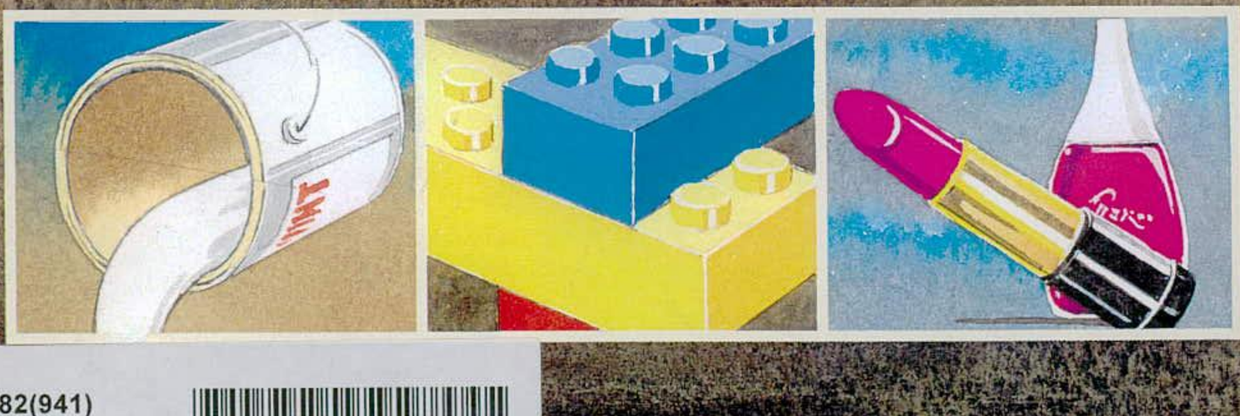
Millennium
Inorganic Chemicals

EXPANSION OF KEMERTON PIGMENT PLANT

CONSULTATIVE ENVIRONMENTAL REVIEW

TITANIUM DIOXIDE - WE'VE GOT YOU COVERED



KINHILL

SCM Chemicals Ltd
Expansion of Kemerton Pigment Plant

HOW TO MAKE PUBLIC SUBMISSIONS

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

SCM Chemicals Ltd (now known as Millennium Inorganic Chemicals) is proposing to expand its existing chloride process titanium dioxide plant at Kemerton to permit an increase in production to 195,000 tonnes per annum, and to establish a new finishing plant at Kemerton with a capacity to process up to 116,000 tonnes per annum of pigment. This Consultative Environmental Review (CER) has been prepared by SCM Chemicals to meet the requirements of the Western Australian Government. This CER describes the proposal, examines the key environmental factors and discusses the proposed environmental management procedures. The CER will be available for comment for 4 weeks commencing Monday 3 November 1997.

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

Copies of the CER may be obtained from:

Millennium Inorganic Chemicals Ltd
PO Box 245
BUNBURY WA 6231
(08) 9780 8333

WHY WRITE A SUBMISSION

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

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

WHY NOT JOIN A GROUP?

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

DEVELOPING A SUBMISSION

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

WHEN MAKING COMMENTS ON SPECIFIC PROPOSALS IN THE CER

- clearly state your point of view:
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

POINTS TO KEEP IN MIND

By keeping the following points in mind, you will make it easier for your submission to be analysed.

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

REMEMBER TO INCLUDE:

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

More information on how to make a submission can be obtained from the free pamphlet *Environmental Impact Assessment - How to Make a Submission* available from the Library of the Department of Environmental Protection. Telephone (08) 9222 7127.

The closing date for submission is Monday 1 December 1997.

SUBMISSIONS SHOULD BE ADDRESSED TO

Environmental Protection Authority
Westralia Square
141 St Georges Terrace
PERTH WA 6000

Attn: Xuan Nguyen

MILLENNIUM INORGANIC CHEMICALS LTD

EXPANSION OF KEMERTON PIGMENT PLANT

CONSULTATIVE ENVIRONMENTAL REVIEW

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October 1997

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SUMMARY

SCM Chemicals Ltd—Asia/Pacific (SCM) (now known as Millennium Inorganic Chemicals Ltd) wishes to obtain environmental approval to expand its existing chloride process titanium dioxide plant at Kemerton, near Bunbury. SCM is seeking to increase the production capacity of the Kemerton plant from its current level of 79,000 t/a of titanium dioxide to 195,000 t/a, and to establish a new finishing plant at Kemerton with a capacity to process up to 116,000 t/a of pigment (see Table S1). The existing Australind finishing and packaging plant, and all support facilities for SCM's operations in the Bunbury region at the Australind site, would remain. The Kemerton and Australind plants combined would then have the capacity to produce a total of 195,000 t/a of finished pigment.

The original application for expansion of the pigment plant was for a total production capacity of 190,000 t/a. However, during the design stages, investigation showed that the plant output could reach 195,000 t/a. All the discussion in this document is based on the higher figure for the expected total output, i.e. on 195,000 t/a. While this figure is marginally higher (by 5,000 t/a) than that quoted in the Guidelines for the preparation of this document, it is not anticipated that this will have any impact on the issues to be addressed by the proponent.

It is proposed to commence construction to upgrade the titanium dioxide processing facilities in mid-2000, to enable production to start by early 2002.

The purpose of this document is to describe the proposal, to review the environmental impacts of the current operation at Kemerton, and to identify the environmental implications associated with the construction and operation of the facilities required to provide an additional 116,000 t/a of finished titanium dioxide pigment.

PROPOSAL

Titanium dioxide is a non-toxic, white pigment used in the manufacture of a wide range of products—including, paint, paper, plastics and rubber—to make them opaque. Titanium dioxide pigment is produced from synthetic rutile, which is produced from mineral sands by a variety of suppliers in western australia.

The chloride process for the preparation of titanium dioxide from synthetic rutile is based on the production of titanium tetrachloride by chlorination of the ore. The purified titanium tetrachloride is subsequently oxidised, yielding titanium dioxide and allowing recovery of chlorine. The raw titanium dioxide pigment is then treated with chemicals and dried to form various grades of finished pigment.

It is proposed to increase pigment production by installing two new chlorinators and associated collection systems with larger capacities than those presently used. As part of the expansion, it is also planned to duplicate the titanium tetrachloride purification equipment. It is proposed to duplicate most of the items of equipment in the titanium tetrachloride oxidation system with units of increased capacity. Some of the items of the expanded chloride process plant can be accommodated alongside the existing units. However, the new chlorination and oxidation stream and plant support facilities would be sited south of the existing chlorinator section.

The finishing plant would be a completely new facility. This would include pigment treatment and vacuum filters, driers, pigment mills and packaging equipment. The finishing plant would be sited to the west of the existing plant.

Extra chlorine, compressed nitrogen and compressed oxygen would be required to serve the proposed expansion. It is proposed to obtain these from external suppliers.

ENVIRONMENTAL AND SOCIAL ISSUES

General

SCM has an exemplary environmental record attained through conscientious and consistent management of its existing operations. SCM has implemented environmental management programmes in accordance with its quality control system and environmental policy. Integrated environmental management systems have been developed for all phases and facets of SCM's Western Australian operations. SCM has a firm corporate commitment to responsible environmental management, striving to achieve full compliance with regulatory requirements and minimise impacts on the surrounding environment. SCM has initiated a programme of continuous improvement and accountability for the entire life cycle of all its sites.

Regular internal audits are undertaken to ensure adherence to the environmental management plan and systems. SCM reports regularly to, and is also audited by, Government authorities and its parent company. Monitoring results demonstrate excellent compliance with regulatory limits and conditions. An environmental performance index, developed by SCM, shows a significant improvement since the plant was commissioned, reflecting a reduction in solid residue generated and an improvement in control of gaseous emissions. No adverse long-term environmental impact has resulted from SCM's operations at Kemerton.

The major potential environmental and social issues arising from the proposed development relate to gaseous emissions, dust, saline water disposal, solid residue disposal, radiation, noise, and risks and hazards. These issues are discussed in more detail in the following sections.

Gaseous emissions

Apart from boilers, heaters and driers, which would emit carbon dioxide, nitrogen oxides and water vapour as a result of the combustion of natural gas, the only gaseous emissions from the chloride process would be produced at the exit of the titanium tetrachloride purification section. The exit gases would be scrubbed with water to remove residual titanium tetrachloride, metal chlorides, and hydrogen chloride. An additional scrubbing train, consisting of a spray tower, a venturi scrubber and a packed tower, would be installed to cater for the expanded plant.

With the expansion of the plant, it is proposed to expand the current suction vent system to collect potential fugitive emissions which would be scrubbed and released to the atmosphere via the existing process stack. It is also planned to direct all scrubbed process emissions to a thermal converter where they would be burnt and to direct all the hot exhaust gases from the thermal converter to a waste heat boiler to generate steam. The steam generated in the waste heat boiler would be used to supplement boiler steam.

The installation of a thermal converter prior to the new main process stack would result in reduced emissions from the entire plant, particularly of carbon monoxide, carbonyl sulphide and hydrogen sulphide. The combustion gases would be scrubbed in a caustic scrubber before they are discharged to the atmosphere through the main process stack in order to remove 95% of the sulphur dioxide produced by the oxidation of the sulphur gases. The resulting solution would be oxidised in a process developed by SCM, to produce a sulphate solution that would be injected into the saline water for disposal. The atmospheric emissions would then consist mainly of carbon dioxide and nitrogen with minor proportions of nitrogen oxides and sulphur dioxide (the 5% that is not removed by the scrubber).

Increased efficiency in the process would reduce the emission of sulphur oxides per unit of finished pigment. Reuse of heat in the process through the thermal converter would reduce the plant's requirement for natural gas and reduce the associated production of carbon dioxide, a greenhouse gas. The specification of efficient, low nitrogen oxide-generating gas burners would also reduce greenhouse gas emissions.

The expected result would be a significant overall reduction in the total atmospheric emissions from the plant per tonne of pigment produced, compared to the total emissions of the present operations at Kemerton. Since all emissions from the current plant have been considerably below licence conditions, where they have been set, as well as SCM's internally imposed goals, it is anticipated that gaseous emissions would have negligible impact on the environment.

Dust emissions

The main potential source of dust from the proposed expanded plant is from the finishing section.

Measures to control dust would include the use of dust extraction systems with bag filters on the product pneumatic conveying system, on the driers, on the bagging machines and on all conveying transfer points. The design emission from the bag filters would be 100 mg/m^3, which is 40% of national guidelines for control of emission of particulate air pollutants from new stationary sources of 250 mg/m^3. Actual dust emissions are likely to be much lower.

As a consequence of these measures, dust generated from the site during operation is not expected to increase ambient levels of suspended particulates in areas outside the boundaries of the plant.

Saline water disposal

The plant would generate wastewater from a number of sources including process water treatment, scrubbing of waste gases and pigment washing. In addition, the plant would accept wastewater from the external suppliers of chlorine, compressed nitrogen and oxygen, and lime.

The chloride process plant at Kemerton currently incorporates extensive internal water recycling. This recycling results in 60% of all water used being recycled within the current plant. The recycling means the current plant uses only 40% as much water per tonne of pigment produced as other plants using the chloride process. A similar water recycling and reuse system would be incorporated into the proposed expansion.

Water treatment plant wastes, which includes filter backwash water and ion exchange regeneration water, would be used to sluice solid residue or prepare lime slurry. In addition, some water generated by the proposed finishing plant would be recirculated or reused.

Reuse of the water increases its salinity. SCM would continue to explore opportunities to recycle and reuse process water within the expanded Kemerton plant, but reuse of all the water produced would not be economic as the water would become too saline for further use. Following reuse of water in as many applications as possible, the saline water that could not be reused would be treated. It is proposed to upgrade the current wastewater treatment section associated with the production of titanium dioxide to cater for the expanded production and to construct a wastewater treatment plant to handle liquid wastes arising from the finishing plant

The treated saline water would be collected in a holding pond and pumped approximately 9 km to an existing ocean outfall located west of the northern extremity of the Leschenault Peninsula. To cater for the increased amount of saline water to be pumped to the ocean from the plant expansion, the pipeline and the ocean outfall would be upgraded. The saline water would be discharged to the ocean via a 'multi-port tee' diffuser. The diffuser has been designed to ensure mixing with sea water occurs within 20 m of the discharge points.

Following mixing of the saline water with seawater, the water quality near the outfall would fall within the limits specified by the EPA for the protection of aquatic ecosystems and human consumers of fish and other aquatic organisms.

SCM is currently licensed to discharge saline water into the ocean off the Leschenault Peninsula. Measurement of the quantity and quality of the discharge, and a monitoring programme within the receiving environment of the outfall, have been undertaken in accordance with these licence conditions. The data from the monitoring programme show that the concentration of all chemical parameters in the saline water have been considerably below the licence conditions. Sampling of the ocean near the marine outfall indicates that outside the mixing zone (a radius of 20 m), there are no significant adverse effects of the discharge on water quality, sediment quality or marine life.

Solid residue disposal

As a result of treating the process water streams from the plant, approximately 340,000 t/a of washed solid residue slurry containing 11–15% solids would be produced. This slurry would be transported by tanker to an existing solid residue storage area at Dalyellup, south of Bunbury. At Dalyellup, the slurry would be discharged into a pond to allow the solids to separate from the supernatant water. Progressive dewatering of the solids would occur through evaporation and seepage.

The solid waste would consist mainly of unreacted ore and coke, and metal hydroxides from the raw pigment process. The potential impacts of the disposal of solid residue include incompatibility with neighbouring land uses, erosion and dust generation, groundwater contamination from the slightly brackish slurry water and increased background radiation levels.

Monitoring data shows that impacts of the existing disposal practice on groundwater are minimal, and no adverse impacts have been observed from the slightly radioactive nature of the solid residue. The rate of deposition of the residue slurry would increase with the increased production rate, but the quality of slurry water would be similar. Consequently, it is anticipated that there would be no adverse environmental impacts from the continuing disposal of solid residue at the Dalyellup site.

SCM has approval to use the site for the 'life of the site'. The increased solid residue production rates associated with the expanded pigment plant would reduce the life of the Dalyellup disposal site. Under current production rates, the existing areas would be full within ten years. The company has in place approvals for the 'life of the site' and the actual time when the site would be fully utilised would be dependent on the expansion commissioning time frame. However, the proposal for expansion of the plant does not involve construction of any more storage areas at this time.

SCM and relevant Government authorities are actively investigating alternatives for the long-term management of the solid residue produced by the plant. This includes investigations into residue minimisation, recycling, alternative uses, alternative residue disposal methods and alternative sites.

SCM has already achieved a 40% reduction in the quantity of solid residue produced since 1988, primarily through recovery of unreacted ore and coke in the residue.

Alternative uses currently under investigation include the potential for use of the residue in brick manufacture, as a pavement base course for roads, and for soil conditioning and nutrient retention, particularly phosphorus.

Trials conducted to date indicate the solid residue performs favourably in all these applications, with little risk of dust, solute leaching or radiation exposure, and SCM has received provisional approval to use the solid residue in bricks and for road base course. However, the cost of transporting the material to Perth could limit its use to the local region, which is probably not a large enough market to use all the residue generated. In addition, the low radiation levels in the material may make it difficult to obtain permission for the use of the solid residue for some of these purposes.

In addition to research into possible uses for the solid residue, SCM is committed to continuing its research into residue minimisation, recycling and alternative methods of disposal.

Radiation

Synthetic rutile, the feedstock for the process plant, contains low levels of thorium and uranium impurities from the original mineral sands. The majority of the radiation associated with these contaminants ends up in the solid residue. However, during processing into raw pigment, the potential exists for these contaminants to become concentrated in certain areas of the plant.

SCM's policy is to ensure that all exposures to radiation are kept 'As Low As Reasonably Achievable'. This includes a decision to adopt the limits of exposure for members of the public for its own personnel, rather than industrial or mining industry exposure limits which are substantially higher. Radiation management procedures have been developed to ensure compliance with appropriate regulations, and to minimise radiation doses to personnel.

As part of the Radiation Management Plan developed by SCM, radiation levels are measured in the plant, in the waste water, in marine sediments and at the Dalyellup solid residue disposal site. Monitoring results indicate that there are no concerns for occupational or environmental radiation exposure from any of SCM's activities, and this is not expected to change as a result of the proposed expansion.

Noise

In designing the new plant, particular attention would be paid to the major noise contributing items to ensure the plant is as quiet as can be reasonably achieved by incorporating Best Practice design features into the new plant. With these measures, it is anticipated that noise levels close to SCM's plant and at the boundary of the Kemerton Industrial Park may increase as a consequence of the plant's expansion. However, on most occasions, the large buffer zone that surrounds the Kemerton Industrial Park, and the location of the plant within SCM's site, would ensure any noise generated meets current and proposed regulations and does not cause disturbance to residences outside the Kemerton Industrial Park.

Risks and hazards

Risks and hazards at the Kemerton plant are controlled in accordance with a comprehensive Total Hazard Control Plan, developed to the requirements of the Department of Minerals and Energy. The Total Hazard Control Plan and safety programmes are regularly audited, internally and externally, to ensure compliance to, and adequacy of, both these systems.

The Kemerton plant's safety record is very good. It is highly rated under the International Safety Rating System. The effectiveness of the Total Hazard Control Plan and SCM's safety system is reflected in the fact that there have been only two 'lost time' accidents since the plant was commissioned in 1989, none of which were related to process-type events.

A Preliminary Risk Assessment (PRA) of the proposed expanded plant has been carried out. This assessment showed that the one-in-a-million risk contour for the proposed SCM plant and the neighbouring Nufarm chlor-alkali plant combined falls almost entirely within the SCM property boundary, thereby easily meeting EPA risk criteria.

MONITORING

SCM currently undertakes regular monitoring of all facets of its operation at Kemerton. This includes stack monitoring for a variety of gaseous emissions, monitoring of production bores and groundwater around its plant site at Kemerton and around the solid residue disposal site at Dalyellup, emission and ambient noise monitoring, monitoring of the quantity and quality of the treated saline water discharged to the ocean, and monitoring of the seawater and sediments surrounding the ocean outfall. Personnel radiation exposure monitoring and radiation surveys at the plant and the solid residue disposal area at Dalyellup are also undertaken regularly.

This programme would continue following the expansion of the plant and would be expanded to include dust emission monitoring from the finishing plant stacks.

Table S1 **Inputs and outputs from current and proposed titanium dioxide plant***

Material	Unit	Current	Proposed expansion		
			Proposed	Absolute Variance	% Variance
Production	tpa	79,000	195,000	111,000	147
Inputs					
Synthetic Rutile	tpa	84,000	206,000	122,000	145
Petroleum Coke	tpa	18,000	42,000	24,000	133
Chlorine	tpa	16,000	35,000	19,000	119
Oxygen	tpa	39,000	96,000	57,000	146
Nitrogen	tpa	59,000	145,000	86,000	146
Water	tpa	1,500,000	5,000,000	3,500,000	233
Natural Gas	Gjpa	370,000	980,000	610,000	165
Electricity	Mwh	29,000	97,000	68,000	234
Outputs					
Wastewater	m^3	950,000	3,000,000	2,050,000	216
Residue Slurry	tpa	141,000	397,000	256,000	182
CO	tpa	6,700	3,600	(3,100)	(46)
CO_2	tpa	70,000	194,000	124,000	177
$TiCl_4$	tpa	<0.5	<0.5	nil	nil
Cl_2	tpa	<0.5	<0.5	nil	nil
HCl	tpa	<0.5	<0.5	nil	nil
COS	tpa	540	540	nil	nil
SO_2	tpa	200	240	40	20
H_2S	tpa	<0.5	<0.5	nil	nil
NO_X	tpa	25	60	35	140
N_2	tpa	59,000	145,000	86,000	146

* *Assumes thermal converter on-line 75% of the time*

Table S2 **Summary of key environmental factors, environmental management objectives, management actions and monitoring, and predicted outcomes**

Key Environmental Factor	Environmental Management Objective	Environmental Management Actions and Monitoring	Predicted outcome
Atmospheric emissions	SCM's management objective is to: • ensure that atmospheric emissions comply with current standards and do not adversely affect the environment, or the health, welfare or amenity of nearby land users; • maintain or reduce stack emissions and ground level concentrations of licensed gases; • reduce fugitive emissions within the plant; • ensure there is no unacceptable odour impact outside the boundary of the Kemerton Industrial Park; • minimise emissions of greenhouse gases; • minimise dust emissions during operation; • minimise dust during construction.	Install a thermal converter to oxidise carbon monoxide, carbonyl sulphide and hydrogen sulphide to carbon dioxide and sulphur dioxide. Install a scrubber to remove 95% of the resultant sulphur dioxide. Scrub the exit gases to remove hydrochloric acid. Utilise hot waste gases from the thermal converter to produce steam. Optimise process and thermal converter efficiency to reduce emissions. Install low NOx emitting burners to gas fired systems. Install chlorine detectors in main process stack. Install a suction vent system to remove fugitive emissions and direct them to the current 66 m stack and associated scrubbing system. Install bag filters on finishing plant stack. Regularly monitor bag filter integrity. Undertake stack and ambient air quality monitoring in accordance with any license conditions. Use water sprays and minimise surface area exposed to control dust during construction.	Reduced emissions of carbonyl sulfide, carbon monoxide and hydrogen sulphide. Ground level concentrations of licensed emissions would not exceed current levels. Recover hydrochloric acid for commercial use. Reduced use of natural gas per unit product. Reduced output of greenhouse gases per unit product. Automatic shutdown of plant and no chlorine releases. Reduced incidence of fugitive emissions. No increase in ambient dust concentrations during normal operation. Compliance with license conditions Minimal increase in ambient dust concentrations.

Table S2 **Summary of key environmental factors, environmental management objectives, management actions and monitoring, and predicted outcomes**

Key Environmental Factor	Environmental Management Objective	Environmental Management Actions and Monitoring	Predicted outcome
Saline water	SCM's management objective is to: • reduce overall water usage and saline water production; • maintain ocean water quality within the levels specified in the draft Western Australian Water Quality Guidelines for Fresh and Marine Waters (EPA Bulletin 711) • minimise impact of saline water disposal on the terrestrial environment.	Continue recycling of process water and seek further opportunities to reduce water usage. Maintain saline water quality to a standard consistent with current DEP licence. Develop a new outfall diffusion system to maintain or improve dispersion of the saline water into the marine environment. Monitor environmental impact by continuing the current water and sediment sampling programme. Construct expanded or duplicate pipeline in same alignment. Bury and mark pipe and rehabilitate any disturbed areas.	Through a continuous improvement programme, water usage has reduced by 32% since 1989. Further reductions in water usage per unit of production are expected. No significant change to ocean water quality outside 20 m mixing zone. No significant change to sediment quality. No significant impact on marine fauna. Minimal disturbance during construction. No change to existing land use or amenities along pipeline route after rehabilitation.
Solid residue	SCM's management objective is to: • dispose of solid residue by utilising methods that minimise environmental impact; • ensure the integrity of the disposal site by continuing the current monitoring and audit programme; • reduce the amount of solid residue produced per tonne of product;	Fully neutralise, treat and wash solid residue. Continue disposal at the Dalyellup site which has an expected life of 10 years at current rates. Use pond management techniques to minimise leaching. Undertake monitoring of groundwater in accordance with Environmental Management Plan and systems manual.	Insoluble metal oxides in the solid phase. Minimal leaching beneath ponds. Minimal impact since 1989. No adverse long term environmental impact to site or surrounding land uses.

