AND GOVERNMENT AGENCIES WHO MADE SUBMISSIONS TO THE EPA

A M Vivian
J Tunstill
P D Rooke
P J Rutherford
Wetlands Conservation Society
E Dorant
L W McKay
K J and D M Hough
M H Johansen
M R Anderson
R W and C F Halls
V M Johansen
G S Gomme
R Triplett
P W Hough
M F Hough
J MacKay
The Federated Miscellaneous Workers' Union of Australia, Hospital, Service
and Miscellaneous, WA Branch
I R Moore
J C Evans
M J and A J Smith
The Scout Association of Australia WA Branch
I R Moore
R Stagoll
S Williams
South West Licensed Fishermen's Association
Bunbury Golf Club Inc
Dr B Bischoff
John Bradshaw, MLA
C Daff
Conservation Council of Western Australia Inc
D C Hough
Australian Conservation Foundation
J Iseppi
Shire of Harvey
Shire of Dardanup
City of Bunbury
W S Curnow, R & A Prentice, L E Gooding, A Perry
Water Authority of Western Australia
Health Department of Western Australia
Government Chemical Laboratories
Department for Community Services
Department of Mines
Leschenault Inlet Management Authority
State Planning Commission
Western Australia Police Department
Department of Industrial Development
Department of Occupational Health, Safety and Welfare of Western Australia
3 petitions

APPENDIX 4

MANAGEMENT COMMITMENTS MADE IN THE ERMP BY THE PROPONENT

CONSTRUCTION

During the construction phase of the project, the proponent would liaise with local authorities to ensure that noise, dust and traffic impacts were minimised.

All construction materials and practices would be in accordance with the relevant Australian or international codes.

OPERATION

The proponent has made the following commitments to environmental management during plant operation:

- . Ongoing control of dust would be implemented.
- . Noise levels within the plant would be in accordance with statutory requirements.
- . The plant site would be attractively landscaped, and buildings would be aesthetically designed.
- . The plant would undergo regular preventative maintenance.
- . All waste products would be disposed of in an environmentally safe manner and in accordance with statutory requirements.
- . The vegetation on the banks of the Collie River adjacent to the plant would be regularly monitored.
- . Surface runoff from the plant would be controlled.
- . A detailed final risk analysis would be undertaken in conjunction with the plant designers to confirm or improve upon the recommendations made in the risk assessment (Cremer & Warner, 1986).
- . A full hazards and operability study would be commissioned, and plant personnel would be trained in safe operating practices and emergency procedures. Training would be based upon the extensive experience available to the proponent from the existing Australind operations and chloride-process plants operating in the United States of America and the United Kingdom.
- . All wastes would be regularly monitored for radio-nuclides.
- . Regular monitoring of the discharge to the Collie River would be implemented to ensure that the system operated as predicted.
- . A centralised control policy would be implemented, whereby no changes to plant detail could be made until approved by the proponent's worldwide Central Safety Department.

SAFETY FEATURES

The safety features that would be incorporated into the plant are summarised as follows:

- . Chloride-process plant:
 - design and operation of titanium tetrachloride vaporiser and oxygen preheater in accordance with the British Standard BS 5885 (British Standards Institution, 1980);
 - housing of the majority of the process containing titanium tetrachloride in a building that is split into cells for the various units of the process;
 - provision of a controlled water system to the building in order to keep it dry; development of operating procedures to ensure it remains dry;
 - duplication and frequent replacement of temperature and pressure-sensing instrumentation in the chlorination section;
 - careful process control, accurate temperature and pressure monitoring, even water-cooling of chlorinator and prevention of solids build-up in the overhead mains;
 - maintenance and cleaning of heat exchangers in a confined area with special ventilation equipment;
 - duplication and frequent routine replacement of sensors in the oxidation section;
 - reliable logic system to control reactor trip system;
 - provision of bursting discs at the entry of the oxidation reactor that vent through relief valves to a scrubbing system;
 - provision of two on-line scrubbing systems: one for the building and one for the 'hygiene snake' system (proprietary equipment), and a back-up for these; scrubbing system stacks to be 46 metres high.

- . Chlor-alkali plant:
 - automatic tripping of direct current power to the membrane cells;
 - duplication of pumps, provision of back-up emergency power supply and appropriate instrument monitoring of the chlorine absorption plant;

- plant design to the standards of the Chlorine Institute (United States) and the Bureau International Technique du Chlor (Europe);
- gravity feeding of brine from storage tanks to membrane cells;
- monitoring of brine feed to individual cells;
- fitting of brine head tanks to cells to maintain differential pressure across the membrane in the event of sudden loss of brine flow;
- installation of emergency buttons in the cell room; controlled shut-down of chlorine manufacturing and liquefaction facilities;
- provision of a back-up absorption column;
- minimum instrumentation of absorption unit to consist of monitoring alarms for caustic concentrations and flows, chlorine concentration in the vent streams, low caustic levels in recirculation tanks and high temperature in the column(s) liquor;
- height of absorption unit column to be 46 metres;
- absorption unit that allows for electrical voltage fluctuations and power failures; provision of a diesels generator as a back-up to drive the caustic recirculation pumps and extraction fans.

. Storage:

- total storage capacity of 50 tonnes of liquid chlorine as intermediate storage between the two process plants (equivalent of approximately one day of buffer stock), this being provided for by 25 tonne vessels;
- design of storage vessels and supports to withstand the worst foreseeable earthquake loading;
- fully refrigerated liquid chlorine storage at -34°C ;
- insulation of storage vessels, and operation at ambient temperature;
- except for a blanked drain connection, no bottom connections on the chlorine storage vessels;

- installation of remotely-operated valves on the liquid chlorine line from the liquefiers to the storage area, and the main chlorine connection on each tank - these being able to be operated either locally, from a safe location or from the control room;
- design of storage vessel instrumentation and relief facilities in accordance with recognised codes of practice (eg Bureau International Technique du Chlor).

. Layout:

- location of air separation plant away from titanium tetrachloride storage areas;
- location of hydrogen away from chlorine compression and liquefaction areas;
- location of liquid chlorine and titanium tetrachloride pipelines away from the bottom rung on pipe tracks, particularly across roads;
- protection of storage vessel areas by traffic barriers (kerbing);
- design of layout such that cranes may remove items for maintenance without having to lift over storage vessels;
- design of plant such that close coupling of each section to minimise chlorine inventory is ensured;

. Maintenance:

- preventative maintenance scheme to replace vulnerable equipment before a failure becomes likely;
- clearing and testing of the chlorine sensor in the tail gas line once per eight-hour shift, with provision to inject caustic into the scrubber, should chlorine be detected;
- regular and frequent maintenance and testing of all sensors as required by service duty.

. General:

- use of a non-explosive grade of coke;
- use of corrosion monitoring techniques such as ultra-sonic thickness surveys;

- design of fuel management system in accordance with BS 5885 (British Standards Institution, 1980) on prevention of explosions;
- ability to operate plant from the control room for sufficient time to enable safe shut-down from there;
- installation of chlorine detectors at appropriate points of the plant site.

MONITORING AND AUDITING

Regular safety audits would be conducted to monitor the effectiveness of the proponent's commitments to safeguard people and property, and to ensure that they were being completely executed.

DECOMMISSIONING

Unlike a mineral development project whose life-span is limited to the period over which a particular resource can be exploited, the proposed plant does not have a planned operational life, although the proponent estimates this to be at least fifty years.

Decommissioning might simply involve the plant being used for other purposes, in which case, another environmental impact study would be required; or could involve dismantling and removal of the facilities from the site.