Table S2 **Summary of key environmental factors, environmental management objectives, management actions and monitoring, and predicted outcomes**

Key Environmental Factor	Environmental Management Objective	Environmental Management Actions and Monitoring	Predicted outcome
Solid residue (continued)	• continue research into potential uses of the solid residue.	Undertake monitoring for radiation in accordance with Radiation Management Plan. Undertake annual audit at disposal site and associated processes. Report annually to DEP and RCWA. Continue to pursue residue minimisation programmes. Identify and pursue markets for proven potential uses of solid residue. Explore options, and seek approval from relevant authorities, for beneficial use of the solid residue. Locate and seek approval for alternative disposal sites in consultation with the Government task force. Continue research into suitable rehabilitation techniques for the Dalyellup site.	Significant usage of the solid residue in various applications. Completed site rehabilitated to meet the requirements of the EPA and Capel Shire Council.
Groundwater	SCM's management objective is to prevent groundwater contamination from process areas.	Seal and bund process area. Direct all process area drainage to wastewater treatment pond. Direct stormwater to infiltration ponds. Continue groundwater monitoring. near the process plant and the solid residue disposal area. Prepare and submit an annual report to the DEP and Water and Rivers Commission.	No significant adverse impact on groundwater quality beneath the process area.

Table S2 **Summary of key environmental factors, environmental management objectives, management actions and monitoring, and predicted outcomes**

Key Environmental Factor	Environmental Management Objective	Environmental Management Actions and Monitoring	Predicted outcome
Noise	SCM's management objective is to: • ensure that noise levels due to SCM's operations meet acceptable criteria at residential areas adjacent to the Kemerton Industrial Park; • minimise noise generation during construction.	Consider noise emission factors during design phase. Enclose noisy machinery, position equipment or fit suppression devices where required. Undertake regular ambient and source noise monitoring. Fit noise suppression devices to construction machinery.	There are no noise problems from the existing plant. Noise levels from the proposed plant will be low and will continue to meet statutory and licence conditions.
Off-site risks and hazards	SCM's management objective is to ensure off-site risk is as low as reasonably achievable and complies with EPA Bulletin 611 which establishes levels of individual and cumulative risk which is considered acceptable by the EPA.	Prepare and maintain Total Hazard Control Plan. Maintain high plant safety rating through plant design and maintenance planning. Undertake regular internal and external audits to ensure Total Hazard Control Plan remains effective. Undertake Quantitative Risk Analysis (QRA) to confirm the results of the Preliminary Risk Analysis to the satisfaction of the Department of Minerals and Energy and to meet EPA criteria.	Preliminary Risk Analysis has shown that plant will meet EPA's risk criteria. The one in a million risk contour falls within the property boundary.
Radiation	SCM's management objective is to ensure that all radiological impacts are in accordance with the ALARA (as low as reasonably achievable) principle and comply with currently accepted standards and Codes of Practice.	Maintain an up-to-date Radiation Management Plan and ensure personnel are aware of its content and responsibilities. Dispose of waste material in accordance with the Radiation Management Plan, Environmental Management Plan and Environmental Systems Manual.	No adverse impacts on employees or the general public. Compliance with statutory requirements

Table S2 **Summary of key environmental factors, environmental management objectives, management actions and monitoring, and predicted outcomes**

Key Environmental Factor	Environmental Management Objective	Environmental Management Actions and Monitoring	Predicted outcome
Radiation (continued)		Install warning signs and control employee exposure to the public limit. Measure radiation levels on all process vessels. Monitor radiation levels and personnel radiation exposure in accordance with the Radiation Management Plan. Implement decontamination procedures.	

1 INTRODUCTION

This chapter of the Consultative Environmental Review for the proposed expansion of the Kemerton titanium dioxide plant presents a brief description of the history of operations at the site and the relationship of the Kemerton plant to the plant at Australind.

The chapter also includes an overview of the project proposal, an introduction to the proponent and a brief description of the legal framework within which the environmental consultation and approval process for the proposal takes place.

1.1 BACKGROUND

Titanium dioxide is a non-toxic, white pigment used in the manufacture of a wide range of products—including, paint, paper, plastics and rubber—to make them opaque.

The manufacture of titanium dioxide started in Western Australia in 1963 at Australind, with the production of some 10,000 t/a of titanium dioxide—using the sulphate manufacturing process. The Australind plant's capacity was gradually expanded, reaching, in 1975, 36,000 t/a. In 1984 the plant was acquired by SCM Corporation.

In 1988, SCM Chemicals Ltd—Asia/Pacific (SCM) expanded its operations by increasing titanium dioxide production to 70,000 t/a and transferring it to a new plant at Kemerton (see Figure 1.1). At the same time, SCM changed the production method over to the chloride process, a more environmentally friendly and viable process than the old sulphate one.

The Australind site was converted into a plant for manufacturing finished pigment products from the Kemerton-produced titanium dioxide, and for packaging the final product.

Kemerton

At the time it was established, the titanium dioxide plant was the first industry to be set up in the recently opened Kemerton Industrial Park Today, the design and operational features of the plant incorporate the knowledge and expertise SCM has gained from managing four chloride plants overseas and from operating in Western Australia for more than thirty years.

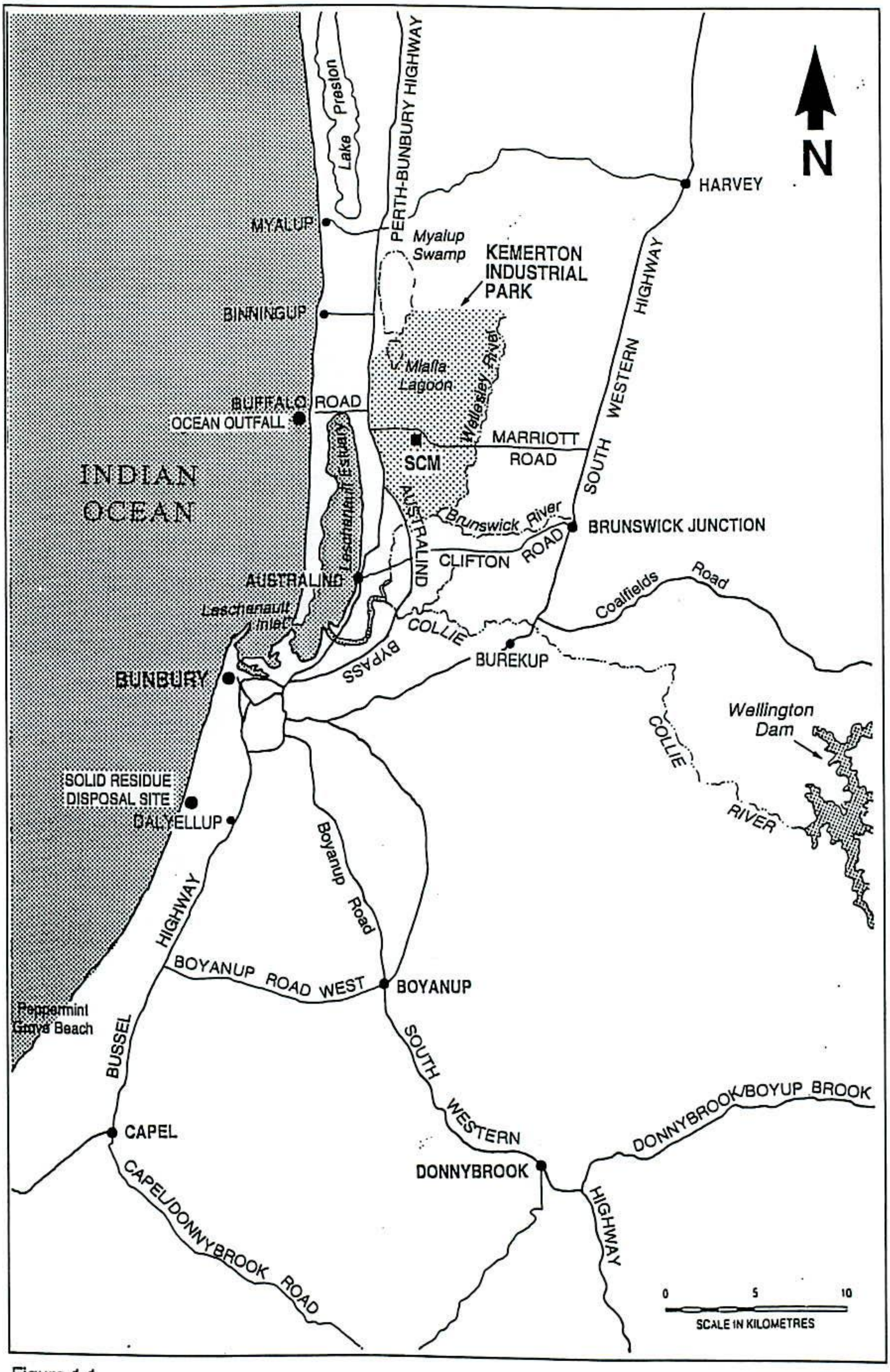

Figure 1.1
REGIONAL LOCATION

PW5003-02-001-Rev.H
10/3/97

The operation at Kemerton is the largest titanium dioxide plant in Australia and the Asia–Pacific region. The capacity of the Kemerton plant was increased by more than 10% in 1994, to reach its current level of 79,000 t/a. The plant now employs some 123 people, out of a total workforce of 426 for SCM in Australia.

Australind

Since the transfer of titanium dioxide processing to the Kemerton plant, SCM has made a number of improvements to the Australind complex. The sulphuric acid plant, previously required for titanium dioxide production, has been removed, along with the titanium dioxide production process plant. The site of these facilities has been extensively rehabilitated and planted with grass. SCM has also developed a nursery, which produces about 3,000 seedlings per year for planting around the sites, adding to the thousands of seedlings produced for planting by volunteers within the Bunbury region.

Stopping sulphate-based titanium dioxide production at Australind has resulted in a number of environmental benefits. Dust and odour emissions have been virtually eliminated. SCM has progressively reduced noise levels at the plant and will continue its noise reduction programme.

SCM has also established a groundwater recovery and decontamination programme to reduce the contaminated groundwater plume from the original plants. The programme has successfully reduced the area affected. The small section of Leschenault Estuary shoreline adjacent to the plant is now decontaminated. Groundwater recovery will continue until contamination has been reduced as far as practicable.

1.2 PROJECT PROPOSAL

The manufacturing operations based at Kemerton and Australind make a significant contribution to the Western Australian economy. As well as employing people and bringing economic benefits to the surrounding communities, the plants are important users of ilmenite, a titanium-bearing ore mined locally in Western Australia. In addition, approximately 70% of the titanium dioxide products manufactured by SCM in Australia are currently exported to Asia, providing a significant value-added benefit to the Western Australian export economy.

SCM would now like to respond to business opportunities by expanding its operational capacity in Western Australia. As a result, SCM wishes to obtain environmental approval to increase the capacity of the chloride process titanium dioxide plant, and to establish a new finishing plant, at the company's site in Kemerton.

Kemerton

The proposed development of the Kemerton plant would increase production capacity to 195,000 t/a of titanium dioxide pigment. SCM also proposes to construct a new finishing plant at Kemerton with a capacity to process up to 116,000 t/a of pigment. The Kemerton and Australind plants combined would then have the capacity to produce a total of 195,000 t/a of finished pigment.

The residue disposal systems at the Kemerton plant would also be upgraded to handle the amount of residue generated by this production rate.

The original application for expansion of the pigment plant was for a total production capacity of 190,000 t/a. However, during the design stages, investigation showed that the plant output could reach 195,000 t/a. All the discussion in this document is based on the higher figure for the expected total output, i.e. on 195,000 t/a. While this figure is marginally higher (by 5,000 t/a) than that quoted in the Guidelines for the preparation of this document, it is not anticipated that this will have any impact on the issues to be addressed by the proponent.

Australind

Up to 79,000 t/a of titanium dioxide would continue to be sent to the existing Australind plant for finishing into various grades of pigment. Within the scope of this project, no changes are proposed to the Australind finishing and packaging plant, and support facilities for SCM's operations in the Bunbury region would remain at the Australind site.

1.3 SCOPE AND TIMING OF THE PLANNED EXPANSION

1.3.1 SCOPE OF PLANNED EXPANSION

The scope of the planned expansion to SCM's titanium dioxide processing facilities is summarised here. The proposal would involve the following:

- increasing capacity to 195,000 t/a by installing additional or upgraded equipment;
- increasing on-site storage of chlorine at the chlorine production plant from 50 t to 150 t;
- constructing a new 116,000 t/a pigment finishing and packaging facility at Kemerton, similar to the facility at Australind;
- continuing the present use of the pigment finishing plant at Australind;
- constructing a process water treatment facility at the new finishing plant;

- increasing the capacity of the existing process water treatment facility from 1.5 to 5 m^3/a (which means 60 % of the process water would be recycled);
- increasing the capacity of the neutralisation plant for the titanium dioxide process;
- increasing disposal of clarified saline water into the ocean to 3 Mm^3/a;
- storage of an additional 340,000 t/a of residue slurry at the approved and already developed Dalyellup facility.

1.3.2 TIMING OF PLANNED EXPANSION

It is proposed to start construction to upgrade the titanium dioxide processing facilities in mid-2000 to enable production to start by early 2002.

1.4 THE PROPONENT

The proponent for the proposed expansion of the Kemerton titanium dioxide processing plant is Millennium Inorganic Chemicals Ltd (formerly SCM Chemicals Ltd), a subsidiary of Millennium Inorganic Chemicals Inc.

The parent company, Millennium Chemicals Inc., is based in Iselin, New Jersey, USA, and was formed as a result of the demerger of Hanson PLC, a UK public company, in October 1996. The main operating units of Millennium Chemicals Inc. subsequently changed their names with effect from 3 March 1997.

Today, Millennium Chemicals Inc. is the third largest producer of titanium dioxide in the world—the second largest using the chloride process—with a total of seven plants on three continents. The company's worldwide headquarters are in Baltimore, USA; with titanium dioxide manufacture based at four plants in the USA, and a further three in the United Kingdom and in Australia.

Millennium Chemicals Inc.'s Australian operation, Millennium Inorganic Chemicals Ltd, is headquarted in Australind,Western Australia. The company operates the Kemerton and Australind plants.

This document was produced prior to the company's name change. Hence, the former company name of SCM Chemicals Ltd–Asia/Pacific (or SCM) is used throughout the text.

1.5 LEGISLATIVE FRAMEWORK AND ENVIRONMENTAL APPROVAL PROCESS

1.5.1 LEGISLATIVE REQUIREMENTS

The legislative and statutory requirements that would apply to SCM's construction and operation of the expanded Kemerton plant are the same as those that apply to the current operations at Kemerton, Australind and Dalyellup. These include the following:

- *Environmental Protection Act 1986* (WA)
- *Water Authority Act 1984* (WA)
- *Occupational Health, Safety and Welfare Act 1984* (WA)
- *Radiation Safety Act 1975* (WA)
- *Radiation Safety (General) Regulations 1983 (WA)*
- *Explosives and Dangerous Goods Act 1961* (WA)
- *Town Planning and Development Act 1928* (WA)
- *Bush Fires Act 1954* (WA)
- *Soil and Conservation Act 1945* (WA)
- *Transport Code 1990* (Cwlth).

SCM's operations are defined as prescribed premises under Part V of the Environmental Protection Act 1986, and expansion of the Kemerton plant would be implemented and operated in accordance with the requirements of all relevant acts and regulations. In addition to the requirements of the licence to operate, SCM would continue to fulfil the Commitments and Ministerial Conditions set on the existing chloride process plant (see Chapter 9).

1.5.2 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The environmental impact assessment process for this proposal is shown in Figure 1.2 and described in this section.

The process commences with a proposal for development being referred to the Environmental Protection Authority (EPA). The EPA determines the appropriate level of assessment required for the referred proposal. Once the EPA has determined the level of assessment, the proponent is advised of the decision and guidelines on the documentation are issued.

The proponent prepares the documentation required by the guidelines and submits a draft to the Department of Environmental Protection (DEP) which must be approved before being finalised and released for public review. The review period allows interested parties and Government agencies to submit written comments on the proposal. At the end of the review period, the DEP summarises the environmental issues raised in all submissions received; this summary is provided to the proponent. A formal response to each of the issues is then provided by the proponent.

SCM refers proposal for the expansion to the EPA and DEP

↓

Decision by the EPA on level of assessment*

↓

The EPA advises SCM on level of assessment—expansion to be assessed under Section 46 of *Environmental Protection Act 1986*

↓

SCM prepares report outlining the expansion and their potential environmental impacts and conducts public consultation programme

↓

The DEP examines report for suitability for review by government agencies and interested groups and individuals

↓

Public review period—four weeks

↓

Government and public submissions prepared and sent to the EPA

↓

The DEP summarizes environmental issues raised in all submissions received

↓

SCM prepares responses to the DEP summary of environmental issues

↓

The EPA undertakes assessment of project and publishes report and recommendations*

↓

Minister for the Environment decides on approval of the proposal and amends environmental conditions** where appropriate

* Point at which an appeal may be lodged
** Appeal by proponent only

Figure 1.2
ENVIRONMENTAL IMPACT ASSESSMENT PROCESS
(relevant to SCM's proposed expansion to Kemerton Pigment Plant)

After reviewing the proponent's responses, the EPA assesses the proposal and reports its findings and recommendations to the Minister for the Environment. The EPA report to the Minister outlines the environmental acceptability of the proposal and, where appropriate, makes recommendations on conditions that may apply if the proposal should proceed.

Following resolutions of any appeals by the proponent, or other parties, against the EPA recommendations, the Minister determines if the proposal is environmentally acceptable and may issue a set of legally binding environmental conditions under which the proposal must be implemented.

1.6 SCOPE AND PURPOSE OF THIS DOCUMENT

The scope of this document is to review the environmental impacts of the current operation at Kemerton, and to identify the environmental implications associated with the construction and operation of the facilities to provide an additional 116,000 t/a of titanium dioxide pigment. The document would be released as a Consultative Environmental Review (CER) for public comment, with the approval of the EPA. The purpose of the CER is to provide the following:

- a description of the planned expansion of the pigment plant, and identification of potential environmental impacts and the measures that would be implemented to manage and monitor these;
- a description of the finishing plant, and identification of potential environmental impacts and the measures that would be implemented to manage and monitor these;
- sufficient information for Government agencies and interested parties involved in the initial Kemerton proposals to make informed submissions to the EPA;
- information to the EPA to enable it to adequately assess the proposal and make its recommendation to Government.

1.7 STRUCTURE OF THE CER

The CER presents the information it contains in the following way:

- the need for the proposed expansion (Section 2);
- an outline of the project and details of the proposed expansion (Section 3);
- a review of the environmental performance and impacts of the current operations at Kemerton (Section 4);

- an outline of the development and analysis of the public consultation programme (Section 5);
- a description of the existing environment at Kemerton, Dalyellup and along the pipeline route towards the ocean at Leschenault Peninsula (Section 6);
- an evaluation of the potential environmental and social impacts of the expansion and their minimisation (Section 7);
- the proposed monitoring programme (Section 8);
- a summarised list of environmental commitments (Section 9).

2 JUSTIFICATION FOR PROPOSED EXPANSION AND EVALUATION OF ALTERNATIVES

This chapter describes the need for, and benefits of, the expansion, and describes alternative options for meeting the requirement.

2.1 FORECAST DEMAND AND ALTERNATIVE SOURCE OF SUPPLY

Demand for titanium dioxide in the Asia–Pacific region is projected to grow at an average rate of 5.7% each year from 1994 to 2002.

The expanding economies in the region, the increasing demand for titanium dioxide and the growing market preference for chloride-based products make this the fastest growing market in the world.

Projected demand for titanium dioxide will soon exceed the capacity of SCM in Western Australia to supply product to the market. Without increased production at the Kemerton plant, additional demand would have to be met from alternative locations.

With the additional capacity from the proposed expansion of the plant, however, SCM would be able to supply market growth and increase market share, without importing titanium dioxide from other regions.

2.2 EVALUATION OF ALTERNATIVES

SCM evaluated three alternatives to the proposed increase in production capacity at the Kemerton plant. These were as follows:

- Increasing capacity to 150,000 t/a (45,000 t/a lower than this proposal), as originally envisaged. Results showed that only the economies of scale produced by expanding to 195,000 t/a would enable the project to become viable.
- Constructing a greenfield plant. This would have resulted in a much larger investment, greater risk in a new area and a longer lead time before starting production. It was, therefore, not considered to be viable.
- Undertaking a joint venture in another part of the Asia–Pacific region. This proposal would also have resulted in a much larger investment, greater risk in a

new area and a longer lead time before starting production, and so was not considered viable.

2.3 BENEFITS OF THE PROPOSED EXPANSION

2.3.1 EMPLOYMENT

The proposed expansion of the raw pigment processing plant at Kemerton would have a significant positive effect on employment in the south-west region of Western Australia.

- SCM currently has 426 employees with an annual payroll of $20 million (1995-96). It is expected that permanent operational employment would increase by 200 jobs, with an estimated total payroll of $31 million. The majority of these employees would live in Bunbury and the surrounding district, and would make a significant contribution to the local economy.

- In addition to the plants at Kemerton and Australind, the Nufarm Coogee Pty Ltd, Cockburn Cement Ltd and BOC Gases of Australia Ltd satellite plants would be expanded to supply resources for the Kemerton operation. Employees of these plants would also be local.

- During the construction phase, employment would peak at 500 people over a twenty-four month period. The income generated during the construction phase, through both direct and indirect employment, would result in a considerable increase in economic activity in the region.

- SCM's policy is to give preference, where possible, to local organisations when contracting out construction, maintenance and services work. The employment multiplier effect to the local economy would be about four times. That is, for every new job created, four additional jobs would be created in local support industries.

- A total of 200 skilled and semi-skilled positions would be directly created as a result of this project. The chloride process technology is advanced and highly sophisticated, requiring an extension of transferable skills in all categories of employment.

- The expansion of the Kemerton plant would mean new opportunities, not only for the company and its employees but for the community. As such, the project would be a commitment by SCM to the future of south-west Western Australia.

2.3.2 PURCHASING

SCM purchases locally wherever possible. For instance the feedstock, synthetic rutile, is obtained from south-west suppliers RGC Mineral Sands Limited and Westralian Sands Ltd.

Many other goods and services are also currently supplied by state and local businesses. During 1995–96, for example, Western Australian purchases were estimated to have been in excess of $110 million. The proposed expansion of the plant at Kemerton would considerably increase the demand for local goods and services by SCM in the future.

2.3.2 PROJECT EXPENDITURE

If the proposed expansion took place, there would be a total of $470 million in direct expenditure, and $70 million or more in indirect expenditure (for example, on the satellite plants gearing up to meet the expanded operational requirements) during the construction phase of the project. In addition, many millions would be spent by support industries as they expanded to supply the increased demand.

The expansion would represent the largest capital expenditure ever undertaken by SCM in the region. It would make the company a world class producer, injecting millions of dollars into a project that would create wealth for the region.

2.3.4 GOVERNMENT REVENUES

During both the construction and operational phases, income for both State and Federal Governments would be generated.

2.3.5 EXPORT INCOME

SCM currently contributes about $120 million annually to the country's export income. This would increase to $300 million when the expansion of the plant became fully operational. The $300 million increase would have a positive effect on the balance of payments for Western Australia and for the nation as a whole.

2.3.6 ADDED VALUE DOWNSTREAM FOR INDUSTRY

The production of finished pigment from ilmenite is carried out in several stages, each process increasing the market value of the original Western Australian resource. Table 2.1 gives an idea of the wealth generated downstream in the economy from each dollar of ilmenite processed by industry.

Table 2.1 **Value added by processing**

Material	Added value ($)
Ilmenite	1
Synthetic rutile	5
Titanium dioxide pigments	22

2.4 NO PROJECT OPTION

If it were decided that the proposed expansion of the raw pigment plant at Kemerton should not proceed, the following benefits would be lost:

- Direct employment for 500 people during the twenty four month construction period, direct employment for an additional 200 people when the plant is operating and flow-on effects in local employment.

- Income generated by the operation during both construction and operational phases, and through flow-on effects.

- Project expenditure by SCM and its suppliers in the south-west, including flow-on effects. .

- Increased export income of up to $300 million each year.

- Revenue for State and Federal Governments.

- Opportunities for local people to gain experience in working with highly sophisticated modern technology.

3 DESCRIPTION OF THE PROPOSED EXPANSION

This chapter describes the process of manufacturing titanium dioxide from synthetic rutile and details the proposed expansion of the plant at Kemerton.

3.1 PROCESS DESCRIPTION

3.1.1 PRODUCTION OF TITANIUM DIOXIDE

The chloride process for the preparation of titanium dioxide (TiO_2) from synthetic rutile is based on the production of titanium tetrachloride ($TiCl_4$) by chlorination of the ore. The purified titanium tetrachloride is subsequently oxidised, yielding titanium dioxide and allowing recovery of chlorine.

The process is shown schematically in Figure 3.1. Details of the various steps are described in the following paragraphs.

Chlorination

Titanium-rich synthetic rutile, together with a supply of carbon in the form of petroleum coke, is fed into a refractory-lined chlorinating vessel which operates at a temperature of approximately 900–1000°C. Chlorine (Cl_2) entering the vessel reacts with the titanium dioxide, and some of the impurities present in the ore, to form volatile titanium tetrachloride and other metal chlorides as well as carbon monoxide (CO) and carbon dioxide (CO_2). The reaction is as follows:

$$3\,TiO_2 + 4\,C + 6\,Cl_2 \rightarrow 3\,TiCl_4 + 2\,CO + 2\,CO_2$$

The gaseous and solid chlorinated products, and unreacted solid fines, pass out of the reactor via refractory lined ducting into the purification area of the plant.

No liquid wastes or atmospheric emissions are produced during this step.

Purification

In the purification area, solid impurities are separated from the hot gas. The gas is condensed and then distilled to produce pure titanium tetrachloride as an intermediate product which is stored in steel vessels prior to the next stage of the process.

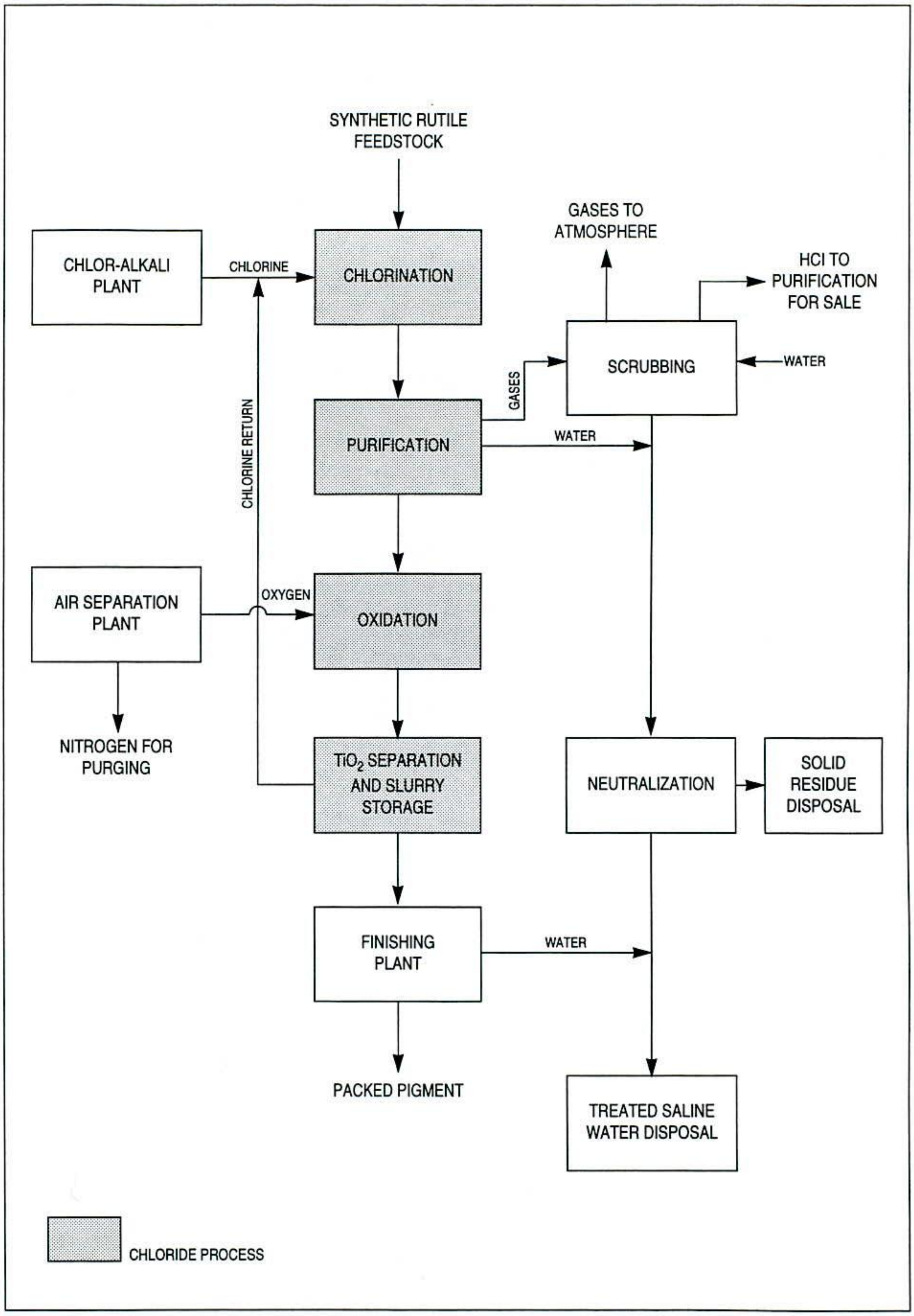

Figure 3.1
CHLORIDE PROCESS TITANIUM DIOXIDE MANUFACTURE

The solid residue separated from the gas stream typically consists of metal chlorides, oxides and hydroxides, various silicates, unreacted ore, coke and ash. These are flushed from the system with recycled water which originates from, and is treated in, the process water neutralising system. Synthetic rutile and coke are also recovered and separated prior to reuse in the production process. The dried residue is an inert, insoluble, non-toxic, clay-like material.

The only gaseous emission from the chloride process is produced at the exit of the purification section. The exit gases are scrubbed with water to remove residual titanium tetrachloride, metal chlorides, and hydrogen chloride. This produces concentrated hydrochloric acid which is recovered for reuse on site and for external sales. A thermal converter is used to burn carbon monoxide, carbonyl sulphide and hydrogen sulphide from exhaust gases. The resulting sulphur dioxide is then absorbed in a caustic scrubber and the resulting sulphur solution is oxidised in a process developed by SCM, to produce a sulphate solution that is reinjected into the saline water for disposal. Carbon dioxide and nitrogen are exhausted to the atmosphere.

Oxidation

After the purification process, the titanium tetrachloride is pumped from storage and passed through a heat exchanger. It is then reacted with preheated oxygen, in a proprietary reactor, to produce titanium dioxide and chlorine. The mixture of solid titanium dioxide, recovered chlorine and nitrogen is cooled before entering the next stage of the process.

The only wastes or emissions produced in this step of the process are the products of combustion resulting from the natural gas used for preheating.

Pigment separation and slurry storage

The cooled mixture of titanium dioxide and gases containing chlorine is passed through a filter where the solid titanium dioxide pigment is removed and slurried in water. The slurry is stored before being transported either to the finishing plant at Australind (by truck) or pumped to the adjacent Kemerton finishing plant.

The gases containing chlorine and nitrogen are separated from the solid titanium dioxide and returned to the chlorinator section, together with fresh make-up chlorine, to chlorinate more feedstock at the start of the process.

No wastes or emissions are produced during this stage of the process.

3.1.2 PRODUCTION OF FINISHED PIGMENT

The Kemerton finishing plant comprises a wet surface treatment followed by drying, micronising and packing. The slurry is surface treated with chemicals and neutralised with caustic soda and hydrochloric acid. The treated slurry is then washed using vacuum filters to remove excess salts, before being thickened and dried in a gas-fired spray drier to remove remaining moisture and produce a fine powder. Dried pigment is collected from the drier exhausts by bag filters. Pigment is air conveyed between processing stages and again collected in bag filters. The bag filters are vented to the atmosphere.

The dried powder is pumped pneumatically to the fluid energy mills, where high pressure steam is used to grind the particles. The ground pigment is then conveyed to surge bins prior to packaging in 25 kg bags or bulk bags. This finishing process is presented schematically in Figure 3.2.

3.1.3 RESIDUE TREATMENT

Gaseous wastes from the purification section are passed through three scrubbers prior to being burnt in the thermal converter and the combustion gases are then scrubbed with an alkaline solution. Gaseous wastes absorbed in the scrubbers are processed to recover valuable materials and minimise the production of waste. The recovery process produces hydrochloric acid which is sold or neutralised before disposal.

In a neutralisation process to treat the solid residue slurry separated from the chlorinated gas stream, lime is added to each of a series of tanks to raise the pH and precipitate the contaminants as hydroxides. The water is then sent to a clarifier where the solids settle. The solid residue is filtered in a vacuum filter, washed to remove a large proportion of the soluble salts, water added to make a 11–15% slurry and transferred to 40 t capacity tanker trucks. The filtrate from the vacuum filter is returned to the process water stream after the lime dosing tanks. Some of the treated saline water is reused for sluicing solid residue after the chlorination section, while the remainder is pumped to a holding pond prior to disposal.

SCM continues to pursue a range of disposal techniques and remains fully committed to on-going research into residue minimisation, recycling and alternative uses for residues. The objective of residue minimisation is to segregate individual constituents of residue and provide material that can be recycled through the process plant or sold. A residue minimisation plant was commissioned in December 1992 and, combined with improved process efficiency, has resulted in a 40% reduction in residue solids.

3.2 COMPONENTS OF THE PROPOSED KEMERTON EXPANSION

The layout of the expanded chloride process plant and the new finishing plant at Kemerton are listed in Table 3.1 and shown in Figure 3.3. Details of the proposed expansion are discussed in more detail in the following sections.

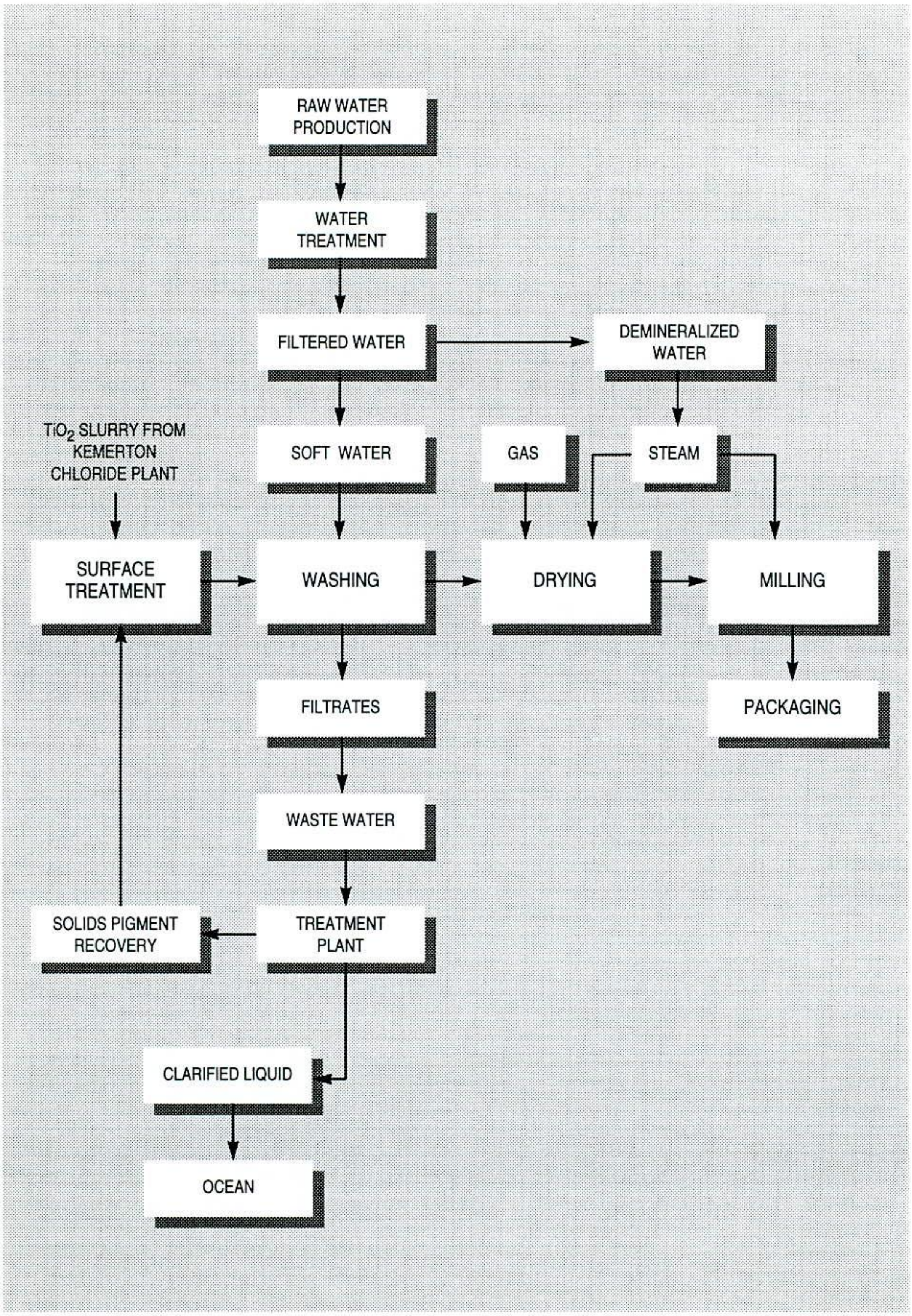

Figure 3.2
FINISHING PROCESS

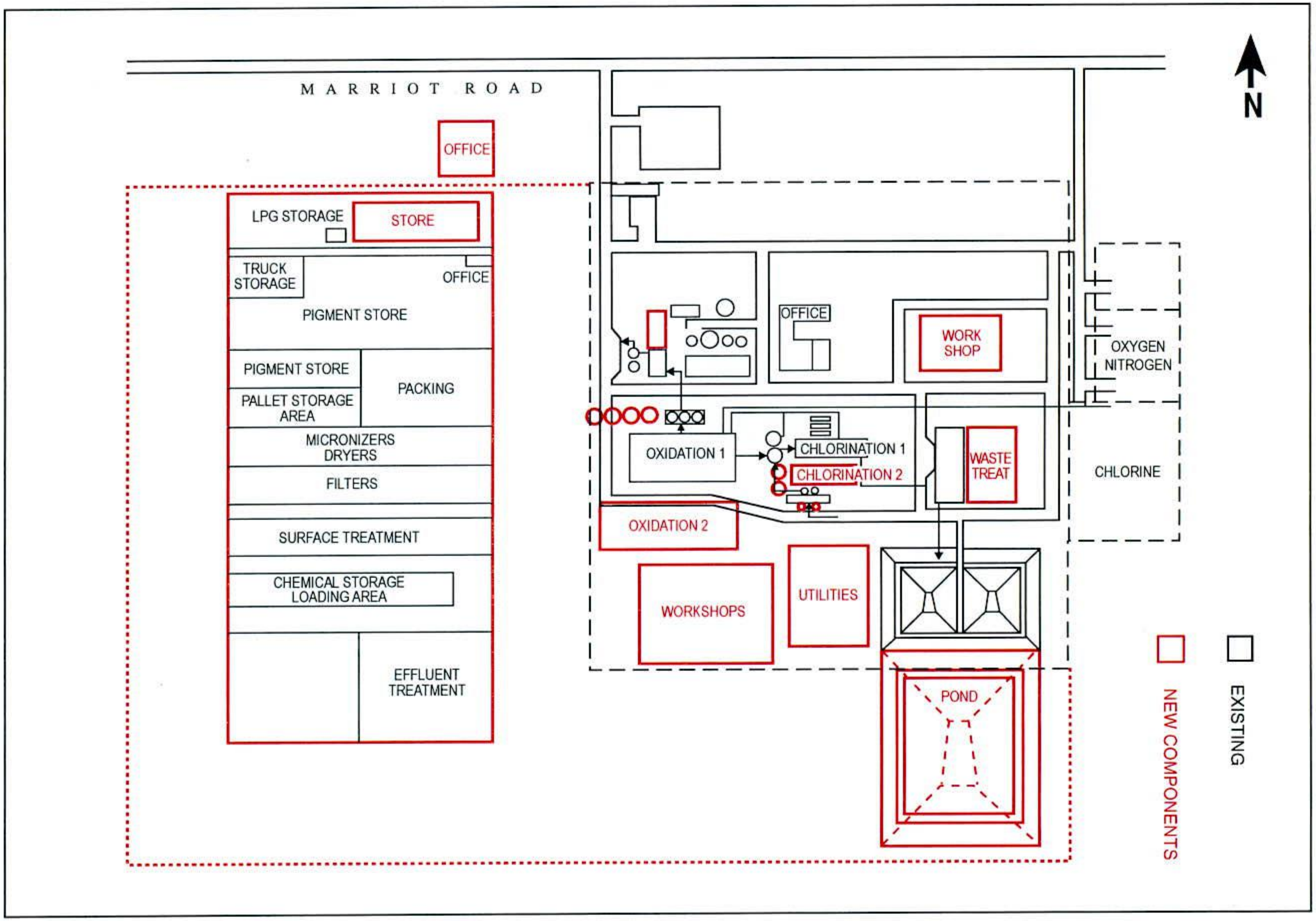

Figure 3.3
PROPOSED CONCEPTUAL LAYOUT

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Table 3.1 **Components of expanded chloride process plant and new finishing plant**

Section	Components
Ore and coke handling	Add two new storage silos Add five new conveying systems Modify ore elevator to feed new silos
Chlorination	Add two new chlorinators Add one new cold cyclone Add one new sluice system
Condensation/purification	Add one new primary condenser Add one new secondary water cooled condenser Add one new brine cooled condenser Add two new brine refrigeration systems Add new purification system
Oxidation	Add new $TiCl_4$ and oxygen heaters Add new aluminium chloride generator Add one new reactor Add new bag filter Add four new slurry storage tanks Add ten new media mills
Finishing	Build two identical lines consisting of one treatment tank three wash filters one drier two fluid energy mills Add four pigment recovery thickeners Add chemicals make-up and storage facilities Add four bag packaging machines Add one semi-bulk packaging machine
Waste treatment	Add new process stack and scrubber Extend piping from existing maintenance scrubber Add thermal converter and waste heat boiler Extend suction vent system Add one new neutralisation system Upgrade pipeline to ocean
Utilities	Upgrade primary electrical substation Replace water treatment system Replace boiler Add new five-cell cooling tower Upgrade utility distribution system
Buildings	Expand workshops Expand laboratories Add new offices Add lunch room, change rooms and toilets Upgrade technical and engineering offices Add finished product warehouse Add materials stores Upgrade computer system

3.2.1 RAW MATERIALS HANDLING

SCM proposes to expand the materials handling equipment on the Kemerton plant site by installing new ore silos and a new coke silo, and converting the existing coke silo to handle ore. New ore and coke conveying equipment would also be installed. The existing off-site coke storage facility would not be upgraded; additional coke requirements would be met by more frequent topping up of the storage facility.

3.2.2 CHLORINATION AND PURIFICATION

It is proposed to increase pigment production by installing two new chlorinators with a larger capacity than those presently used. As part of the expansion, it is also planned to duplicate the current gas–solids separation system, titanium tetrachloride ($TiCl_4$) condenser, crude $TiCl_4$ accumulation tank, and crude and pure $TiCl_4$ storage tanks with larger units. The $TiCl_4$ purification equipment, including a distillation vessel, reboiler, cooler and heat exchangers, would be duplicated with larger capacity equipment. Two additional refrigeration units would be installed.

Extra chlorine would be required to serve the proposed expansion, and it is proposed to obtain this from an external supplier. Extra compressed nitrogen would also be required to convey raw materials and products around the plant. This would also be obtained from an external supplier.

A new gas scrubbing train, consisting of a spray tower, a venturi scrubber and a packed tower, would be installed to cater for all the process gas wastes from the entire plant. In addition, a thermal converter would be installed following the scrubbing system to incinerate all waste gases including those from the existing plant. Treated gases would be scrubbed to remove acid gases before release to the atmosphere through a new main process stack.

3.2.3 OXIDATION

It is proposed to duplicate most of the items of equipment in this area with units of increased capacity. The duplication includes oxygen and $TiCl_4$ heaters, oxidation and aluminium chloride reactors, gas/solid separation filter, slurrying and slurry water tanks, cooling pond, water cooler and slurry storage tanks.

Additional compressed oxygen would also be required to oxidise the $TiCl_4$. This would be obtained from an external supplier.

3.2.4 FINISHING

This section would be all new equipment. This equipment would include pigment treatment and pre-treatment tanks, as well as vacuum filters with associated vacuum pumps and slurry tanks for washing and dewatering pigment. Driers would be used to remove the remaining water from the pigment cake. Bag houses would separate the pigment powder from the drying air stream and the powder would be pneumatically conveyed to a fluid energy mill to grind the powder. The ground pigment would then be conveyed to surge bins prior to packaging in 25 kg bags or bulk bags.

A ducted vacuum system would be installed throughout the dry pigment handling areas and a dust extraction system would be included within the packaging area. Both systems would make use of a fan and baghouse to allow recovery of the pigment dust for reuse or disposal.

3.2.5 WASTE TREATMENT

The suction vent system would be expanded to collect fugitive emissions from tanks, sample points, equipment washdown areas and other locations. Fugitive emissions would be scrubbed before emission to the atmosphere.

It is proposed to expand the process water treatment section associated with the production of titanium dioxide and construct a waste treatment plant to handle wastes arising from the finishing plant. A diagrammatic representation of the existing system is provided in Figure 3.4.