APPENDIX 5

EXTRACT FROM A CREMER & WARNER TELEX TO THE EPA
REGARDING INDEPENDENCE OF RISK ANALYSIS

The Chairman
Environmental Protection Authority
1 Mount Street
PERTH
Western Australia

Dear Sir,

Cremer & Warner are an independent firm of Consulting Engineers, entirely owned by the Directors and are members of the Association of Consulting Engineers who maintain a strict code of ethical and responsible standards. Directors and members of staff also uphold the ethical standards of the professional institutions of which they are members, in particular the UK Institution of Chemical Engineers.

Our report 86157 was prepared by Messrs P.J. Waite, M.A. English, V. Harker and J. Walkley in Cremer & Warner's London office. The Risk Assessment was based upon factual information supplied by SCM Chemicals from Australia, UK and USA, and by impartial analysis. Cremer & Warner maintain internal quality assurance measures to ensure objectivity and high technical standards. Therefore, our assessment was produced independently.

Regards,

D.G. BLACKBURN
CREMER & WARNER LIMITED
16-11-86

APPENDIX 6

This Appendix presents the comments of Cremer & Warner Ltd to the EPA regarding the sensitivity of the Consultant's model to differing input parameters.

CREMER & WARNER

Report No. 87035

SENSITIVITY ANALYSIS1. Introduction

Cremer & Warner Ltd (C&W) have had many years experience in both developing and using models for risk analysis of installations handling toxic materials. The model used in the present projection was developed in 1982 following identification of deficiencies in earlier models. At this time a thorough sensitivity analysis was undertaken in addition to the validation procedure. Relevant sensitivities are discussed below. Note, that although numbers quoted are not directly for the proposed SCM development, it is expected that similar numbers would be produced if an equivalent sensitivity analysis runs for it.

2. Sensitivity to Release Frequency

The largest source of uncertainty in a risk analysis is the estimation of release frequencies. Since the overall frequency of risk is directly proportional to the release frequency, no further discussion is given.

3. Sensitivity to Release Duration

If the release durations are increased, ie: if no allowance is made for automatic shutdown of equipment, the risk contours will move out, typically 10 per cent at the 400 m distance and nearly 20 per cent at 600 m. The frequency of events causing one or more fatalities would rise by 30 per cent but much lower rises would be expected for events causing thirty or more fatalities.

4. Sensitivity to Vaporisation Characteristics

A realistic model has been used to calculate the vaporisation rates from liquid pools, both chlorine and titanium tetrachloride. However, if the vapour generation rate is doubled the individual risk levels at any distance from the site will vary by 30 to 50 per cent.

Note, that in the particular case of the SCM plant at Bunbury, many of the cases which have the highest contributions to individual risk are gaseous releases and so the analysis would be less sensitive to this particular parameter.

5. Sensitivity to Meteorology Data

The selection of four typical weather cases to represent the full spectrum of weather cases is a coarse approximation. However, the uncertainties associated with the release frequency data mean that a more rigorous analysis cannot be justified. Moreover, the meteorology data from Glen Iris is only available for a short period. Therefore, there is no guarantee that it is representative of average conditions.

Typically, doubling the number of weather categories can vary the calculated individual risks by about ten per cent maximum.

6. Sensitivity to Toxicity Data

There are a large number of toxic models for chlorine which have been published. The one used in this study is that developed by Cremer & Warner. This is a mid-range model. Other models are considerably more pessimistic, eg: US Coast Guard model (Reference 1). The US Coast Guard model is now generally acknowledged to be inappropriate for risk analysis

(Reference 2), whilst the Akzo model contains no allowance for the high variability in chlorine resistance found in the general population and so is representative only of healthy adults not the very young or very old, asthmatic, etc.

The overall results of the risk analysis are more sensitive to this choice of toxicity model than to any other parameter. If the Akzo model is used the individual risk at the 400 m level decreases by a factor of about 50. Further from the plant the decrease in risk is even more dramatic. If, however, the US Coast Guard model is used the risks increase by a factor of 4 at 400 m. Again, the difference increases at greater distances.

7. Sensitivity to Fractions of People Outdoors and Escape Model

For many releases the effects can be mitigated by potentially exposed people escaping indoors. In this study individual risk has been calculated based on 100% outdoors. No allowance has been made for people initially outdoors escaping indoors.

The risk analysis program has been tested with an escape model based on that in Reference 3. The difference the including of this model makes is small (10%) when only a relatively small fraction of people outdoors is assumed.

If a large number of people are assumed to be outdoors then the number of fatalities that can be expected from a large event will increase. This effect is greatest for those releases which only cause a few fatalities. The increase in the number of fatalities caused by a large release to changes in this assumption are small.

If the number of people present in the area during the 'day' is reduced to fifty per cent in order to allow for people going to work, etc. then the effect on the risk is small because the greatest risk occurs during stable conditions which tend to occur only at night or in the early morning.

8. Sensitivity to Ventilation Rate

Variations in the value assumed for the ventilation rate have only a small effect on both individual and societal risk in the case of chlorine. This is because the majority of the risk is posed to people outdoors rather than indoors.

9. Sensitivity to Surface Roughness

The dispersion models used are quite sensitive to the surface roughness length assumed, particular in F stability. If the roughness length is reduced from 0.35 m to 0.1 m, a considerable reduction, it is anticipated that the risk contours would move out by up to thirty per cent.

APPENDIX 7

This Appendix presents the explanation, given by Cremer & Warner Ltd, in a telex dated 16 November 1986 to the Environmental Protection Authority, on the difference in risk levels between the CSBP's chlor-alkali plant at Kwinana and the proposed SCM plant at Australind.

- A. There are significant differences in the aims of the SCM chlor-alkali plant at Bunbury and the CSBP chlor-alkali plant at Kwinana. The SCM plant is a dedicated plant producing chlorine for the sole purpose of feeding the proposed titanium dioxide process while the CSBP plant is producing chlorine mainly for off-site export.
- B. The following are the main differences in the equipment and operation of the two plants.

<u>Risk Producing Units</u>	<u>SCM</u>	<u>CSBP</u>
Storage	2 x 25 tonne (TE) tanks + one spare	2 x 25 tonne (TE) tanks + one spare + cylinders (4 x 50 TE tanks originally + one spare)
	Refrigerated storage	Pressurised storage
Export	No export	Exported in 1 tonne 70 kg and 33 kg cylinders
Loading requirements	None	Cylinder loading (+ road tanker loading originally)
Liquefaction of chlorine (CL2)	Partial + revaporisation most CL2 direct to T102 process in gas phase	Full-direct to storage
Hypochlorite unit	46 m stack assumed	10 m stack assumed

The major influences on the differences in the risk around the two plants concern the storage and loading facilities in conjunction with the pressurised system used at Kwinana and not the small difference in plant production rates.

1. The number and size of the storage tanks at each site is the same (2 x 25 TE), however, because the CSBP tanks are pressurised, in the event of a release some chlorine will flash entraining liquid in aerosol form. In the event of a release of refrigerated liquid the rate of vapour evolution is limited to the evaporation rate. Therefore it is usual for vapour rates forming a cloud to be greater from pressurised systems than from refrigerated systems (for chlorine).
2. The 1 tonne cylinders (which are always pressurised) also contribute significantly to the risk levels, as accidents can occur when moving cylinders, and will present a small risk at distances of 2 000 metres. There will not be cylinders of chlorine of any size at SCM's Bunbury plant.
3. Loading of cylinders or tankers presents an extra potential for spillage and produces a high rate of incidence due to the need for manual intervention in coupling and uncoupling the various connections. Rates of release sufficient to cause offsite hazard are possible.
4. As less of the cell gas is liquefied at Bunbury then the size of a release of liquid chlorine from the liquefaction circuit will be smaller or of a shorter duration and hence will present a lower risk at any particular distance downwind.
5. If the hypochlorite unit is overloaded (similar frequency at each plant) there is less of a risk from the SCM plant as chlorine will be emitted from a 46 m stack as opposed to a 10 m stack at the CSBP plant. There is a negligible risk from the SCM plant at ground level while although there is a small risk at ground level from these releases at CSPB it is low in comparison with other risks at the CSBP plant.