The additional units to be installed include the following:

- neutralisation tanks;
- thickeners;
- solid residue washing filter and vacuum pump;
- filtration and thickener tanks;
- solid residue holding tank;
- saline water pipeline descaling (pig) launcher.

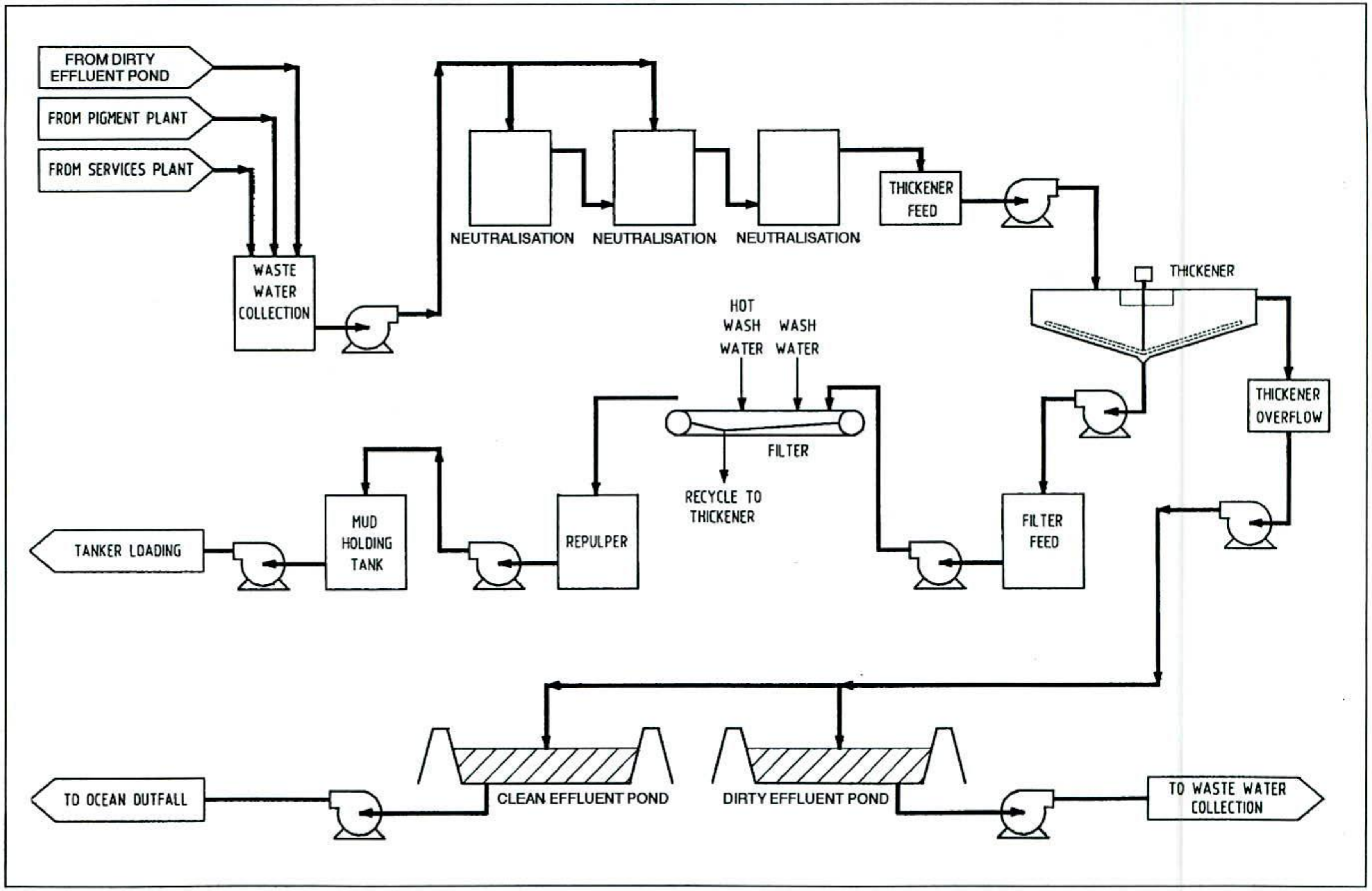
The existing saline water pipeline descaler retrieval system would be replaced with a larger and more efficient pipe cleaning system. A second water recovery pond would be added to the existing pond system.

A new pigment finishing process water treatment plant consisting of filtrate recovery thickeners, polishing thickeners, clarifiers and neutralisation facilities would be installed.

3.2.6 AUXILIARIES

With the expansion of the plant, it is proposed to direct all hot exhaust gases generated from the thermal converter to a waste heat boiler to generate steam, before they are passed through a caustic scrubber and discharged to the atmosphere through the main process stack. The steam generated in the waste heat boiler would be used to supplement boiler steam. Options for a co-generation facility to provide additional power requirements are also being investigated.

Figure 3.4
WATER TREATMENT PROCESS—EXSISTING



Additional bulk water storage tanks, cooling towers and a water distribution network would be installed. A larger water treatment plant and a self-contained package sewage treatment plant would be constructed.

New offices, pigment storage areas and maintenance facilities would be constructed to cater for the finishing plant. The existing office and laboratory complex would be expanded. Additional motor control centres would be constructed. Computer systems to support the motor control centres would be upgraded to meet the control demands of the new facility.

3.3 LOCATION AND CONCEPTUAL LAYOUT OF PROCESS PLANT

The conceptual layout of the expanded chloride process plant and the new finishing plant are shown in Figure 3.3. Some of the items of the expanded chloride process plant can be accommodated alongside the existing units. However, a new oxidation stream, plant support facilities and waste pond would be sited south of the existing chlorinator section.

The finishing plant would be sited to the west of the existing plant in an area that is presently uncleared.

3.4 RAW MATERIAL REQUIREMENTS

The raw material requirements for the proposed plant expansion, compared to existing requirements, are shown in Table 3.2.

Table 3.2 **Process raw material requirements (t/a*)**

Major inputs	Current requirements	Requirements of proposed expanded plant
Synthetic rutile	84,000	206,000
Petroleum coke	18,000	42,000
Chlorine	16,000	35,000
Oxygen	39,000	96,000
Nitrogen	59,000	145,000
Water (m^3/a)	1,500,000	5,000,000
Natural gas (GJ/a)	370,000	980,000
Electricity (MWh)	29,000	97,000

*Note * unless indicated*

3.5 WATER REQUIREMENTS

With the expansion of the plant and construction of a finishing plant, the quantity of water required would increase considerably from the quantity required for the existing operation at Kemerton. At present, water for the existing chloride process plant is obtained from three bores which extract water from sub-artesian aquifers. Within these aquifers, two bores extract water from the Cockleshell Gully Formation and one bore extracts water from the Leederville Formation. These aquifers would not be able to supply the water requirements of the expanded plant, due to existing uses and commitments.

Options to obtain additional water include the following:

- nearby surface waters, such as the Wellesley River;
- Wellington Dam;
- shallow groundwater;
- deep groundwater.

Use of shallow groundwater to supply the plant may cause a lowering of the water table which would adversely affect wetlands in the immediate vicinity. The nearby rivers, such as the Wellesley, are highly variable in flow and quality. The quantity available is not adequate for the proposed expansion without compromising existing uses and stream flow. These two options are therefore not appropriate.

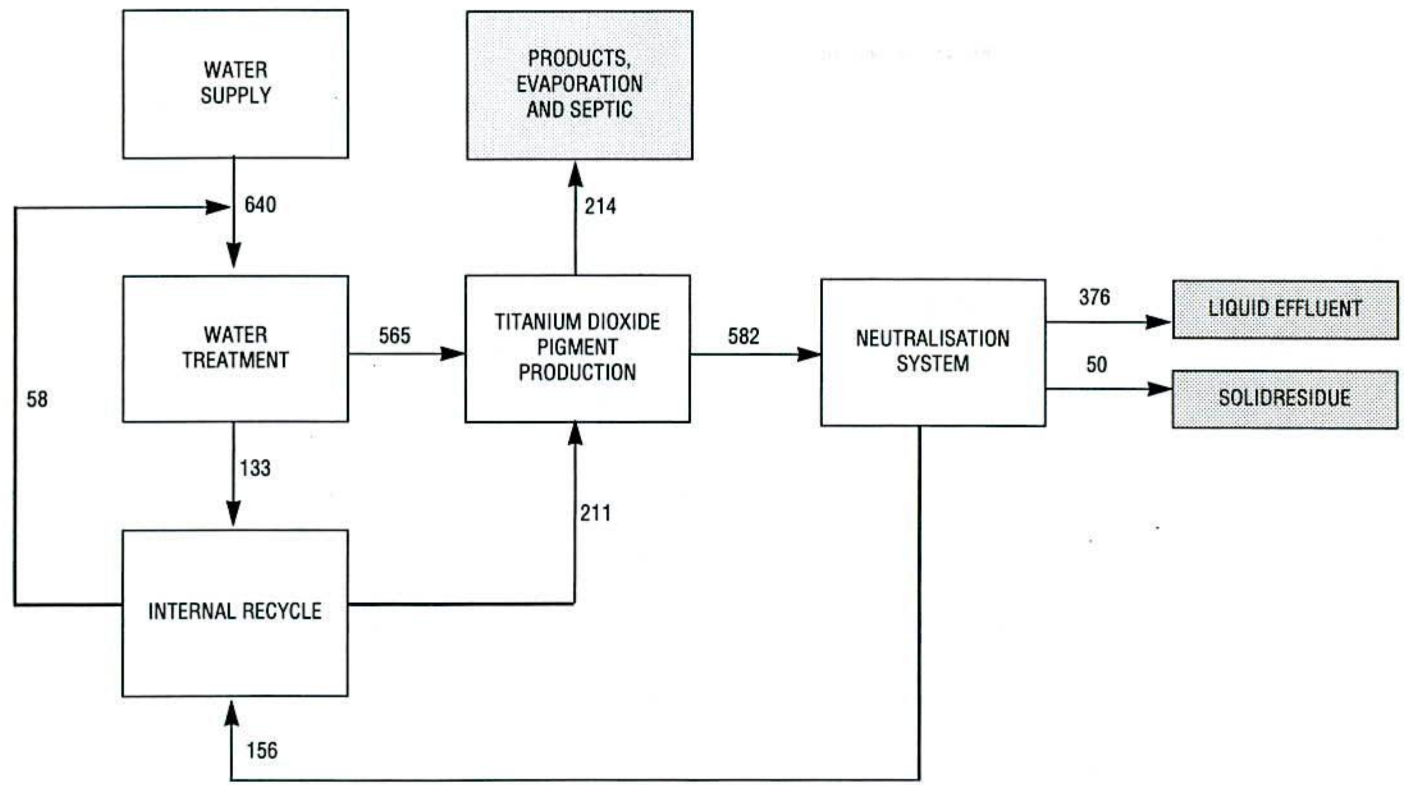
The Office of Water Regulation has recently received environmental approval to construct the Kemerton Industrial Park water supply pipeline to supply water to the Kemerton area (EPA 1994). This proposal involves the release of water into the Collie River from the Wellington Dam. The water would be collected at a weir on the river at Burekup and pumped to the Kemerton Industrial Park (Water Authority 1993). SCM could utilise this pipeline to provide the balance of water required for the proposed plant expansion.

The raw water would require treatment, including filtering, before being used by the pigment plant. Approximately 70% of this filtered water would be passed through a water softening process in the proposed plant. A third of this water would then be demineralised. Residual liquids from the treatment processes would be treated in the process water treatment system. A flow diagram describing the water balance and recycling proposal is presented in Figure 3.5.

The design of the expanded chloride process plant and the new finishing plant incorporates several water-saving innovations currently in use at the existing Kemerton and Australind plants. Table 3.3 details the current and predicted water used in tonnes per tonne of titanium dioxide or finished pigment produced.

Reuse of the finishing plant effluent in the raw pigment plant, and utilisation of closed cooling water loops, are estimated to conserve 65 m^3/h of water. Recycling of recovered water to Cockburn Cement would save an additional 19 m^3/h. These conservation measures would reduce the water required to produce each tonne of finished pigment from 40.9 to 31.9 t of water.

Figure 3.5
WATER BALANCE



NOTE:
This balance displays hourly water flows in m^3/h, based on a full years usage. Instantaneous flows may be higher.

Table 3.3 **Comparison of raw water usage**

Plant	Current production*	Proposed production*
Titanium dioxide plant–Kemerton	18.6	11.8
Finishing plant–Australind	22.3	23.3
Finishing plant–Kemerton	–	18.7
Total (based on typical proportional production at each finishing plant)	40.9	31.9

*Note * water usage in tonnes per tonne of product*

A survey of fifteen similar plants worldwide has shown typical raw water use to be 120–140 t to 1 t of finished pigment produced in plants using the chloride process, and 200–400 t to 1 t of finished pigment produced in plants using the sulphate process. In comparison, the water-saving technologies at the Kemerton and Australind plants provide significant economies in water use.

SCM would continue to supply filtered water to the Nufarm, Cockburn Cement and BOC satellite plants and accept their effluent for treatment.

3.6 PRODUCTS AND BY-PRODUCTS

3.6.1 PRODUCTS

The quantities of products and by-products generated by the proposed plant expansion, compared to present production, are shown in Table 3.4.

Table 3.4 **Quantities of products and by-products produced at Kemerton (t/a)**

Major outputs	Current production	Proposed production
Finished pigment	79,000	195,000
Hydrochloric acid (as 100% acid)	6,000	14,400
Solid residue slurry	141,000	397,000
Neutralised saline water*	950,000	3,000,000
Carbon monoxide	6,700	3,600
Carbon dioxide	70,000	194,000
Titanium tetrachloride	<0.5	<0.5
Chlorine	<0.5	<0.5
Carbonyl sulphide	540	540
Sulphur dioxide	200	240
Hydrogen sulphide	<0.5	<0.5
Nitrogen oxides	25	60
Nitrogen	59,000	145,000

Note Atmospheric emissions assume thermal converter with 25% bypass
** cubic metres per annum*

The Kemerton plant would be able to produce up to 183,000 t/a of raw pigment, which could be processed into 195,000 t/a of finished pigment. It is proposed to produce 116,000 t/a of the finished pigment at Kemerton. The remainder, i.e. 79,000 t/a, would be produced at the Australind plant.

3.6.2 ATMOSPHERIC EMISSIONS

Gaseous emissions would be generated from the following sources:

- main process stack
- suction vent system stack
- start-up stack
- raw pigment plant boilers and heaters
- finishing plant driers
- finishing plant boilers

The boilers, heaters and driers would only emit carbon dioxide, nitrogen oxides and water vapour as a result of the combustion of natural gas. The installation of a thermal converter prior to the main process stack would result in reduced emissions, particularly of carbon monoxide, carbonyl sulphide and hydrogen sulphide. Heat from the thermal converter would be used to generate steam, therefore reducing natural gas uses. Scrubbing of the gases after they have passed through the thermal converter would remove 95% of the sulphur dioxide.

The integrated thermal conversion system is new technology and would require further development to achieve optimum reliability. While SCM is committed to the principle of introducing 'best available technology', its experience suggests that to establish consistent and continuous operation of the overall process, bypassing the thermal conversion system would be required to allow for process optimisation. It is the company's intention to maximise the potential of the thermal converter. The proposed emission levels (Table 3.4) allow down time for any maintenance and modifications that might be required for optimum emission control. The emissions would meet current licence limits, even during down time periods.

In addition, the chloride process plant would produce hydrogen chloride gas as a by-product. This gas would be recovered in a scrubber prior to combustion of the remaining gases in the thermal converter. The recovered hydrogen chloride would be converted into 14,400 t/a of hydrochloric acid. This acid would either be used within the process, sold or neutralised prior to disposal.

3.6.3 SALINE WATER

Effluent from the water filtration plant, water softening plant, demineralisation plant, residue wash facility and raw pigment plant, along with the effluent from off-site providers, would be sent to the neutralisation treatment system for treatment. The effluent would be neutralised, clarified and then piped to saline water holding ponds prior to ocean disposal. Saline water from the finishing plant filtration system would also be sent to the saline water holding ponds. A diagram describing the current process water treatment system is presented in Figure 3.4.

The upgraded process water treatment system includes a new saline water pond with three times the capacity of the existing ponds. The rate of disposal to the ocean outfall would increase from 110 m^3/h to 395 m^3/h. This includes wastewater generated by the pigment surface treatment facilities at Kemerton.

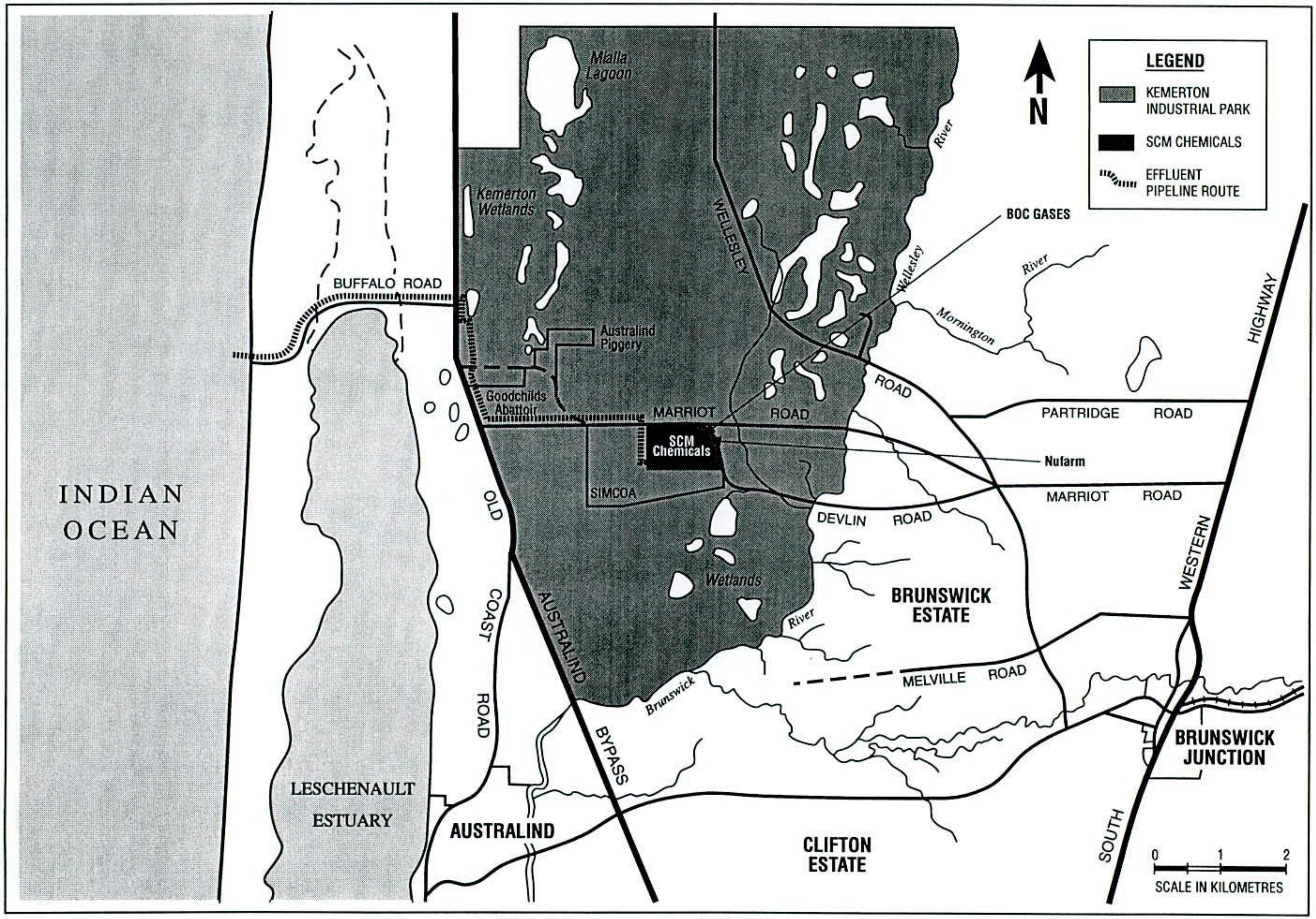
The chloride process plant at Kemerton currently incorporates extensive internal water recycling. This recycling results in 60% of all water used being recycled within the current plant. The recycling allows the current plant to use about 40% of the total water usage of most other plants using the chloride process. A similar water recycling and reuse system would be incorporated into the proposed expansion. Water treatment plant wastes, which includes filter backwash water and ion exchange regeneration water, would be used to sluice solid residue or prepare lime slurry. In addition, some water generated by the proposed finishing plant would be recirculated or reused.

Reuse of all the water produced would not be economic as the water would become too saline for further use. Following reuse of water in as many applications as possible, the saline water that could not be reused would be treated. The treated saline water would be collected in a holding pond and pumped approximately 9 km to an existing ocean outfall located west of the northern extremity of the Leschenault Peninsula. To cater for the increased amount of saline water to be pumped to the ocean from the plant expansion, the pipeline would be upgraded. The proposed pipeline would be constructed of high density polyethylene pipe and would be buried up to a depth of 600 mm.

The route of the proposed pipeline would follow the existing pipeline route, as shown in Figure 3.6. Generally the pipeline follows Marriott Road, the Perth–Bunbury Highway and Buffalo Road. From the plant, the pipeline crosses the road and runs through private property along the northern side of Marriott Road. It then runs through cleared private property along the eastern side of the Perth–Bunbury Highway. The pipeline crosses underneath the Perth–Bunbury Highway and runs, partly through cleared private property and partly in the road reserve, along the northern side of Buffalo Road, through the dunes at the northern end of the Leschenault Peninsula and terminates in a break tank situated behind the final dune line. The route then continues in a south-westerly direction along a natural gully down to the shoreline.

From the shoreline, the pipeline would be partially buried in the ocean floor, and continue westwards for a distance of 270 m off shore. The treated saline water would be discharged through an expanded diffuser attached to the end of the pipeline, in a water depth of approximately 7 m. The pipeline would be adjacent to a proposed pipeline to be installed by Western Power, but the outlet of Western Power's pipeline would be outside the zone of influence of SCM's outlet.

Figure 3.6
SCM LOCATION WITHIN KEMERTON INDUSTRIAL PARK AND SALINE WATER PIPELINE ROUTE



3.6.4 SOLID RESIDUE

The waste treatment plant would produce about 340,000 t/a of 11-15% residue slurry. This slurry would be thoroughly washed, allowed to settle, filtered and re-slurried in water for transport by road tanker to the existing solid residue storage area at Dalyellup, south of Bunbury.

At Dalyellup, the slurry would be discharged into the disposal pond to allow the solids to separate from the water. Progressive dewatering of the solids would occur through evaporation and seepage. The downward seepage of pore water contained within the residue would infiltrate the unsaturated zone of the superficial formation.

During this process, leachate constituents would chemically interact with a range of soil materials. Research and site monitoring results indicate that trace levels of soluble heavy metals in the slurry water leachate are immobilised or attenuated within the soil layer. Leachate passing through the soil layer would be mixed and diluted by groundwater as it flowed toward the ocean and was mixed at the interface with the seawater (SCM, 1991).