D. The risks calculated at Kwinana are also higher than those at Bunbury because of topography and meteorology differences.

1. The Kwinana area is flatter and less broken up by trees and vegetation than the Bunbury site, hence the surface roughness length chosen for Kwinana (0.1 m) is lower than the value chosen for Bunbury (0.36 m). This variable is explained in Section 3.2.4. of Report 86157. The higher its value the greater the effect on mixing and dispersion of a vapour cloud, thus reducing predicted downwind concentrations and the potential for harm.
2. The higher average temperature at Kwinana also means that on average the rate of evaporation of chlorine from a similar sized liquid pool will be greater at Kwinana than at Bunbury. The higher the release rate the further downwind will effects be felt, assuming all other variables are equal.
3. There is a large potential for releases of titanium tetrachloride from the dioxide process; the majority of these releases will be inside a building from which there is a twofold benefit. Firstly, the presence of significant quantities of water needed to generate a toxic vapour cloud can be more readily controlled and kept to a minimum by design and operating procedures. Secondly, this building will have four different ventilation scrubbing systems so any vapour produced has an extremely high probability of being neutralised. Additionally, if the scrubbing systems fail the emission will still be via a 46 m high stack which will ensure that ground level concentrations are not high enough to cause serious harm to an individual.

APPENDIX 8

WATER QUALITY CRITERIA FOR MARINE AND ESTUARINE
WATERS OF WESTERN AUSTRALIA

Beneficial Use No.7
Maintenance and Preservation of Aquatic Ecosystems
Schedule 7(2)

**WATER QUALITY CRITERIA
for
MARINE AND ESTUARINE WATERS
of
WESTERN AUSTRALIA**

Report of the Working Group
established by the Environmental Protection Authority

Department of
Conservation & Environment
Western Australia

BULLETIN No 103
APRIL 1981

BENEFICIAL USE NO. 7

MAINTENANCE AND PRESERVATION OF AQUATIC ECOSYSTEMS

An ecosystem comprises a physicochemical environment together with a more or less stable community of evolutionarily adapted organisms, which interact in such a way that there is transportation of energy and materials through the system and recycling of material resources within the system. Thus an ecosystem can be viewed in terms of abiotic elements such as sunlight, temperature, pH, inorganic nutrients, etc., and biotic elements, the interacting organisms and populations which constitute an ecological community. The biotic community of an ecosystem comprises three groups of organisms, distinguished by their trophic status within the system, i.e. the producers, the consumers and the decomposers.

The producers synthesise organic material from inorganic nutrients using abiotic sources of energy. Producers form a fundamental component of an ecosystem since they biologically fix energy in a form which other organisms may utilise. Consumers are those organisms which derive nutrients and energy by assimilation of preconstituted organic material. Various trophic levels may be recognised within this class of organisms on the basis of their positions in food chains. Decomposers are those organisms which derive nutrition from the metabolic waste products of other organisms and their remains. This class of organisms including bacteria plays an important role in the ecosystem since they release inorganic nutrients for re-use by producers, thus completing the cycle.

An important realisation that comes from the recognition of the integrated nature of ecosystems is that interferences with one element or process may have far-reaching repercussions for other parts of the whole ecosystem.

Properly functioning aquatic ecosystems are important to man in a number of ways:

- Aquatic ecosystems are valuable food, recreation and educational resources. In most countries, including Australia, commercial and sport fisheries are economically important, as are other water-based sporting activities.
- Properly constituted marine and freshwater communities are essential to the efficient assimilation of organic matter and recycling of nutrients in the aquatic environment. Such processes are important in maintaining water quality.
- Not only do aquatic communities play an important role in maintaining water quality, they also provide a reliable indicator of the quality of water and hence of its suitability for other beneficial uses by man.