3.7 ASSOCIATED INFRASTRUCTURE

3.7.1 STORMWATER DRAINAGE

To prevent leakage into the groundwater, all process plant areas would be sealed using concrete or bitumen. Stormwater and runoff from within the process plant would be contained, collected and pumped to the neutralisation plant for treatment. Some of this water would be recycled within the process.

Stormwater and surface runoff from hardstand areas, such as car parks and roads, outside the process plant areas would be collected through a series of covered drains, and directed to low-lying areas where stormwater basins and ponds would be constructed. Additional parking areas would be constructed using the principles of water-sensitive design, where only kerbing is used to redirect stormwater into planted areas or natural vegetation.

It is anticipated that plants indigenous to the local area would be used for buffers and shade around car parking areas.

3.7.2 DANGEROUS GOODS STORAGE

To undertake production of raw and finished pigment, a number of substances classified as 'dangerous goods' within the provisions of the Explosives and Dangerous Goods Act, are currently stored at Kemerton. The goods are stored in accordance with Department of Minerals and Energy (DOME) licence conditions. For the expansion, additional storage facilities would be provided in accordance with the *Dangerous Goods Regulations 1992* and relevant Australian Standards (AS). The goods and their storage are described below.

A hydrocarbon used in the process is stored in an underground $55.5m^3$ tank from where it is transferred to a 2 m^3 day tank prior to use. The hydrocarbon is inflammable with a threshold limit value (which represents the safe working atmospheric concentration) of 100 parts per million. Groundwater monitoring bores are located down gradient to detect any leakage. Spill suppression equipment is maintained on site. The effect of a spill would be confined to the tank area.

Hydrogen peroxide is used to react with any dissolved chlorine in the raw pigment. Hydrogen peroxide is stored in a 46 m^3 tank from which it is supplied to a 2.5 m^3 day tank before being added to the process. These tanks are situated next to the hydrocarbon fuel storage and day tanks, described above.

Diesel is currently used on site; it is stored in an above ground tank.

Natural gas is delivered to the site through the Alinta Gas reticulation network and distributed around the site through 50 mm and 80 mm pipework at a pressure of 350 kPa. The pipework complies with AS 1697.

A liquefied petroleum gas storage tank, similar to those at service stations, would be installed next to the maintenance workshop. Liquefied petroleum gas is used to fill the fuel cylinders on the forklift trucks. The tank would be installed and operated in accordance with AS 1596. The tank would be protected from damage by forklift trucks, and would be installed away from other potential sources of heat that could cause tank failure or ignition. The tank's location would be readily accessible to fire suppression equipment.

Hydrochloric acid would be stored in three tanks with a combined capacity of 500 m^3. They would be contained in a bunded area equipped with foam applicators. The effects of a spill from any of these tanks could be contained within the confines of the site using on-site control procedures.

The process requires intermediate storage of titanium tetrachloride and sodium hydroxide in above ground tanks. The additional titanium tetrachloride would be stored in six new tanks with a total capacity of 410 m^3. The sodium hydroxide would be stored in a new tank with a capacity of 85 m^3.

All underground tanks have been installed with cathodic protection to minimise deterioration of the tank shell. All above ground tanks stand within bunded cells which are capable of holding the total capacity of the tank, should it rupture or spill. The contents of the bund would be directed, via drains, to the neutralisation plant, which is designed to handle and treat any spills.

3.8 WORKFORCE REQUIREMENTS

The construction workforce on the expansion project is expected to peak at about 500 persons. SCM proposes that this work force, wherever practical, would be segregated from the ongoing operations of the existing pigment plant during the construction phase. This separation is planned to be achieved through judicious project planning and construction management.

The construction work force would receive adequate training to create an awareness of the personal and occupational hazards associated with the existing plant. The emergency procedures to be observed and undertaken when required would be included in the induction of the construction work force. Their training would include an environmental awareness component to ensure they understood the basic strategies associated with the environmental management required for completion of the construction phase with minimal environmental impact.

An additional 200 employees are expected to be necessary to operate and maintain the expanded pigment plant. These employees would be selected to complement the existing SCM work force. Their induction would include introduction to the environmental policies and ethic that exists within the existing Kemerton and Australind operations. They would also be introduced to the role of the Kemerton Industrial Park and the place of SCM's operations within it. They would be encouraged to take part in environmental management programmes as part of their daily work, in a manner consistent with current work practices on the site.

4 ENVIRONMENTAL REVIEW OF EXISTING OPERATIONS

This chapter provides an overview of the environmental aspects of the existing development at Kemerton, and demonstrates SCM's exemplary environmental performance.

4.1 BACKGROUND

In 1986, SCM sought environmental approval under the *Environmental Protection Act 1971* (WA) and *Laporte Industrial Factory Act 1961* (WA) to convert its titanium dioxide pigment plant at Australind from the sulphate process to chloride process technology (Kinhill Stearns 1986).

The EPA assessed the proposal and presented its recommendation in Bulletin 275 (EPA 1987a). This report concluded that the chloride process plant could be operated in an environmentally acceptable manner, but that the Australind site was an environmentally inappropriate location.

Subsequently, in 1987, SCM submitted a Notice of Intent (NOI) for a 70,000 t/a chloride process plant at Kemerton. The EPA assessment of this proposal was presented in Bulletin 283 (EPA 1987b) which concluded that the proposal was environmentally acceptable and required the plant to operate under the *Environmental Protection Act 1986*. This plant was commissioned in 1989.

In 1994 SCM sought environmental approval to increase production to 79,000 t/a by 'debottlenecking' the process or unblocking some of the slower stages. Environmental approval for this project was granted.

4.2 EXISTING ENVIRONMENTAL LEGISLATIVE CONDITIONS

The Department of Environmental Protection (DEP) has defined the operation as prescribed premises under Section 5 of the *Environmental Protection Act 1986* and has issued pollution control licences. In addition to these operational licences, SCM is also bound by Ministerial Conditions and their own environmental commitments given at various stages of development. These commitments and Ministerial Conditions are discussed in Chapter 9 and copies are provided in Appendix H and Appendix I.

Specific elements of the operation are covered by additional licences and permits. These include the following:

- Operation of prescribed premises (chemical works class 2 and waste water discharge) from 1 October 1994 to 30 September 1995: DEP Licence 5223;
- Extraction of groundwater from three deep production bores: Water Authority of Western Australia (Water Authority) Licence 0042481 Cockleshell Gully Formation, and Licence 0042480 Leederville Formation;
- Storage of chlorine gas: Health Department of Western Australia (HDWA) Poisons Permit 7-1579;
- Radiation monitoring: Radiological Council of Western Australia (RCWA) Industrial Gauges Licence 1003/91-7191, and Licence RS 226/88-5390;
- X-ray analysis equipment: RCWA X-ray Analysis Licence LX 367-87-5004;
- Storage of dangerous goods: Department of Minerals and Energy (DOME) File 10886.

SCM is required to submit annual reports to various Government departments detailing monitoring data and performance. Examples of annual reports and reports of monitoring data produced since 1989 are as follows:

- Woodward-Clyde. 1996. Kemerton water supply wellfield assessment—annual report;
- Woodward-Clyde. 1989-1996. Kemerton pigment plant groundwater monitoring programme—annual reports;
- Dames & Moore. 1989-1996. Management review of the Dalyellup residue disposal facility;
- Kinhill. 1989-1996. Environmental monitoring studies of the wastewater ocean outfall at Kemerton, Years 1-8;
- SCM. 1988, 1993, 1996. Progress and compliance reports to Department of Environmental Protection on conditions and commitments set on chloride project;
- SCM. 1992-1996. Environmental audit reports - Dalyellup residue disposal facility;
- SCM. 1993. Radiation management plan.
- SCM. 1996. Environmental management plan.
- SCM. 1996. Environmental systems manual.
- Terry. 1989-1996. Radiation Wise - Dalyellup Radiation Monitoring. Reports on operational radiation monitoring programme at solid disposal site, Dalyellup.

4.3 EXISTING ENVIRONMENTAL MANAGEMENT PROGRAMMES

SCM has a separate environmental department which co-ordinates all its environmental management programmes. Importance is given to maintaining a high standard of environmental performance. The company is committed to continually improving its environmental procedures and performance.

4.3.1 QUALITY SYSTEM

SCM is a quality endorsed company through accreditation of its quality control system to AS/NZS ISO 9002:1994. The company has been registered and received quality accreditation in Singapore and Japan.

The Environmental Management Plan (EMP), developed in 1989 and revised in 1996, the Total Hazard Control Plan (THCP) and the Radiation Management Plan (RMP) are tied into, and compatible with, the company's quality system and are regularly upgraded to accommodate improvements in control systems.

4.3.2 ENVIRONMENTAL POLICY

SCM has a firm corporate commitment to responsible environmental management, always striving to achieve full compliance with regulatory requirements and minimise impacts on the surrounding environs. SCM has initiated a programme of continuous improvement and accountability for the entire life cycle of all its sites.

In addition to the operational, water use, groundwater and waste disposal programmes as covered by licences, the environmental department is involved in a broad range of community and employee based activities. The department conducts environmental management and radiation procedures courses, distributes literature and mounts workplace displays as part of an ongoing employee environmental awareness programme. The aim of these programmes is to ensure that all facets of the operation are conducted in an environmentally friendly manner and incorporate the current best practices of environmental management.

SCM works closely with such groups as the Leschenault Inlet Management Authority (LIMA) and the Water and Rivers Commission (WRC) to further environmental awareness within the community and promote regional environmental management. This is achieved, in part, by development and sponsorship of the school based 'Caring for our Waterways' education programme, presentations to community groups on environmental management procedures at SCM, and sponsorship of several Leschenault Inlet Management Authority projects.

As part of the company's commitment to the 'Responsible Care' codes of practice of the Plastics and Chemical Industry Association (PACIA), formerly the Australian Chemical Industry Council (ACIC), , regular open days are held to ensure that the community has every opportunity to inspect and become familiar with company operations. SCM's public commitment to the code is presented in Figure 4.1.

SCM CHEMICALS LTD

is proud to be an active participant in

Responsible Care®

A PUBLIC COMMITMENT

As a member of the Australian Chemical Industry Council this Company is committed to the industry's responsible management of chemicals. We pledge to:

- ☐ Recognise and respond to community concerns about chemicals and our operations.
- ☐ Operate our plants and facilities in a manner that preserves the environment and protects the health and safety of our employees and the public.
- ☐ Develop and produce chemicals that can be manufactured, transported, used and disposed of safely.
- ☐ Give health, safety and environment considerations priority in our planning for new products and processes.
- ☐ Report information on relevant chemical-related health or environmental hazards promptly to appropriate authorities, employees, customers and the public and to recommend protective measures.
- ☐ Give advice to customers on the safe use, transportation and disposal of chemical products.
- ☐ Increase knowledge by conducting and/or supporting research on the health, safety and environmental effects of our products, processes and waste materials.
- ☐ Co-operate with customers, authorities and affected groups and individuals to resolve problems created by the handling and disposal of chemical substances considered hazardous.
- ☐ Co-operate with government in developing laws and regulations to safeguard the community, the workplace and the environment; to endeavour to ensure that such laws are based on scientifically supported data and/or expert opinion.
- ☐ Promote these principles and practices by sharing experience and offering assistance to others who produce, handle, use, transport or dispose of chemicals.

D A Payne — Managing Director

Signature — Title

ACIC Australian Chemical Industry Council

Figure 4.1
PUBLIC COMMITMENT TO PACIA "RESPONSIBLE CARE" CODE

4.3.3 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan, and its associated Environmental Systems Manuals, cover all facets of SCM's operations from the design phase, through construction, commissioning, operational, decommissioning and rehabilitation phases, to the post-rehabilitation phase.

The Environmental Systems Manuals describe the various management systems and procedures that SCM has established to minimise any impact from its activities. The systems particularly cover corrective action and procedures for abnormal operating situations or incidents. The systems are, where appropriate, cross-referenced to other SCM systems and related data collection records.

4.3.4 ENVIRONMENTAL PERFORMANCE INDEX

SCM maintains comprehensive records of all monitoring results to demonstrate compliance with regulatory limits and conditions. An environmental performance index has been developed to measure the effectiveness of the various environmental programmes. The parameters chosen are as follows: the amount of solid residue produced, total dissolved solids and total suspended solids concentration in certain waste water streams, and the amount of atmospheric emissions of carbon monoxide and hydrogen chloride. The weighted parameters are combined and expressed as a percentage of the base year, 1990. The lower the number, the greater the reduction in the parameters, and the fewer releases to the environment.

The environmental performance index since 1990 is shown in Table 4.1. The large reduction in the index in 1992 reflects the introduction of SCM's solid residue minimisation programme.

Table 4.1 **Environmental performance index**

	1990	1991	1992	1993	1994	1995	1996
% of 1990	100	99	58.3	54.9	48.6	46.0	34.5

Source: SCM 1996 Environmental Status Report.

4.3.5 AUDITS

SCM adheres to PACIA's code of practice and auditing procedures, and is a member of its 'Responsible Care' programme. PACIA requires members of this programme to have independent audits of their operations on a random basis to maintain accreditation and conform to programme objectives.

SCM conducts environmental audits annually on its south-west operations. Both performance and compliance audits are carried out by the environmental department and SCM's legal department in the USA. All corrective actions arising from these audits have been completed.

In August 1993, the DEP Auditing Branch conducted an environmental impact audit on the SCM Western Australian operations. This included the Kemerton chloride process plant, the Australind finishing plant and the Dalyellup disposal facility. This audit covered all Ministerial Conditions and company commitments in relation to the Kemerton, Australind and Dalyellup operations. The audit found compliance with all conditions and commitments. SCM have submitted a progress and compliance audit report for 1996 to the DEP Auditing Branch.

The Total Hazard Control Plan (THCP) is regularly independently audited in accordance with DOME procedural requirements. The most recent audit found that all DOME requirements had been complied with.

4.3.6 SAFETY POLICY

SCM's comprehensive safety policy and plans complement the Environmental Management Plan. One of the stated aims of the safety policy is 'commitment and support for the minimisation of incidents (safety, health, environmental)'.

The Kemerton plant's safety record is very good. It is highly rated under the International Safety Rating System (ISRS). The system provides a systematic analysis to determine the extent and quality of management control. It measures 'performance and control' through auditing. The various system elements are as follows:

- Leadership & Administration
- Leadership Training
- Planned Inspections
- Task Analysis & Procedures
- Accident/Incident Investigations
- Task Observations
- Emergency Preparedness
- Rules & Work Permits
- Accident/Incident Analysis
- Knowledge & Skill Training
- Personal Protective Equipment
- Health Control
- System Evaluation
- Engineering and Change Management
- Personal Communication
- Group Communications
- General Promotions
- Hiring & Placement
- Materials & Service Management
- Off-the-Job Safety

Safety will continue to be a priority of SCM operations and the latest safety features would be incorporated into the design of the expanded facilities.

4.3.7 SOLID RESIDUE USES

In addition to regular monitoring, reporting and auditing of its operations, the company has commissioned studies into the nature and possible uses of the treated solid residue. In 1992, a residue minimisation plant was commissioned that considerably reduced the dry solid residue produced per tonne of raw pigment. SCM is committed to continuing research into residue minimisation, recycling and possible alternative uses for the residue.

4.3.8 COMPLAINTS

The SCM Kemerton Plant has received only six valid environmentally related complaints since the plant was commissioned in 1989. All of the complaints were from within the Kemerton Industrial Park buffer zone; none were from the general community. These complaints were all addressed and resolved, and the DEP and complainant notified of the outcome.

4.4 ENVIRONMENTAL PERFORMANCE

4.4.1 ATMOSPHERIC EMISSIONS

SCM discharges process gases into the atmosphere from the process stack in accordance with their DEP licence. Licence limits and SCM's more rigorous limits for the process stack are given in Table 4.2.

Table 4.2. **Emission limits from the process stack**

Parameter	Licence limit (g/m^3)	SCM internal limit (g/m^3)	1996 average (g/m^3)
Carbon monoxide	200		42.4
Acid gases	0.4	0.0005	0.0003
Titanium tetrachloride	to be determined		Nil
Chlorine and chlorine compounds	0.8		<0.003
Carbonyl sulphide	to be determined	5.7	3.4
Sulphur dioxide	not a licence condition	6.7	1.21
Hydrogen sulphide	no odour beyond KIP*	0.012	0.002
Reduced sulphur compounds	nil		

Note Kemerton Industrial Park.*

These data show that all emissions have been considerably below any specified licence conditions, as well as SCM's internally imposed goals.

Any abnormal emissions are reported to SCM's environmental department. When an incident occurs, the relevant Environmental Systems Manual procedures are implemented to determine the cause and consequence of the incident, and to initiate the required remedial action.

There were four 'reportable' incidents in 1994. Of these, the only one with an apparent odour at the boundary of the Kemerton Industrial Park resulted from a hydrogen chloride release on 30 March 1994. In 1995, only two reportable incidents occurred and one reportable incident occurred in 1996. They were all of a short term nature involving relatively small releases of titanium tetrachloride, hydrogen chloride or chlorine gases with no long term impacts. There have been no reportable incidents to date in 1997.

4.4.2 SALINE WATER DISCHARGE

SCM is licensed to discharge saline water into the ocean off the Leschenault Peninsula. Measurement of the quantity and quality of the discharge, and a monitoring programme within the receiving environment of the outfall, have been undertaken in accordance with these licence conditions.

Table 4.3 gives the licence limits for the treated saline water, the quality attained in 1995, and predicted future levels.

Table 4.3 **Wastewater discharge concentration limits**

Parameter	Licence limit	Current average	Predicted future levels
Discharge volume (m^3/h)	150	115	376
Temperature (°C)	50	33	45
pH	7-10	8	8
Total suspended solids*	100	14.9	20
Total dissolved solids*	55,000	29,700	30,000
Chromium*	7	0.1	0.1
Chlorate*	400	51	60
Iron*	7	0.2	0.2
Manganese*	7	0.2	0.2
Vanadium*	7	0.4	0.5
Radium 226†	15	4	4
Radium 228†	30	12	15
Thorium-228†	260	0.2	1

* *g/m^3* mg/l 1000
† *kBq/m^3*

Discharge through the pipeline began in December 1988, and monitoring of the receiving environment has been undertaken by Kinhill on a biannual basis since 1988. This monitoring programme measures quality of both water and sediments at the outfall.

These data show that the concentration of all chemical parameters in the saline water have been considerably below the licence conditions. Sampling of the ocean near the marine outfall indicates that outside the mixing zone (i.e. outside a radius of 20 m), there are no significant adverse effects of the discharge on water quality, sediment quality or marine life (Kinhill, 1995).

4.4.3 SOLID RESIDUE DISPOSAL

Solid residue disposal at the Dalyellup site began in March 1989 under an agreement with the Capel Shire and the EPA. Initially the EPA provided a licence for three years, until February 1992, with an option for extension of time if environmental performance was satisfactory.

SCM submitted proposals for, and was granted, time extensions for use of the Dalyellup site in 1991 and 1993. Approvals were issued to continue the use of this site for the 'life of the site'. At the current rate of disposal, the Dalyellup site has capacity to accept solid residue to the year 2006. Continuation of the use of the site is dependent on SCM providing the EPA with sufficient information to show that environmental performance is satisfactory.

SCM is required to submit annual audit reports. Audit reports have been issued in 1992, 1993, 1994, 1995, 1996 and 1997.

A groundwater monitoring bore network of twenty bores at sixteen sites has been installed. Monitoring data show that impacts on groundwater quality and levels from the disposal operations are minimal. This issue is discussed further in Section 7.4.

Radiation monitoring is continuing in accordance with the Radiation Management Plan and SCM commitments. The RCWA has reduced the reporting periods from biannual to biennial as no adverse impacts have been observed. The monitoring period remains biannual. These results confirm that the solid residue is not a radioactive substance under the *Transport Code 1990* (Cwlth) nor under the *Radiation Safety (General) Regulations 1983* (WA).

Monitoring reports conclude that all conditions required under the agreement with the Capel Shire and the DEP pollution control licence have been complied with. The environmental performance of the Dalyellup disposal site continues to be satisfactory with no adverse impacts observed.

SCM remains committed to continuing investigations into alternative residue disposal methods, residue minimisation, recycling and alternative uses. A 40% reduction in the quantity of solid residue produced has been achieved since 1988.

A number of alternative uses currently under investigation include the following:

- potential use in brick manufacture;
- provision of pavement base course (the layer immediately below the bitumen surface) in road construction;
- soil conditioning and nutrient attenuation (retaining nutrients in soils), due to the dried oxidised residue's ability to absorb nutrients, especially phosphorus.

Brick manufacture

SCM has conducted trials to assess the suitability of aged, solid residue for incorporation with clay in the production of kiln-fired clay bricks and pavers. The trials included production, testing and performance evaluation. The results indicated the material was suitable for use in brick manufacture.

A submission to produce and use bricks produced from solid residue was considered by the RCWA, approval was given, and a suggested criteria to determine the quantity of residue incorporated was agreed.

Development work on using residue in brick manufacture is continuing.

Road construction

The solid residue has shown considerable potential for use in road pavement construction in trials conducted at Dalyellup. This potential is confirmed by both *in situ* and laboratory trials.

The EPA has approved the proposal, provided appropriate management of the following issues was addressed:

- radiation
- solute leaching
- dust during construction
- construction methods

Monitoring of dust and solute leaching to date indicate radiation levels are well within acceptable limits and only vary marginally from background levels.

Other potential uses

The solid residue has shown it has a high level of phosphorus retention and, as a result, has excellent soil conditioning and potting mix potential. Trials conducted to date indicate the residue compares favourably with other soil conditioners and potting mixes currently available on the market.

Present radiation levels in the material make it difficult to obtain permission for the use of the solid residue for these purposes, but reduction of the level of radiation in the residue continues to be investigated.

4.4.4 CLOSURE CRITERIA AT THE DALYELLUP SOLID RESIDUE DISPOSAL SITE

Rehabilitation trials of the Dalyellup site have commenced. The trials, to date, indicate that the site can successfully be returned to native bushland or planted with turf for recreational use.

In the latest development at the site, SCM rehabilitated a blowout in the sand dunes by filling the area with sand, and contouring, brushing and seeding the area.

Final rehabilitation of the site, in accordance with a Rehabilitation Management Plan approved by the DEP, RCWA and Capel Shire Council, would occur once the site is decommissioned.

4.4.5 NOISE

Ambient noise measurements have been taken on an annual basis and these studies indicate that SCM has met the licence requirements. SCM now conduct daily noise monitoring at several locations in and adjacent to the KIP. The large buffer zone that surrounds the Kemerton Industrial Park, and the location of the plant within SCM's site, ensure any noise generated does not cause disturbance to residences outside the Kemerton Industrial Park.

4.4.6 RADIATION

The RCWA licences the use of industrial gauges, X-ray analysis equipment and all aspects of radiation procedures and management relating to the Kemerton plant, and the disposal of wastewater and solid residue.

To ensure compliance with the appropriate regulations, minimise radiation doses to employees and reduce environmental risks, a Radiation Management Plan has been developed. The Radiation Management Plan was developed in consultation with the RCWA and approved by the RCWA and the DEP. Implementation of the plan resulted in measures including display of radiation warning signs, revised maintenance procedures and implementation of decontamination procedures.

Radiation levels are measured at the plant area, in the waste water, in marine sediments and at the Dalyellup residue disposal site. Monitoring results confirm that the solid residue is not a radioactive substance as defined by the Transport Code 1990 nor Section 5.1 of Radiation Safety (General) Regulations 1983.

Monitoring of radioactivity levels, auditing of the management plan and investigations will continue to be undertaken in accordance with the Radiation Management Plan. The Radiation Management Plan will continue to be revised to minimise environmental impacts, particularly if radioactivity levels change.

4.4.7 GROUNDWATER

The DEP, in conjunction with the WRC, has set conditions regarding protection of groundwater resources beneath or adjacent to the Kemerton site. As part of these conditions, quarterly water level measurements and quality analysis, and an annual review of groundwater status, are undertaken and reported.

The Kemerton plant was designed to protect the groundwater system. Possible spillage areas have been sealed and bunded, and a network of monitoring bores are in place to detect any changes to the groundwater beneath the site. Any spillage of potentially polluting material must be reported to the WRC, along with the proposed corrective action programme. Minor spillages have been successfully contained, and the clean-up programmes have prevented any measurable effect on the groundwater system from these incidents.

Monitoring of groundwater began in 1989 and is carried out each quarter. Monitoring results indicate that operation of the raw pigment plant is having little or no effect on the groundwater system beneath the plant site. The quality remains similar to that of late 1989, when monitoring commenced. Groundwater levels remain unchanged, apart from the expected seasonal fluctuations.

4.4.8 RISKS AND HAZARDS

Risks and hazards on the existing plant are effectively managed by a Total Hazard Control Plan (THCP) developed to meet the requirements of the Department of Minerals and Energy (DOME). The THCP sets out the management philosophy, organisation and procedures put in place by SCM to control risks and hazards. It places strong emphasis on the production management process and the importance of maintaining continuous awareness through training and regular safety drills. In addition, SCM uses the International Safety Rating System throughout its operations.

The aim of these systems is to keep employees and neighbouring communities free from illness or injury caused by the Kemerton operation. The Total Hazard Control Plan and safety programmes are regularly audited, internally and externally, to ensure compliance to, and adequacy of, both these systems and to keep government authorities aware that the controls are functional and maintained.

The effectiveness of the Total Hazard Control Plan and SCM's safety system is reflected in its low 'lost time' incident rate. Since commissioning of the Kemerton plant in 1989, there have been only two 'lost time' accidents in 1.7 million work hours. The most recent annual audit, conducted by Stratex-EWI Pty Ltd in 1995 for DOME, found no non-compliances with the Total Hazard Control Plan document, and no increase in risk from the Kemerton operation.

Storage of dangerous goods, particularly inflammable liquids and titanium tetrachloride, is licensed by DOME. Under an industrial poisons permit, the use and storage of chlorine gas, manufactured for SCM by Nufarm, is controlled by the Health Department of Western Australia.

4.5 CONCLUSIONS

SCM has implemented environmental management programmes in accordance with its quality control system and environmental policy. Integrated environmental management systems have been developed for all phases and facets of SCM's Western Australian operations. Regular internal audits are undertaken to ensure adherence to the environmental management plan and systems. SCM reports regularly to, and is also audited by, Government authorities, and its parent company.

SCM has an exemplary record of environmental performance. Monitoring results demonstrate excellent compliance with regulatory limits and conditions. An environmental performance index, developed by SCM, shows a significant improvement since 1990, reflecting the reduction in solid residue generated and an improvement in control of gaseous emissions since the plant was commissioned.

Annual reports to the DEP demonstrate SCM's commitment to the minimisation of environmental impacts, and to continuous improvements to environmental management practices. No adverse long-term environmental impact has resulted from SCM's operations at Kemerton.

5 PUBLIC CONSULTATION

This section discusses the public consultation activities that have been undertaken for the proposal, the issues that have been raised, and where they are discussed.

5.1 BACKGROUND

As described in Section 4.3.2, SCM works closely with the community to further awareness and care for the environment within the Bunbury region. This is achieved by the following activities:

- sponsorship of environmental education in schools and community projects;
- presentations to community groups about SCM's actions and commitment to sound environmental management;
- providing opportunities for the community to visit each plant site to gain an appreciation of the company's operations.

SCM had previously announced it's proposal to expand the pigment plant at Kemerton to the community in July 1995.

5.2 THE CONSULTATION PROGRAMME

With the announcement of SCM's proposal to proceed with the expansion of pigment production to 195,000 t/a, the company has undertaken to advise the community about the proposal by:

- providing press releases to the local and regional media;
- providing media releases in Australia and to International Trade Journals;
- mailing information pamphlets to the local community to introduce the project and seek community comment about the proposal and issues of concern to the community as a whole or to individuals;
- establishing information displays in local shopping centres (during the public review period);

- offering to make presentations to key community groups, Local Governments and State Government agencies based in the Bunbury region.

Discussions and presentations have already been made to the following groups:

- Communities for Coastal Conservation
- Capel Shire Council
- Harvey Shire Council
- Kemerton Advisory Board
- Bunbury Chamber of Commerce
- State Government authorities including DEP, Water Corporation, DOME and South West Development Corporation.

An offer has also been made to meet with the Conservation Council of WA

A plant Open Day was held at Kemerton on 22 March 1997. An information display on the expansion was provided and copies of a summary of the CER were made available. Questions were answered by personnel from the Environmental Department. As the consultation programme continues, further presentations will be made as required, and public information displays will be held at various community centres.

To keep the local community and interested groups informed, a newsletter including a summary of this CER will be produced.

5.3 ISSUES RAISED

The principal issues raised during the initial consultation programme and the section of the document in which each issue is addressed are listed below. This list represents issues raised and is not presented in any order of perceived importance.

The issues raised during the initial public consultation programme were:

- Australind site—closure expectation (Section 1.2);

- Ore and coke storage—expansion of the Stanley Road site (Section 3.2.1);

- Number of jobs (Sections 2.3 and 3.8);

- Use of local people in the construction phase (Section 7.9);

- Local content policy (Section 2.3.2);

- Water supply–concerns about quality, particularly during dam scouring. (Section 3.5);

- Odours—odour requirement is outside the KIP boundary, not near the site (Sections 3.6.2 and 4.4);
- Light spill (Section 7.7);
- Rain water run off the site into pits in the ground (Section 3.7.1);
- Sealing the entire site to prevent groundwater contamination (Section 3.7.1);
- Wastewater discharge volumes (Section 3.6.3 and 7.3);
- Re-use of the wastewater (Section 3.6.3);
- Limit on recycling of water (Section 3.6.3);
- Constituents of wastewater (Section 7.3);
- Similarity of wastewater to sea water—it contains calcium chloride not sodium (Section 7.3);
- Concentration of radionuclides increasing when the amount of wastewater is increased (Section 7.3);
- Off-specification wastewater reaching the ocean (Section 7.3);
- Problems with the Western Power pipeline right next to the SCM line (Section 3.6.3);
- Size of the affected area around the SCM diffuser (mixing zone) (Section 7.3);
- Nature of the fenced structure in the sand hills on the pipeline near the beach (Section 3.6.3);
- Consequence of wastewater discharge not being permitted (Section 2.4);
- Solid waste disposal (Sections 3.6.4 and 7.4);
- Life of Dalyellup residue disposal site (Section 7.4);
- Transport concerns and alternative routes when residential development takes place (Section 7.8);
- Residue uses (Sections 4.4 and 7.4);
- Rehabilitation of Dalyellup–particularly the current work on the southern blowout (Section 4.4);
- Security of Dalyellup site (Section 7.4);

- Tip capping project (Section 7.4);
- Increase in truck movements (Section 7.8);
- Movement of the increased production through the Port of Bunbury or elsewhere (Section 7.8.1);
- DEP audit of environmental performance (Section 4.3);
- Any other environmental auditing (Section 4.3);
- Impact of the environmental control improvements on the existing operations (Section 4.3).

6 EXISTING ENVIRONMENT

This chapter describes the environment around the Kemerton processing plant, the Dalyellup solid residue storage area, the land along the saline water pipeline route and the area around the ocean outfall.

6.1 REGIONAL SETTING

SCM's processing plant is situated in the Kemerton Industrial Park (KIP) (see Figure 3.6), which was established as the principal site for heavy industry in the south-west region of Western Australia. The industrial park is in the Shire of Harvey, 140 km south of Perth and 17 km north-east of Bunbury, with easy access Bunbury's associated social and economic infrastructure (Kemerton Steering Committee et al. 1989.)

Bunbury is the major centre of the south-west region and is Western Australia's second largest city. Outside the Perth metropolitan area, the south-west region is Western Australia's most diverse and populous region, with a rapidly expanding population and range of facilities. Agriculture, forestry and mining have traditionally been the main industries and while these continue to develop, tourism and manufacturing are now also becoming major industries for the region. From a deep water port at Bunbury, the principal exports are alumina, wood chips and mineral sands (South-West Development Authority 1995).

The KIP's core heavy industry zone, of some 1,250 ha, is surrounded by a multi-use zone that provides a buffer of at least 1 km between the industries within it and any future urban developments. The buffer zone approach locates high and medium risk industries in the core zone and light industries in sections of the buffer zone.

The Kemerton buffer study (Dames and Moore 1991) concluded that KIP has substantial capacity to accommodate additional high and medium risk industries.

6.2 KEMERTON INDUSTRIAL PARK

6.2.1 PHYSICAL ENVIRONMENT

Climate

The Kemerton Industrial Park has a Mediterranean climate, with hot, dry summers and mild, wet winters. The mean annual rainfall is approximately 870 mm and the average annual evaporation (1,490 mm) exceeds rainfall by approximately 620 mm. Average daily temperatures in the Kemerton Industrial Park range from 12.3 to 22.9°C, based on meteorological data collected at the KIP weather station.

Winds in summer are dominated by the local sea breeze–land breeze system, with dominant light south-easterly winds in the early morning and at night, and stronger south-westerlies during the day (Dames and Moore 1989).

Landform, geology and soils

The Kemerton Industrial Park lies on the western edge of the Swan Coastal Plain with soil formation occurring from marine, riverine or aeolian processes. Most of the landscape in the region consists of broad, low rises with intervening low-lying, poorly drained valleys. These low-lying areas form an extensive chain of permanent and seasonal wetlands.

The Bassendean Dune System covers all of the Kemerton Industrial Park. The dune system consists of gently undulating dunes which are randomly orientated and seldom more than 20 m high. Soil mapping of the Bassendean Dune System by Dimmock (1985) shows the site as consisting mainly of Jandakot and Gavin sands, as well as Joel series and Swamp complex 2 sands.

The Leederville Formation, consisting of dune systems of Quaternary age, underlies the surface soils and overlies sandstones, silts and shales of the Cretaceous period. Underlying these systems are the Yarragadee and Cockleshell Gully Formations which consist of interbedded sands and shales of the Jurassic period.

Surface water resources

The Leschenault Estuary to the west of the site receives water discharge from the Collie River and its tributaries, the largest tributaries being the Brunswick River and the Wellesley River (5 km east of the site) (see Figure 1.1). Peak flows in these watercourses occur in winter and early spring.

There are numerous seasonally flooded wetlands near the site. Although many have been degraded by agricultural land clearing, encroachment by stock and discharge of fertiliser-enriched water, they are considered to retain high conservation values as they provide an important wildlife refuge and contain a diverse wetland flora (Department of Conservation and Environment 1985).

Water quality of the Brunswick River varies. The Collie River has a variable, and comparatively high, salinity of an average 1,100 g/m^3. The salinity exhibits short-term fluctuations, between 2,000 and 2,600 g/m^3, as a result of scouring from the Wellington Dam (BHP Engineering 1993).

Groundwater resources

The regional groundwater consists of three deep semi-confined aquifers (within the Leederville, Cockleshell Gully and Yarragadee Formations) and a unconfined surface aquifer (within Bassendean and Karrakatta sands). The deep aquifers provide for agriculture and industrial uses and the surface aquifer, extracted by low-yield bores, for irrigation.

The shallow water table is 5–11 m above sea level. The unconfined surface aquifer is fairly permeable with groundwater flows in the order of 50–100 m/a Department of Conservation and Environment 1985). The water table lies at an average depth of 2 m during summer, and typically rises and falls according to the seasonal rainfall pattern.

A groundwater divide, aligned north-east to south-west and consistent with the alignment of the eastern ridge, occurs to the west of the site. On the western side of the divide, groundwater flows west towards the Leschenault Estuary and the sea, some of it via the western Kemerton wetlands. To the east of the site, groundwater flows towards the Wellesley River. Groundwater beneath the current and proposed site flows in a south-westerly direction.

The salinity of the surface aquifer is variable and ranges from 500–1,000 g/m^3. Leakage may occur between the surface aquifer and the semi-confined aquifers of the Leederville and Yarragadee Formations. The salinity of the Leederville Formation groundwater is approximately 1,000–1,200 g/m^3, with an increase, with depth, in the concentration of iron and other dissolved minerals. The quality of the groundwater decreases with depth (BHP Engineering 1993).

6.2.2 BIOLOGICAL ENVIRONMENT

SCM's Kemerton site has previously been cleared for agricultural purposes and the present vegetation cover results from natural regeneration following the cessation of grazing and agricultural activity. The diversity of flora on the site is significantly less than would be expected in an undisturbed area of similar vegetation associations. The original vegetation in the region, prior to its clearance, was eucalypt woodland. The site itself previously supported a jarrah–banksia woodland with a moderate cover of *Xanthorrhoea pressei*. Only remnants of some of these species are present on the area of the proposed expansion.

Some of the tree species regenerating on the site include jarrah (*Eucalyptus marginata*), *Banksia grandis* and *B. attenuata*, *X. pressei*, sheoak (*Allocasuarina fraseriana*) and marri (*E. calophylla*). Shrub species present include *Acacia stenoptera, Adenanthos cygnorum, Calytrix flavescens, Conostephium pendulum, Kunzea ericifolia, E. vestita, Jacksonia furcellata, Pericalymma ellipticum, Hibbertia hypericiodes* and *H. vaginata*.

Surveys of the Kemerton area have recorded a total of twelve mammal species, seventy-nine bird species, seventeen reptile species and eight amphibian species. The fauna is typical of similar habitats elsewhere on the Swan Coastal Plain and the region is not significant because of any single species. No gazetted rare and endangered species occur in the Kemerton area. However, the potential presence of the honey possum (*Tarsipes rostratus*) is noteworthy (EPA 1987b). No evidence of the honey possum was found during an inspection of the proposed site for the plant expansion during visits to the site in 1996. The paucity of proteaceous plant species and ground-covering heath within the area of the plant site would be an attributing factor to low potential for the presence of the honey possum at the site.

Conservation significance

No wetlands occur on or adjacent to the SCM site. Wetlands in the wider Kemerton Industrial Park buffer zone that are subject to System 6 recommendations (EPA 1993) are Mialla Lagoon, Leschenault Estuary and the Brunswick, Collie and Wellesley Rivers.

The Department of Conservation and Land Management (CALM) has acquired System C63 (Mialla Lagoon, 4 km north-west of the site) for conservation.

System C66 Leschenault Estuary (4 km west of the site) is being implemented as regional park and Class 'C' reserve.

The area of Wellesley River being implemented as regional park (System C67 Brunswick, Collie and Wellesley Rivers) is located 5 km east of the site.

6.2.3 LAND USE

The Kemerton Industrial Park is part of an area previously used as dry land pasture and fodder crop production. Other land uses in the region are described as dairy and beef cattle grazing on irrigated pastures, special rural and irrigated fodder crops, market gardens and orchards. The SCM plant is located within the industrial core of the Kemerton Industrial Park.

The SCM site is within the Bunbury Region Plan Policy Area 11 and Shire of Harvey Town Planning Scheme No. 10 (designated as an 'additional use' area), and located in the Kemerton Industrial Park which is divided into four separate policy areas:

- heavy industry
- support industry
- inter-industry buffer
- parkland buffer.

Each policy area has a number of policy statements relating to the permitted use and overall strategy for its future development. The SCM site is within, and is consistent with, the heavy industry policy area.

The Australind piggery and the Goodchild abattoir are located 2 km and 2.5 km north-west of the site respectively. Other industries include the Simcoa Operations Pty Ltd silicon plant, the Nufarm Ltd chlor-alkali plant, the BOC Gases of Australia Ltd air separation plant and the Cockburn Cement lime slurry plant.

6.2.4 LANDSCAPE DEVELOPMENT

The Kemerton Industrial Park landscape study (Churchill 1992) describes a landscape development concept that would create a series of landscape zones within the industrial park. The SCM plant and its ancillary service industries are located in an industrial zone that provides for a heavy industry core, support industries and industry buffers. According to the study's recommendations, SCM's plant is situated away from roads to provide a buffer between park visitors and the industry site.

The study also seeks to minimise visual impact from within and beyond the park. The SCM site is visually protected, by a row of dunes, from the Perth–Bunbury Highway. However, it can be seen from the Darling Scarp and, to a lesser degree, from the South-West Highway.

The current works are contained within the 400 m buffer zone between industrial and recreational users of the park.

6.3 DALYELLUP

6.3.1 PHYSICAL ENVIRONMENT

The SCM solid residue disposal site located at Dalyellup is within the coastal interdunal system, about 200 m from the ocean, 8 km south of Bunbury (Figure 1.1).

The topography of the area is steeply undulating, with a maximum elevation of approximately 45 m Australian Height Datum (AHD). The dunes are generally well vegetated and stable. A series of ridges are orientated parallel to the coastline. The disposal site is situated in the swale or interdunal valley, between the vegetated linear primary dunes and the vegetated parabolic secondary dunes.

The sediments below the disposal site are fine to medium grained lime sands, ranging in depth from 10 to 20 m. Limestone, sand and sandy clays occur in the area at depths between 10 and 30 m. Below these sediments are dark grey, silty, clays resembling mica. Some heavy minerals and silty organic matter occur throughout the profile. The secondary dunes are overlain by approximately 0.5–1 m of top soil.

The site is underlain by superficial formations which extend from ground surface to approximately –10 m AHD. The superficial formations form an unconfined aquifer which consists of sand and limestone with less permeable silty-sand and sandy-clay horizons in the underlying section. The depth to the water table beneath the disposal site is approximately 10 m and varies with topographic elevation and seasonal fluctuation. The water table slopes in a westerly direction, with flow discharging across a sea–water interface due west of the site.

The Yarragadee Formation directly underlies the superficial formations in the area and forms a confined multi-layered aquifer. The aquifer comprises interbedded sandstone, siltstone and shale. Regional groundwater flow in the Yarragadee Formation is in a north-west direction and discharges via the superficial formations into the ocean. Beneath the disposal site the natural groundwater salinity in the Yarragadee Formation is between 600 and 1,000 g/m^3 (SCM 1991).

6.3.2 BIOLOGICAL ENVIRONMENT

Vegetation within the disposal site is representative of that within the primary and secondary dune systems common in the area (Martinick and Associates 1987).

No gazetted Declared Rare Flora or Priority Flora species occur within the area of the disposal site.

6.3.3 LAND USE

The disposal site covers an area of about 21 ha and is leased from LandCorp. The nearest development to the disposal site is the Bunbury No. 2 waste water treatment works, located 500 m to the north. The disposal site forms part of the buffer zone around the waste water treatment works. The Gelorup rubbish disposal facility, now closed, was located about 1,500 m to the east.

6.4 PIPELINE ROUTE AND LESCHENAULT PENINSULA

6.4.1 PIPELINE ROUTE

Between Kemerton and the ocean, the pipeline route traverses cleared private property and road reserves situated along Marriott Road, the Perth–Bunbury Highway and Buffalo Road, as shown in Figure 3.6. The land adjacent to Marriott Road and the Perth–Bunbury Highway is mostly privately owned and comprises remnant tuart–jarrah woodland or dry land pasture used for grazing. Two areas situated immediately north and south of the intersection of the Perth–Bunbury Highway and Buffalo Road (on the western side of the Perth–Bunbury Highway) are used for irrigated cropping and are included in the Leschenault Estuary System 6 area. West of these areas along Buffalo Road, land adjacent to the roadside mainly consists of remnant vegetation (scattered tuart and tuart woodland) or cleared pasture used for grazing purposes.

From the end of the Buffalo Road, the pipeline crosses the nature reserve vested in the National Parks and Nature Conservation Authority. In the reserve, the pipeline follows a cleared access track and partly revegetated route to the break tank. From the break tank, it crosses a naturally eroded area to the shoreline and continues to the diffuser offshore.

6.4.2 WETLANDS ALONG THE PIPELINE ROUTE

A chain of permanent wetlands running in a north-south direction occurs to the east of the pipeline route where it traverses the Perth–Bunbury Highway. The most northerly of these wetlands is Mialla Lagoon which is subject to System Six recommendations for conservation. The lagoon has been acquired by CALM and was recommended as a conservation park in CALM's 1992 draft south-west forests strategy (EPA 1993).

Immediately south of Mialla Lagoon lie the Kemerton wetlands, which consist of sumplands that are seasonally inundated. These wetlands are fed by the waters of the superficial and unconfined aquifers in the area. The salinity of these wetlands is unknown but likely to be variable throughout the year, ranging from very low in winter (almost fresh) to moderate in summer (2–5,000 g/m^3).

Although these wetlands may have undergone varying degrees of degradation as a result of agricultural clearing and grazing by stock, they provide suitable habitats for various birds, marsupials, amphibians, reptiles and invertebrates and, as such, are of local significance. Two of the wetlands situated immediately east of the Perth–Bunbury Highway (see Figure 3.6) are protected by the Environmental Protection (Swan Coastal Plain Lakes) Policy for lakes on the Swan Coastal Plain. Wetlands protected by this policy have the highest level of protection under the Environmental Protection Act and any unauthorised filling, mining, drainage, into or out of, or effluent discharge into these lakes can result in prosecution under sections of the Act.

Two other wetlands in the area, situated immediately south and west of Marriott Road and the Perth–Bunbury Highway respectively, are also protected by this policy . The pipeline passes between these wetland areas prior to crossing the highway and entering Buffalo Road.

6.4.3 LESCHENAULT ESTUARY AND PENINSULA

The pipeline route runs along the north of the Leschenault Estuary, which is listed as a recommended conservation area (C66) in the EPA System Six Red Book (EPA 1984). The area is considered to have a high conservation value due to the presence of samphire, sedgeland and woodland communities at the northern end of the estuary. The estuary itself represents an important waterbird habitat, particularly at the northern end which is used as a refuge by several species of water bird during mid and late summer (EPA 1984). The shallow waters are saline and provide an important nursery ground for numerous commercial species of fish and crustaceans. The samphire flats at the northern shore of the Leschenault Estuary are directly connected to the estuary and would periodically contain highly saline estuarine water.

The peninsula to the west of the northern extremity of the Leschenault Estuary, through which the pipeline passes, comprises a beach ridge system with mobile and fixed dunes over most of its surface. The pipeline follows Buffalo Road along a cleared access track to a partly revegetated route passing through a natural gully between the beach foredunes.