Levels of Protection

Although localised deterioration of an aquatic ecosystem, due to degradation of water quality, may be reversible, in general the recovery of the abused system to its former state is far more costly than prevention of the abuse. Where pollution is widespread and severe, rehabilitation of aquatic communities may be economically, if not practically, impossible.

In order to provide clear alternatives from which to formulate environmental protection policies for particular waters it is useful to delineate various levels of protection to be satisfied by different sets of criteria. Three levels of protection are recognised.

Class 1

This represents maximum protection for ecosystems and corresponds to water quality of a natural or pristine state. Waters subject to such a level of protection should not receive any waste discharges whatsoever, nor be affected by man-made changes within the surface or ground watersheds, nor the body of water itself. (See Schedule 7 (1)).

Class 2

A high level of protection such that any waste discharges or man-made changes which do occur may be readily assimilated or withstood by the system without any detectable effects on the biota or the structure of the ecosystem to which they belong. Water quality criteria for Class 2 protection are given in Schedule 7(2).

Class 3

A minimal level of protection such that any waste discharge or man-made changes which do occur may lead to changes in the present biota, but do not change the nature of the residing biota to the point where it no longer functions as an ecosystem, i.e. has the recognisable components of an ecosystem as discussed above. Water quality criteria for Class 3 protection are given in Schedule 7(3).

The Working Group, whilst appreciating the need for this level of protection, has found some difficulty in setting relaxed levels for many parameters. Where it is known that the level of a particular parameter can be relaxed, then this less stringent level has been used. However, where insufficient data are available, the more conservative values applying to Class 2 protection have been used.

SCHEDULE 7 (2)

MARINE AND ESTUARINE WATER QUALITY CRITERIA FOR MAINTENANCE AND PRESERVATION OF AQUATIC ECOSYSTEMS

Class 2

Parameter	Criterion	Source
Aesthetic Considerations	As on page 8.	USA EPA (Comp)
Floating and Submerged Litter	No materials should be present which directly or indirectly have an adverse effect upon aquatic organisms.	WG
Barriers	No barrier should be constructed, substances added nor alterations made to the marine or estuarine environment which will prevent the normal movement and migratory patterns of marine and estuarine organisms to the detriment of their populations or cause changes in the normal water movement pattern which will lead to adverse effects upon them.	WG
Light Attenuation	The combined effects of turbidity and colour should not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonal background value.	USA EPA
Settleable Matter	Unnatural inputs of settleable material should not cause the formation of deposits which are harmful to aquatic organisms.	VIC EPA (M)
Suspended Solids	Upper limit of 80 mg/L and depth of compensation point for photosynthetic activity should not be reduced by more than 10% from the natural seasonal norm.	Hart/USA EPA
Temperature	The maximum acceptable variation in the weekly average temperature due to artificial sources is 1°C for waters north and 2°C for waters south of latitude 27°S during all seasons of the year, provided that no single value exceeds the highest summer maximum recorded over the previous five years inclusive.	USA EPA
Salinity	Unnatural influences should not change the seasonal mean salinity, measured preferably over not less than five years, by more than 0.25 of the standard deviation, nor change the salinity beyond the range recorded over that period.	WG/VIC EPA (G)
Ionic Ratio	The ratios of major ions should not be altered such that this beneficial use is affected.	WG
pH	6.5-8.5 and no change in excess of 0.2 units from normal. For waters of salinity below 5 000 mg/L (5‰) the pH range should be 6.0 to 9.0 and no change in excess of 0.5 units.	USA EPA/WG/Hart
Dissolved Oxygen	Not to fall below 4.0 mL/L (5.7 mg/L) for more than 6 consecutive hours, and never to fall below 3.5 mL/L (5.0 mg/L).	WG
Arsenic	6 month median not to exceed 8 µg/L No more than 20 per cent of readings to exceed 80 µg/L. No single reading to exceed 500 µg/L.	Calif (K&S)
Cadmium	6 month median not to exceed 3 µg/L. No single reading to exceed 8 µg/L.	Calif (K&S)
Chromium (total)	6 month median not to exceed 2 µg/L. No single reading to exceed 7 µg/L.	Calif (K&S)