6.4.4 OCEAN RECEIVING ENVIRONMENT

The saline water from the plant would be discharged into the ocean, off shore from the Leschenault Peninsula. The area around the outfall consists of a gently sloping sea bed as shown in Figure 6.1. The depth of the water increases gradually to reach a depth of 10 m approximately 700 m off shore, and a depth of about 20 m, approximately 6 km offshore. The sea bed then remains relatively flat up to the edge of the continental shelf, which is approximately 90 km offshore. There are no well-developed reefs in the immediate vicinity of the proposed outfall, although isolated limestone outcrops occur up to 750 m offshore.

A survey of the offshore area in the vicinity of the proposed outfall location has identified three major sea floor habitat types:

- bare sand—gently or deeply rippled;
- limestone pavement covered in a thin veneer of sand with associated seaweed (macroalgae) and seagrass;
- exposed limestone pavement with rocky outcrops and associated seaweed.

The area of gently rippled bare sand occurs at depths of about 6 m, approximately 150–250 m offshore. The terrain seaward of this area, extending approximately 650 m offshore, largely consists of exposed limestone pavement interspersed with rocky outcrops. Some of these outcrops are colonised by red and brown macroalgae.

Occasional patches of seagrass (*Posidonia sinuosa*) occur in sand overlying the limestone pavement. These patches range from 1 to 10 m^2 in area and generally appear as mounds on the sea floor. The seagrass patches seem to be more common directly to the west of the existing outfall, and occur less frequently further north.

Macroalgae (seaweed) occur in large, continuous areas of sparse to moderate density. They are found on limestone pavement with a thin veneer of sand and on rocky outcrops in areas up to some 650 m off shore. Near the proposed location of the new outfall, the sea bed consists predominantly of deeply rippled bare sand, at depths of 9–10 m, which is occasionally interspersed with limestone pavement and associated macroalgae.

This section of coastline is classified as a 'high energy' coastline. The full force of the ocean swell reaches the shoreline because there are no seaward reefs to act as barriers and reduce the energy of the waves as they meet the shore. Due to this high energy, the mosaic of coarse and fine grained sands along the coastline continually shifts (Kinhill 1991a and 1991b). For the same reason, turbidity in the water column is generally high all year round as the fine grained sediments and other particulate matter are continually resuspended.

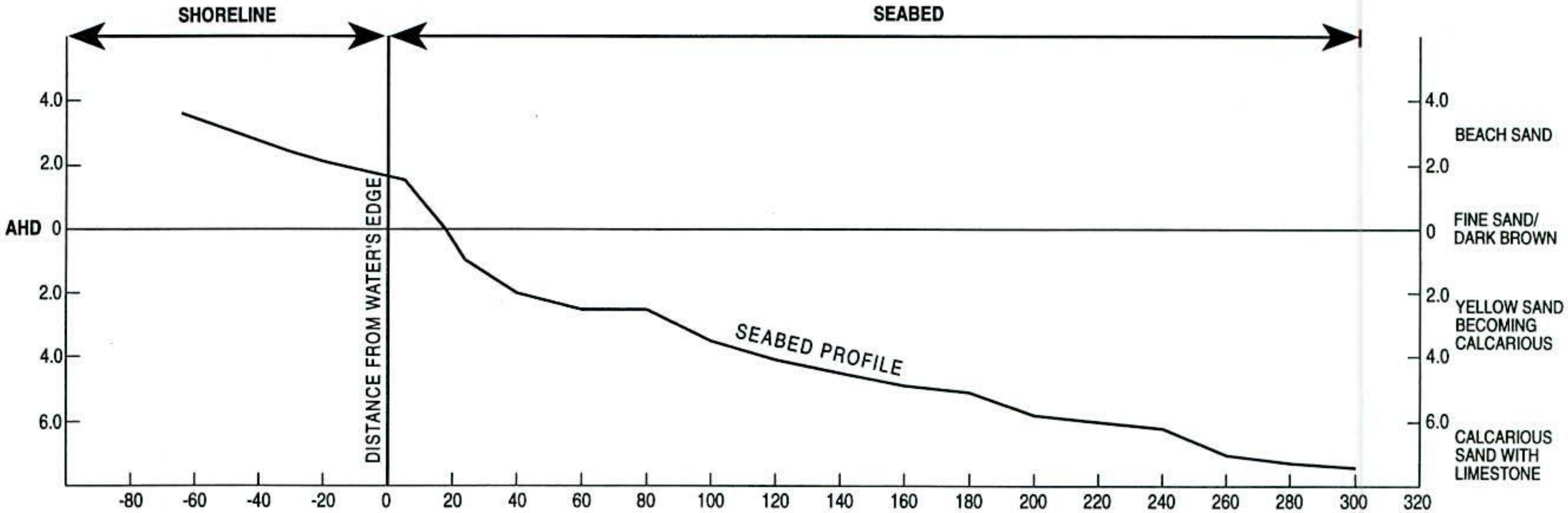


Figure 6.1
SEABED PROFILE

Most of the reef areas, and seagrass and algal meadows in the area offshore from the Leschenault Peninsula, are relatively low in both species composition and abundance (Meagher and LeProvost 1975). Laurenson et al. (1993) reported the relative abundance of marine fauna caught at nine survey sites between Fremantle and Geographe Bay in 1991/92. At a shallow water site near Preston (almost directly offshore from the outfall location), a total of 85 species were recorded, compared to a total of 202 species across the whole survey area. Of the eight species caught in large numbers, only *Upeneichthys lineatus* (Red mullet or Blue-striped goatfish) and *Pterygotrigla polyommata* (Sharp-beaked gunnard) were considered commercially marketable and none were listed as important to recreational fishers. The Southern school whiting (*Sillago bassensis*), the most commonly caught recreational species in the south-west of Western Australia, was not recorded at this site.

Productivity of commercial species, such as fish and crustaceans, is relatively low and, the inshore waters are not of major significance as commercial fisheries. Recreational fishing is not intensive, although some beaches are fished regularly. The degree of intensity of recreational fishing increases closer to Bunbury. Oceanic species that migrate to nearshore areas are commonly targeted.

6.4.5 COASTAL CIRCULATION ADJACENT TO BUNBURY

The mixing and dispersion of the saline water, discharged by SCM during the pigment production process would largely be determined by the prevailing ocean conditions.

The coastline to the north of Bunbury is also described as highly energetic, resulting in rapid initial mixing and dispersion of any water discharged into it. Wind and wave action would ensure adequate mixing and dilution, even at a short distance from the shore.

Winds in the Bunbury region are predominantly southerly, with directional changes occurring seasonally. During winter easterly winds generally occur at night, while westerly winds are common in the afternoon. During the night in summer, strong south-easterly winds are common, turning south-westerly in the afternoon.

Tidal currents in the nearshore area are very weak so currents are wind dominated. This results in a distinct daily oscillation of current flow, which may also be influenced by the swell and by sea surface waves (Imberger and Pattiaratchi 1990). However, the predominantly southerly component of the sea breeze results in a northerly movement of waters and sediments along the shore.

The movement of coastal waters further offshore is also dominated by wind-driven currents. During the summer months, surface waters tend to move northwards over the continental shelf. A flow reversal usually occurs during the winter months, with water movement following a southerly direction past Cape Naturaliste and Cape Leeuwin, as part of the Leeuwin current.

Offshore surface currents exert a minimal influence on the movement of inshore waters off Bunbury (Steedman and Associates 1980). These currents would, therefore, have little immediate effect on the movement of saline water discharged inshore at the proposed outfall.

It is therefore expected that dispersion of the saline water after discharge and initial mixing would be variable, both seasonally and annually, and would depend on prevailing, wind-driven currents. In general, the flow would be mainly northwards (parallel to the coast), with occasional flow reversals during winter storms that have prevailing northerly winds.

6.5 SOCIAL ENVIRONMENT

The social environment likely to be affected by expansion of the Kemerton plant is covered by the Australian Bureau of Statistics census area of Preston. The City of Bunbury and Shire of Harvey fall within this census area.

This region is only a few hours' travel from Perth and can draw on many of its services and facilities. The major transport link to the region is by road, with the Perth–Bunbury Highway passing along the western side of the industrial park.

6.5.1 POPULATION

The estimated resident populations for the Preston area are shown in Table 6.1. The population growth associated with the Kemerton Industrial Park peaked with the construction of its industrial buildings during the late 1980s. However, the population growth within the region continues to expand at rates above the State's average. The population growth rate for the whole of Western Australia for 1991–92 was 1.94%, while the Shire of Harvey's population grew by 3.76% over the same period.

Table 6.1 **Population for the Preston census area**

	1986	1991	1996*	2001*	2006*	% growth '91–'92
Bunbury	23,031	25,662	28,900	30,800	32,600	1.84
Capel	3,740	4,931	5,900	6,800	7,600	4.03
Collie	9,077	9.058	9,700	9,800	10,100	2.85
Dardanup	4,159	5,037	5,800	6,400	6,800	4.49
Donnybrook	3,491	3,844	4,300	4,500	4,700	2.65
Harvey	9,609	12,394	14,800	16,800	19,000	3.76
Preston total	**53,107**	**60,929**	**69,400**	**75,100**	**80,800**	**2.84**
State total	**1,406,929**	**1,586,393**	**1,796,100**	**1,954,300**	**2,117,200**	**1.94**

* *Projected Growth*
Source: *Australian Bureau of Statistics.*
South-West Development Authority 1995.

The 1991 census indicated that almost 40% of the population falls into the 20–44 age bracket. This 'younger than average' population reflects the high employment and education opportunities with the region.

6.5.2 EMPLOYMENT

There are significant variations in employment characteristics throughout the south-west region, reflecting its economic diversity. Service related employment dominates the area with more than 60% of the work force in the service sector.

Table 6.2 outlines the employment profile for the Preston census area in 1992. Unemployment rates in Harvey and Bunbury were above the State's average.

Table 6.2 **1992 Labour force and unemployment estimates**

	People employed	% unemployment
Bunbury	15,004	12.1
Capel	2,918	8
Collie	5,173	10.3
Dardanup	2,780	2.1
Donnybrook	2,421	9.4
Harvey	6,493	13
State total	**853,600**	**10.6**

Source: Department of Employment, Education and Training

6.5.3 HOUSING AND ACCOMMODATION

The majority of dwellings in the Preston area are occupied, with a high percentage of home ownership. Over 70% of the homes in Bunbury and Harvey are fully owned, or being purchased, indicating a reasonably well established society (South-West Development Authority 1995).

6.5.4 EDUCATION AND COMMUNITY SERVICES

Bunbury is the regional center for educational facilities. There are some 150 government or private schools catering to more than 20,000 pupils in the south-west.

Tertiary education is provided by the Bunbury campus of the Edith Cowan University, the South-West College of Technical and Further Education and several smaller technical colleges and specialist institutes in other towns in the south-west.

6.5.5 ABORIGINAL HERITAGE

The south-west region has a wide range of aboriginal ethnographic and archaeological sites. However, during a survey of all 1,500 ha of the Kemerton Industrial Park industrial zone, no archaeological sites were found (BHP Engineering 1993).

7 ENVIRONMENTAL IMPACTS OF THE PROPOSED EXPANSION AND THEIR MANAGEMENT

This chapter describes the potential environmental impacts associated with the proposed plant expansion and the management objectives and measures proposed to alleviate or minimise them. Sections 7.1 to 7.8 of this chapter cover operational environmental management issues; Section 7.9 covers issues relating only to construction; while Section 7.10 covers decommissioning. Section 7.11 and Table 7.6 describe the environmental management framework and summarize the management objectives, management strategy and management actions.

7.1 ATMOSPHERIC EMISSIONS

7.1.1 MANAGEMENT OBJECTIVES

SCM's objectives with respect to atmospheric emissions are as follows:

- to ensure that atmospheric emissions comply with the DEP licence and do not adversely affect the environment, or the health, welfare or amenity of nearby land users by maintaining or reducing stack emissions and ensuring ground level concentrations do not increase;
- to minimise emissions of greenhouse gases;
- to reduce fugitive emissions within the plant;
- to ensure there is no unacceptable odour impact outside the boundary of the Kemerton Industrial Park.

7.1.2 GENERATION

Atmospheric emissions would arise from the following sources:

- main process/thermal converter stack
- suction vent system stack
- emergency high pressure release system
- start-up stack
- boilers and gas burning devices.

7.1.3 TREATMENT AND DISPOSAL

All process gaseous emissions from the existing plant pass through a multiple water scrubbing system to remove particulates, hydrogen chlorine and chlorine prior to discharging to the atmosphere through a 66 m stack. The exit gases currently contain nitrogen, carbon dioxide, carbon monoxide, carbonyl sulphide, hydrogen sulphide and water vapour.

The new plant would incorporate a similar system in which all process gas emissions from the existing and expanded raw pigment plant would pass through a gas scrubbing train, consisting of a spray tower, a venturi scrubber and a packed tower. In addition, the scrubbed gases would be passed through a thermal converter system where carbon monoxide, carbonyl sulphide and hydrogen sulphide would be oxidised to carbon dioxide and sulphur dioxide. The energy released in the thermal converter would be used to generate steam in a waste heat boiler.

The thermal converter exhaust gases would be scrubbed in a caustic scrubber to remove 95% of the resultant sulphur dioxide and then vented to the atmosphere through the new main process stack, currently proposed to be 90 m high. The resulting scrubber solution would be oxidised in a process developed by SCM, to produce a sulphate solution that would be injected into the saline water for disposal. The atmospheric emissions would be mainly carbon dioxide and nitrogen with minor proportions of nitrogen oxides, carbon monoxide and sulphur dioxide (the 5% that is not scrubbed). The thermal converter is designed to meet the emission limits shown in Table 7.1.

Table 7.1. **Proposed emission limits from the process stack during thermal converter operation**

Parameter	Design limit (mg/Nm^3)†
Carbon monoxide	100
Nitrogen oxides	200‡
Acid gases (sulphur dioxide)	10
Hydrogen chloride	10
Chlorine and chlorine compounds	40
Hydrogen sulphide	no odour beyond KIP*
Reduced sulphur compounds	no odour beyond KIP*

Note † *at 0C and 1 atmosphere pressure*
‡ *at 7% oxygen*
* *Kemerton Industrial Park.*

The thermal converter would be designed to handle all possible start-up, normal running, upset and shutdown combinations. The thermal converter would be taken off line while the process is being optimised and during regular maintenance. When the thermal converter is off line, process gases would continue to be water scrubbed and vented via the main process stack. Emissions would then include carbon monoxide, carbonyl sulphide, and small amounts of sulphur dioxide and hydrogen sulphide.

7.1.4 POTENTIAL IMPACTS AND PROPOSED MANAGEMENT ACTIONS

The existing plant has been designed to meet acceptable ground level concentration criteria and has consistently done so since start up in 1989. Few problems or complaints have been experienced in the past. Currently proposed design ground level concentration criteria for residential areas 3,330 m west of SCM's plant (DEP 1997) are shown in Table 7.2.

Table 7.2. **Proposed ground level concentrations of various gases at nearest residential area***

Parameter	Design ground level concentrations (ppm)	Limit (ppm)†
Carbon monoxide	2.6	25
Carbonyl sulphide	0.14	0.17‡
Sulphur dioxide	0.024	0.2
Hydrogen sulphide	0.00005	0.0007‡

Note * *3,330 m west of SCM Kemerton plant*
† *Source: DEP (1997)*
‡ *SCM internal limit*

The proposed plant would be designed to meet or better the criteria shown in Table 7.2 using Best Practice technology. This technology is based on the experience gained from the company's plants overseas and further refined by a continuous improvement programme . With the thermal converter on-line, all the gases listed in Table 7.2 would be effectively removed. Even with the thermal converter off line for maintenance and process optimisation, computer modelling predicts that the ground level concentrations of carbon monoxide, carbonyl sulphide, sulphur dioxide and hydrogen sulphide would be well within the DEP guidelines at maximum production rate.

The suction vent system would be based on the existing effective suction vent system. All fugitive emissions collected by the suction vent system would be scrubbed and released to the atmosphere via the existing 66 m tall stack currently used to discharge process gas to the atmosphere from the existing plant.

Design of the proposed emergency pressure release systems would be based on the existing plant design. The plant would operate at 30% of the bursting disc pressure. The pressure release systems would vent to emergency relief stacks which would be sized to ensure the appropriate design ground level concentrations are not exceeded.

Gas burned for heating or steam generation and process gases burned in the thermal converter would generate carbon dioxide, water vapour, oxides of nitrogen and sulphur oxides which are so-called greenhouse gases. Greenhouse gas emissions would be managed according to a greenhouse gas control strategy. This strategy aims to improve energy efficiency and minimise the net generation of greenhouse gases.

Firstly, greenhouse gas emissions would be minimised by using fuels with low greenhouse gas emissions. Carbon dioxide would be further reduced by installing a thermal converter and reusing the heat generated in the waste heat boiler in the process.

Secondly, release of sulphur oxides would be minimised by removing it in scrubbers. Thirdly, generation of nitrogen oxides would be minimised through the use of high efficiency, low nitrogen oxide-emission burners. Other greenhouse gases such as halons and CFCs would be phased out and a tree planting programme utilising native species grown in the company nursery would be initiated.

SCM would amend and implement the company's Environmental Management Plan and Systems Manuals to reflect the changes.

7.2 DUST

7.2.1 MANAGEMENT OBJECTIVES

SCM's objective with respect to dust is to ensure there is no increase in dust generation during normal operation of the plant.

7.2.2 GENERATION

The main potential source of dust from the proposed expanded plant would be from the finishing section, where dust generation could occur once the pigment is dried.

7.2.3 TREATMENT AND DISPOSAL

Dust control would be achieved by building design and equipment specifications.

The finishing plant would be serviced by a dust collection system. This would comprise a baghouse, a vacuum fan and a substantial vacuum reticulation system. Pigment would be air conveyed between processing stages and collected in bag filters that would be vented to the atmosphere through a duct at or near ground level. Exhaust gases from the finishing plant driers would be filtered through bag filters before being discharged through the stack. Rotary air valves would also be vented through filter socks. Steam micronising exhaust would be vented through a condenser and closed circuit cooling tower loop. Bagging machines would be fully automatic low dusting machines.

7.2.4 POTENTIAL IMPACTS AND PROPOSED MANAGEMENT ACTIONS

The maximum design emission from the bag filters would be 100 mg/m^3 (at 0°C and 1 atmosphere) which represents 40% of the 250 mg/m^3 recommended in national guidelines for control of emissions of particulate air pollutants from new stationary sources (Australian Environment Council/National Health and Medical Research Council, 1985). Actual dust emissions are likely to be much lower.

Bag filter collectors would be fitted with overpressure interlocks that automatically shut down the pigment conveying system prior to venting. Emissions from the cooling towers would be monitored by regular visual inspections of cooling water colour to identify if filter socks are leaking pigment.

As a consequence of these measures, dust generated from the site during operation is not expected to increase ambient levels of suspended particulates in areas outside the boundaries of the plant. The potential for dust emissions to exceed these levels would be further reduced in plant design by adoption of the best environmental management technologies for dust control.

All transport of pigment would be in palletised, sealed, plastic-wrapped bags. Therefore, there would be virtually no potential for dust emissions from product transport.

7.3 SALINE WATER

7.3.1 MANAGEMENT OBJECTIVES

SCM's objectives with respect to water management are as follows:

- to continue to reduce overall water usage and saline water production;
- to ensure the saline water quality complies with the DEP licence;
- to minimise and monitor the impact of the disposal of saline water on the marine environment;
- to maintain ocean water quality within the levels specified in the draft Western Australian Water Quality Guidelines for Fresh and Marine Waters.

7.3.2 GENERATION

The chloride process plant would generate process water from the following sources:

- sand filter backwash water;
- water for scrubbing exit gases from the purification section;
- regeneration and rinse waters from ion exchange water softening and demineralisation.

The finishing plant would generate process water from pigment washing.

In addition, the plant would accept process water for treatment from the following sources:

- the chlor-alkali plant, supplying chlorine to the plant;
- the air separation plant, supplying nitrogen and oxygen;
- the lime plant.

The water flow is shown in diagrammatic form in Chapter 3 (Figure 3.3).

7.3.3 TREATMENT AND DISPOSAL

All liquid streams from the raw pigment production plant, the air separation plant and the chlor-alkali plant would be collected and neutralised. In the neutralisation process, lime would be added to the liquids sequentially to raise the pH and precipitate the solids. Following neutralisation, the pH of the liquids would have been returned to near neutral condition. The solids, prior to washing and disposal, would be separated from the neutralised solution in a clarifier. The neutralising system is illustrated in Figure 3.3.

Process water from the finishing plant would be treated and reused where possible. The finishing plant would produce about 150 m^3/h of neutral saline water which would either be combined with the raw pigment plant effluent in the neutralisation plant or be directed to a dual-lined holding pond. Saline water from the neutralisation plant would be discharged to a separtate dual-lined holding pond. The combined treated saline water flow be about 376 m^3/h.

The treated saline waters would then be pumped to the existing ocean outfall. The outfall would consist of a discharge pipe, with a 'multi-port tee' diffuser constructed on the end of the pipe. The existing saline water pipeline would require upgrading to handle the proposed increases in volume. This may involve installing a new larger pipeline and diffuser, or a second pipeline to separately handle the treated saline water from the new finishing plant.

7.3.4 POTENTIAL IMPACTS AND PROPOSED MANAGEMENT ACTIONS

Whatever the ultimate design of the ocean outfall, it would be designed to ensure adequate mixing of the saline water with the sea water occurs within 20 m of the discharge point and the resultant water quality complies with water quality criteria specified in EPA Bulletin 711 (EPA 1993b). In Table 7.3, the likely composition of the treated saline water from the plant, both before and after mixing with sea water, is compared with the composition of sea water and the water quality criteria (EPA 1993b).

Table 7.3 **Composition of treated saline water and water quality guidelines**

Parameter*	Treated saline water	Water quality 20m from diffuser**	Water quality guideline***	Typical sea water****
pH	8.0	8.2	8–8.4	8.2
Total dissolved solids	29,700	34,450	32,800–36,200	34,500
Suspended solids	15	10	<10% change	10
Calcium	10,500	500	NC	400
Magnesium	26.5	1,386	NC	1,400
Iron	0.2	0.012	NC	0.01
Manganese	0.2	0.004	NC	0.002
Chloride	15,110	18,960	NC	19,000
Sulphate	2,890	2,450	NC	2,450
Bicarbonate	ND	140	NC	140
Silica	ND	6	NC	6
Nitrate (as nitrogen)	0.35	0.023	0.01–0.06	0.02††
Phosphate (as phosphorus)	0.05	0.01	0.001–0.01	0.01††
Chlorate	50	0.50	NC	
Cadmium	<0.005	0.0001	0.0002†	0.0001
Chromium	0.1	0.001	0.002†	0.00005
Cobalt	ND	0.0004	NC	0.0004
Copper	<0.05	0.003	0.004†	0.003
Lead	<0.05	0.00003	0.001†	0.00003
Mercury	0.0005	0.000055	0.0001	0.00005†††
Nickel	<0.05	0.002	0.015	0.002
Vanadium	0.4	0.004	NC	
Zinc	<0.05	0.01	0.02	0.01
Radium 226	4	0.04	NC	
Radium 228	12	0.121	NC	
Thorium 232	0.2	0.002	NC	
Hydrocarbons (total)	ND	0	0.01	0

* *All measurements g/m^3, except pH (not applicable) and radium and thorium (kBq/m^3)*
** *At the perimeter of the mixing zone*
*** *Source: EPA 1993, Table 2.2 (except as noted)*
**** *Source: Fairbridge 1972 (except as noted)*
† *Source: EPA 1993, Table 2.7*
†† *Source: South West Development Authority 1992*
††† *Source: Riley and Chester 1971*
NC No criteria set.
ND Not detectable

The data in Table 7.3 indicate that the chemical composition following dilution would fall within the limits specified by the EPA for the protection of aquatic ecosystems and human consumers of fish and other aquatic organisms.