Copper	6 month median not to exceed 5 µg/L. No single reading to exceed 40 µg/L.	Calif (K&S)
Lead	6 month median not to exceed 8 µg/L. No more than 20 per cent of readings to exceed 80 µg/L. No single reading to exceed 200 µg/L.	Calif (K&S)
Mercury	6 month median not to exceed 0.14 µg/L. No more than 20 per cent of readings to exceed 1.4 µg/L. No single reading to exceed 3 µg/L.	Calif (K&S)
Nickel	6 month median not to exceed 20 µg/L. No more than 20 per cent of readings to exceed 200 µg/L. No single reading to exceed 450 µg/L.	Calif (K&S)
Silver	6 month median not to exceed 0.45 µg/L. No more than 20 per cent of readings to exceed 4.5 µg/L. No single reading to exceed 10 µg/L.	Calif (K&S)
Zinc	6 month median not to exceed 20 µg/L. No single reading to exceed 200 µg/L.	Calif (K&S)
Aldrin	Not to exceed 0.003 µg/L	USA EPA
Azinphosmethyl	Not to exceed 0.01 µg/L	USA EPA
Camphechlor	Not to exceed 0.005 µg/L	USA EPA
Chlordane	Not to exceed 0.004 µg/L	USA EPA
2,4-D	Not to exceed 4 µg/L	NAS/NAE
DDT	Not to exceed 0.001 µg/L	USA EPA
Dieldrin	Not to exceed 0.003 µg/L	USA EPA
Endosulfan	Not to exceed 0.001 µg/L	USA EPA
Endrin	Not to exceed 0.004 µg/L	USA EPA
Heptachlor	Not to exceed 0.001 µg/L	USA EPA
Lindane	Not to exceed 0.004 µg/L	USA EPA
Maldison	Not to exceed 0.1 µg/L	USA EPA
Methoxychlor	Not to exceed 0.03 µg/L	USA EPA
Parathion	Not to exceed 0.04 µg/L	USA EPA
Other Pesticides	Not to exceed 0.01 of the 96-hour LC ₅₀ value for the selected test species.	WG
Ammonia (expressed as Nitrogen)	6 month median not to exceed 600 µg/L. No single reading to exceed 2000 µg/L.	Calif (K&S)
Chlorine (total residual)	6 month median not to exceed 2 µg/L. No single reading to exceed 10 µg/L.	Calif (K&S)
Cyanide	6 month median not to exceed 5 µg/L. No single reading to exceed 10 µg/L.	Calif (K&S)
Fluoride	6 month median not to exceed 2 mg/L. No single reading to exceed 10 mg/L.	WG
Hydrogen Sulphide	Not to exceed 2 µg/L	USA EPA
Total Hydrocarbons	Not to exceed 10 µg/L	WG
Aromatic Hydrocarbons	Not to exceed 1 µg/L	WG
Phenolic Compounds	6 month median not to exceed 300 µg/L.	Calif (K&S)
Polychlorinated Biphenyls (PCBs)	Not to exceed 0.001 µg/L	USA EPA
Surfactants	Not to exceed 0.01 of the 96-hour LC ₅₀ value for the test organisms.	WG

Other Toxic Substances	No material should be present in an amount exceeding 0.01 of the 96-hour LC ₅₀ value for the test organism.	WG
Radioactive Substances	Radioactive substances should not be present in concentrations that are deleterious to human, plant, animal, or aquatic life or that result in the accumulation of radioactive substances in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life.	Calif.
Nutrients and Other Biostimulants	The loads of nutrients and other biostimulants to receiving waters should not cause excessive or nuisance growths of algae or other aquatic plants or deleterious reductions in dissolved oxygen concentrations in those waters.	VIC EPA (M)
General Provision	Should any individual species or component of the ecosystem be known to have lower tolerances than those specified in the above criteria, then these levels should be those used in setting water quality objectives.	VIC EPA (M)