SCM would continue to explore opportunities to recycle and reuse process water within the expanded Kemerton plant to further reduce the requirements for raw water. It is anticipated that savings could be made by reuse of water from the finishing plant in the process plant. However, these opportunities cannot be fully explored until the plants are commissioned and their operations optimised. Reuse of water would further concentrate the parameters altering the data shown in Table 7.3. However, the total quantity discharged per year would be very similar. There could be slight reductions as elements from the raw water would be reduced.

7.4 SOLID RESIDUE

7.4.1 MANAGEMENT OBJECTIVES

SCM's objectives with respect to solid residue are as follows:

- to reduce the amount of solid residue produced per tonne of product;
- to use the solid residue as a resource in building and road construction, soil amendment and other potential uses;
- to minimise the impact of solid residue disposal on the surrounding soil, groundwater and land use;
- to identify alternative disposal sites.

7.4.2 GENERATION

As a result of treating the process water streams from the raw pigment plant in the lime neutralisation system, approximately 900 t/d of residue slurry would be produced containing 11–15% solids. Treatment of the process water from the finishing plant would generate another 35 t/d of residue slurry containing 11–15% solids.

The quantity of solid residue that would be produced by the proposed plant, compared to the amount produced by the existing plant, is shown in Table 7.4.

Table 7.4 **Solid residue production**

Plant	Finished pigment production (t/a)	Solid residue slurry (t/a)
Existing	79,000	136,000
Proposed	195,000	340,000

Solid waste from the finishing plant would form about 4% of the total solid residue. The solid residue would consist mainly of unreacted ore and coke, and metal hydroxides from the raw pigment process. Table 7.5 shows the elemental composition of the solid residue.

Table 7.5 **Elemental composition of typical residue solids***

Parameter	Concentration (mg/kg unless otherwise stated)
Total solids @ 105°C	8.33%
Total organic Carbon	10%
Total Sulphur	0.90%
Loss on ignition 650°C	20.5%
Loss on ignition 950°C	22.3%
Aluminium	3.00%
Arsenic	3
Boron	43
Barium	310
Calcium	2.22%
Cadmium	4.6
Chloride	1.86%
Chromium	1,800
Cobalt	110
Copper	93
Iron	13.1%
Lead	16
Magnesium	2.05%
Manganese	3.67%
Mercury	<0.05
Nickel	370
Niobium	830
Phosphorus	970
Potassium	510
Selenium	14
Silicon	4.11%
Sodium	1,200
Thallium	<0.5
Thorium	400
Titanium	4.87
Uranium	33
Vanadium	4,700
Zinc	72

* *Composition in table does not total 100% because elements are present as oxides, and oxygen content not listed*

7.4.3 POTENTIAL USES

SCM is committed to investigating alternative uses for the solid residue. Research programmes currently operating will continue and where feasible additional programmes would be developed. Alternative uses currently being investigated for the solid residue include the following:

- road base
- brick manufacture
- soil conditioner
- nutrient adsorption.

The Materials Engineering Section of Main Roads Western Australia has indicated that the solid residue has appropriate properties, when mixed with sand, for use as a road base (replacing limestone). SCM has constructed test sections of roads which are performing satisfactorily; further roads are being considered. The cost of transporting the material, however, could limit its use to the local region, which is probably not a large enough market to use all the residue generated.

The solid residue has proven suitable in brick manufacture. However, the cost to transport the product to Perth, the greatest potential market, might reduce demand.

Uses in soil mixes as conditioners, and to encourage nutrient absorption, have also proven beneficial.

Studies are being undertaken to determine methods to reduce uranium and thorium levels in the feedstock, which would result in a corresponding reduction in radioactive levels of the residue. This would allow a wider use of the material in a number of varied applications.

In addition to research into possible uses for the solid residue, SCM is committed to continuing its research into residue minimisation, recycling and alternative methods of disposal.

7.4.4 TREATMENT AND DISPOSAL

The solid residue would continue to be transported to Dalyellup for disposal at the existing, DEP approved, residue disposal site (SCM 1991 and 1993). The slurry would be transported to Dalyellup by road tanker. Currently, tankers arrive at an average of ten over 24 hours. After the expansion, this would increase to twenty four tankers over 24 hours. The slurry would be discharged by gravity into the active pond. To enable gravity discharge of the residue, and to alleviate effects from dust, the residue would continue to be transported and disposed of in a slurry state. This slurry would be moderately alkaline, with a pH of 8–10, and have a total dissolved solids level of about 2,600 g/m^3.

The expanded production rates would reduce the life of the Dalyellup disposal site. Under current production rates, the existing areas would be full within ten years; the actual time when the site would be fully utilised would be dependent on the expansion commissioning time frame.

This proposal for expansion of the Kemerton titanium dioxide pigment plant does not involve construction of any more storage areas at this time. SCM and relevant Government authorities are actively investigating alternative disposal options or sites for the long-term management of the solid residue produced by the plant. Any alternative disposal method or site would require a specific environmental impact assessment.

A Government task force (consisting of representatives from DRD, LandCorp and the DEP Office of Waste Management) is investigating possible alternative disposal sites. The Department of Resources Development (DRD) has sought to commission a consultant to report on the alternative sites available within the Bunbury region for long-term disposal of solid wastes. SCM is maintaining contact with this task force to stay informed of the progress of this study.

7.4.5 POTENTIAL IMPACTS AND PROPOSED MANAGEMENT ACTIONS

Operation of the existing solid residue disposal facility at Dalyellup was the subject of a separate environmental assessment and approval process (SCM 1991). Following a further environmental assessment (SCM 1993), approval was given by the Minister for the Environment for disposal operations to continue for the "life of the site".

The potential impacts of the disposal of solid residue at Dalyellup were identified as being the following:

- incompatibility with neighbouring land uses;
- direct impacts associated with construction of the ponds;
- erosion and dust generation;
- groundwater contamination;
- increased background radiation levels.

These potential problems were addressed in the earlier Consultative Environmental Review prepared for the continued operation of the Dalyellup site (SCM 1991), and appropriate control measures have been incorporated into SCM's management programmes.

The Dalyellup site is located within the buffer zone of the Bunbury sewage treatment plant. As a consequence, the site is relatively isolated from residential areas and there are unlikely to be any requirements or plans for other uses of the area. To prevent accidental entrance to the storage area, the site is fenced and patrolled by a security firm. The effectiveness of these measures would continue to be assessed, and revised if necessary.

Operational practices, including discharge of the solid residue as a slurry, have prevented the generation of dust at the Dalyellup site becoming a problem. Monitoring for dust during the initial years of operation showed that dust was not generated and monitoring has ceased following approval from the DEP and RCWA. The situation is regularly assessed and addressed in the annual environmental audit report.

Water infiltrating from the residue to the underlaying soil profile would have a slightly elevated salinity level in comparison to the up gradient, natural groundwater. Monitoring of the groundwater surrounding the Dalyellup site indicates that previous disposal has resulted in the formation of a brackish plume beneath and down gradient of the active ponds. The brackish water, following mixing and dilution with the westward moving groundwater, discharges across the saline interface to the ocean.

The rate of deposition of the residue slurry would increase with the increased production rate but the quality of slurry water would be similar. Therefore, groundwater both up and down gradient of the disposal ponds should remain stable and no significant adverse environmental effects should occur. The quality of the groundwater at the disposal site is expected to remain within the current parameters with only minor fluctuations occurring down gradient of the active ponds.

Monitoring data indicates that groundwater metal levels are similar to background levels. Research has shown that this is most likely a consequence of the alkaline nature of the solid residue and the alkalinity of the underlying soils, both of which reduce the solubility of the heavy metal elements. SCM would continue to use this natural buffer by ensuring management procedures maintain the alkalinity of the residue.

Radiation monitoring is undertaken in accordance with the Radiation Management Plan and forms part of the annual environmental audit report. Monitoring results confirm there are no concerns for occupational radiation exposure from radon, thoron or their daughters associated with residue disposal at Dalyellup (Terry 1993). Combined with the inaccessibility, and limited use, of the site, the risk of exposure would be below acceptable levels; as a result no additional measures are required to limit exposure

The alkaline nature of the solid residue, supported by ongoing monitoring of current disposal practices, indicates that no adverse environmental impacts are likely to occur from the disposal of solid residue at the Dalyellup site.

All the disposal ponds given approval have been constructed. The top soil and vegetation removed have been used in the rehabilitation of the area.

Following decommissioning, the site would be rehabilitated either to native vegetation or to turf-based recreational facilities. Rehabilitation studies and trials have already been undertaken, and show the site can be rehabilitated successfully.

SCM would continue monitoring and undertaking environmental audits at the solid residue storage area at Dalyellup in accordance with their Environmental Management Plan and the Radiation Management Plan, to the satisfaction of the DEP.

7.5 NOISE

7.5.1 MANAGEMENT OBJECTIVES

SCM's objectives with respect to noise are as follows:

- to minimise noise generation to within regulatory standards as stipulated in the proposed Environmental Protection (Noise) Regulations when promulgated;
- ensure that noise levels due to SCM's operations meet acceptable criteria at residential areas adjacent to the Kemerton Industrial Park.

7.5.2 GENERATION

The expanded process plant would generate noise from the following sources:

- sand milling;
- condensation;
- purification;
- chlorination;
- oxidation;
- boilers;
- refrigeration;
- gas scrubbers;
- waste gas incineration;
- cooling towers;
- pigment surface treatment;
- pigment filtration;
- pigment drying;
- pigment milling;
- pigment packing
- water treatment.

The total predicted sound power level from the expanded plant including the finishing plant is expected to increase by approximately 7 dB(A).

7.5.3 POTENTIAL IMPACTS AND PROPOSED MANAGEMENT ACTIONS

In designing the new plant, particular attention would be paid to the major noise contributing items to ensure the plant is as quiet as can be reasonably achieved by incorporating Best Practice design features into the new plant. These features include the following:

- all items of equipment would comply with current occupational health and safety noise specifications;
- all major noise sources, such as micronisers, vacuum pumps and compressors, would be housed in noise attenuation enclosures;
- the micronisers, a major potential noise source, would be located at ground level;
- major noise sources would be located on the east side of the finishing plant building so that the building acts as a noise barrier between the noise source and residential areas to the west of the plant.

The impact of noise on the surrounding environment as a result of the proposed plant expansion was assessed through the computer noise modelling program ENM. A summary of this noise modelling is presented in Appendix D.

The noise modelling shows that the noise levels outside the Kemerton Industrial Park due to the proposed expansion of the raw pigment plant and development of a finishing plant alone would be below 38 dB(A) under most no wind conditions. For a 2.5 m/s wind from the east/south-east or north-east, the noise levels outside the Kemerton Industrial Park due to SCM's expanded plant alone would be predominantly below 38 dB(A). However, there would be small areas to the east of the plant near the Australind By-pass where noise levels would exceed 38 dB(A). There would also be small areas to the east of the Brunswick River where noise levels would exceed 38 dB(A) under a 2.5m/s west/south-west wind.

If the sound power levels of the microniser, surface treatment and spray drying areas were reduced by 6 dB(A) using further noise control measures, then, with the exception of a very small area east of the Brunswick River during an extreme temperature inversion, the predicted noise level outside the Kemerton Industrial Park would be below 38 dB(A) for all modelled meteorological conditions.

7.6 RADIATION

7.6.1 MANAGEMENT OBJECTIVES

SCM's objectives with respect to radiation are as follows:

- to ensure radioactive materials introduced into the pigment plant are contained within the pigment plant and the saline water or solid residue at a level that does not compromise public or personnel safety;
- to maintain a comprehensive and up to date radiation management plan and ensure personnel are aware of its content and their responsibilities;
- to comply with all regulations pertaining to radiation management.

7.6.2 GENERATION

The feedstock for the process plant, synthetic rutile, is derived from mineral sands. Thorium, and to a lesser extent uranium, are present in the mineral sands of Western Australia. While the mineral separation plants remove the majority of the impurities, low levels of thorium and uranium impurities, and their decay products such as radium and radon, remain from the original mineral sands ore. Minor quantities of these elements are also present in the coke and lime slurry feeds.

Figure 7.1 shows the percentages of thorium and uranium in raw materials and products at various stages of the chloride process. This figure shows that the vast majority (99.9%) of the thorium and uranium initially present in the raw materials would end up in the solid residue.

The solid residue would contain small quantities of radioactive elements, but the radioactivity of the solid residue would be low. Consequently, the solid residue would not be classified as a radioactive substance under the Transport Code.

During processing into raw pigment in the chloride process, the potential also exists for thorium and uranium, and their decay products such as radium and radon, to be released or become concentrated in certain areas of the plant.

Similar to most modern industrial complexes, radiation gauges and X-ray analysis equipment would be used for process control purposes. These pieces of equipment are classified as 'radiation sources' and are licensed by the RCWA Radiation Health Branch. SCM's standard procedures for the use of this equipment are based on the requirements of the National Health and Medical Research Council Codes of Practice.

7.6.3 TREATMENT AND DISPOSAL

As indicated in Section 7.4, the solid residue (which contains low levels of radioactivity) would be disposed of at the approved disposal site at Dalyellup. Materials and equipment from the process plant would be periodically examined and removed. Only materials and equipment with surface contamination (alpha emitter) levels not exceeding 3.7×10^3 Bq/m^2 would be given unrestricted clearance for disposal. Materials and equipment with levels above this would be decontaminated and/or disposed of in a manner approved by the RCWA. Typically, decontamination would involve descaling. Scale from the decontamination process would be gradually fed back into the neutralisation plant for disposal in the solid residue.

Records would be kept of all radioactive substances on site. The results of annual audits of radioactive substances and plant radiation surveys would be reported to the authorities.

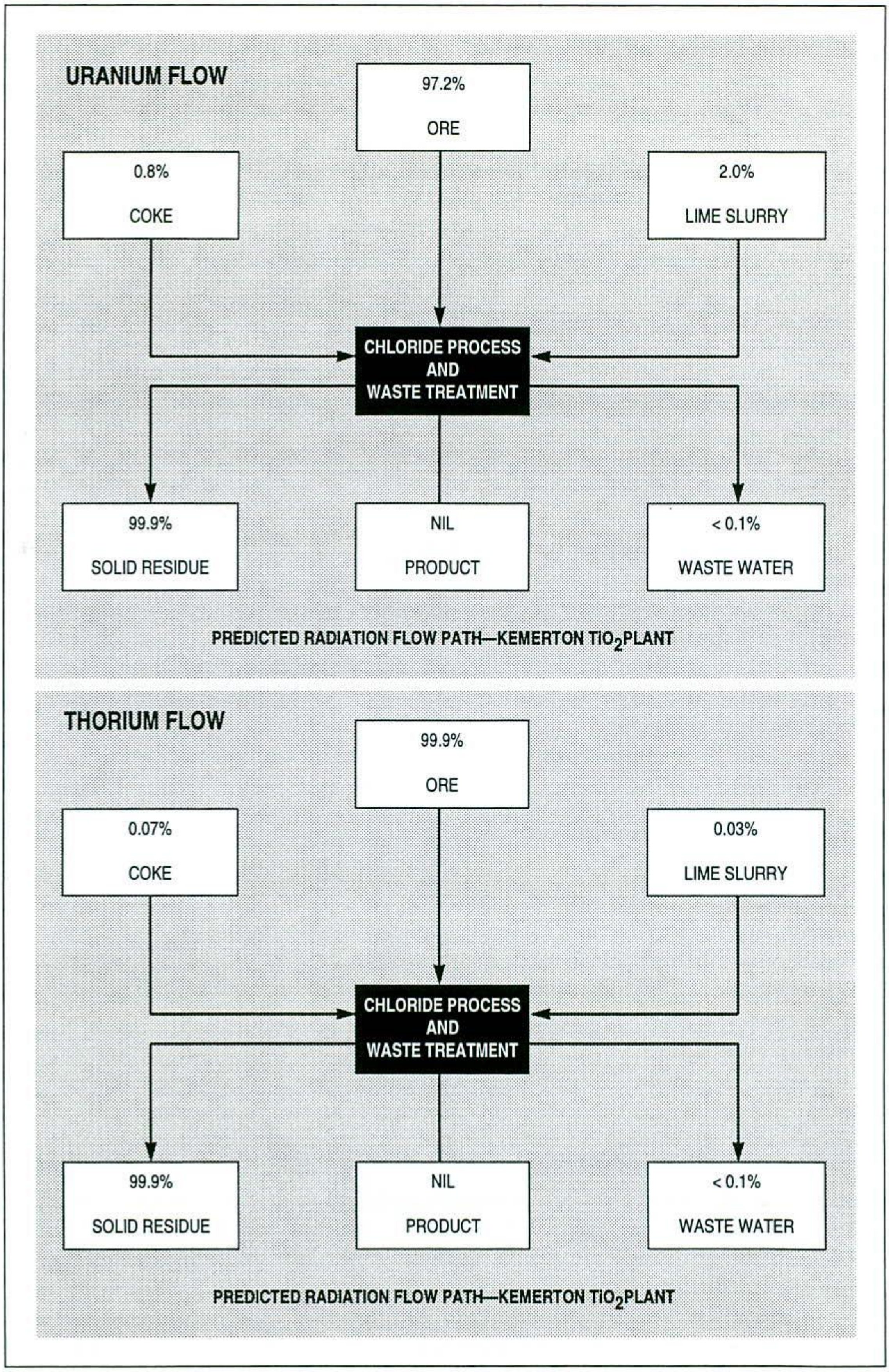


Figure 7.1
RADIATION FLOW PATHS

7.6.4 POTENTIAL IMPACTS AND PROPOSED MANAGEMENT ACTIONS

SCM's Environmental Manager has responsibility for the preparation of the Radiation Management Plan and for ensuring compliance with the regulations. Under the Radiation Safety (General) Regulations, an authorised Radiation Safety Officer must be appointed. It is the responsibility of SCM's Radiation Safety Officer to ensure that all applicable radiation safety regulations and codes of practice are adhered to. It is also this officer's responsibility to ensure all personnel have an understanding of the safe working procedures necessary to limit exposure to radiation sources.

SCM's Radiation Management Plan covers all their Western Australian operations including:

- the Kemerton plant
- the Australind plant
- the saline water disposal system
- the solid residue disposal system.

This plan has been approved by the RCWA.

SCM's general radiation protection procedures are designed to ensure that all exposures are kept to the 'As Low As Reasonably Achievable' (ALARA) principle. Radiation management procedures have been developed to ensure compliance with appropriate regulations to minimise radiation doses to personnel. It is SCM's policy to adopt the limits of exposure for members of the public for its own personnel, rather than industrial or mining industry exposure limits which are substantially higher. The proposed expansion would not alter the radiation flow path through the plant. The established safe work practices and radiation management would still be applicable.

Radiological aspects of the solid residue have been considered in the disposal site management. The assessment of radiation doses at the disposal site are detailed in the Operational Radiation Monitoring Programme for the Dalyellup site. The results indicated that there are no concerns for occupational radiation exposure from the radon, thoron or their daughters associated with the residue handling facilities at Kemerton, with transport or from solid residue disposal at Dalyellup.

The radiation aspects of any proposed alternative uses of solid residue have also been addressed. Results show that all measured parameters are within environmental limits and no concerns of increased risks have been determined to date.

Radiological aspects have been considered in the monitoring programme for the saline water treatment system, the treated saline water and the receiving environment. Based on monitoring to date, radon and other decay products at the neutralisation plant would occur at normal environmental levels.

Current monitoring indicates uranium and thorium would not be detectable in the treated saline water and radionuclide levels in the receiving ocean water would be within normal environmental levels. Recent monitoring of the sediments around the ocean outfall indicates that trace radionuclides are present at detection limits. While there are naturally occurring patches of mineral sands in the area, the source of these trace radionuclide levels has not been determined and monitoring is continuing.

SCM would continue to audit the effectiveness of its Radiation Management Plan.

7.7 RISKS AND HAZARDS

7.7.1 MANAGEMENT OBJECTIVES

SCM's objective with respect to risks and hazards is to ensure off-site risk is as low as reasonably achievable and continues to comply with EPA Bulletin 611 (EPA 1992). The risk criteria specified in EPA Bulletin 611 are as follows:

- a level of risk in residential zones of one-in-a-million per year (1×10^{-6}/year) or less is so small as to be considered acceptable to the EPA;
- a risk level in 'sensitive' developments, such as hospitals, schools, child care facilities and aged care housing developments, of between one half and one-in-a-million per year (0.5×10^{-6}/year and 1×10^{-6}/year) is so small as to be considered acceptable to the EPA;
- risk levels from industrial facilities should not exceed a target of fifty-in-a-million per year (50×10^{-6}/year) at the site boundary for each individual industry and the cumulative risk level imposed upon an industry should not exceed a target of one hundred-in-a-million per year (100×10^{-6}/year); and
- a risk level for any non-industrial activity located in a buffer zone between industrial facilities and residential zones of ten-in-a-million per year or lower (10×10^{-6}/year) is so small as to be acceptable to the EPA.

7.7.2 PRELIMINARY RISK ASSESSMENT

A Quantitative Risk Assessment (QRA) carried out by Cremer and Warner (1988) on the original 70,000 t/a Kemerton plant identified the following three materials as having the potential to result in hazardous conditions off-site if released in sufficient quantities:

- chlorine
- hydrogen chloride
- titanium tetrachloride.

Materials with secondary hazardous impacts such as carbon monoxide, carbon dioxide, hydrogen peroxide, hydrocarbons and oxygen were also considered in the assessment.

A Preliminary Risk Assessment (PRA) of the proposed expanded plant has been carried out by Stratex Worley Pty Limited (1996). A summary of this PRA is shown in Appendix E.

The results of this PRA show that both individual and societal risk levels from the proposed expansion fall within the EPA criteria. As shown in Appendix E, the one-in-a-million risk contour for the proposed SCM plant and the neighbouring Nufarm chlor-alkali plant falls almost entirely within the SCM property boundary.

A full Quantitative Risk Assessment (QRA) will be undertaken when the detailed project design is completed.

The THCP will be amended prior to commissioning to incorporate the proposed changes to the plant and meet the requirements of the DEP and DOME.

7.8 SOCIAL IMPACTS

7.8.1 MANAGEMENT OBJECTIVES

SCM's objectives with respect to social impacts are as follows:

- to minimise any impact on the local and regional community resulting from traffic movements or visual impacts;
- to create positive links with the community and respond to concerns;
- to minimise impact on archaeological or historical sites.

7.8.2 TRAFFIC

Traffic to and from the Kemerton site would be along Marriott Road and the Perth–Bunbury Highway or the South-Western Highway, with most traffic gaining access to the site via the Perth–Bunbury Highway. Total traffic movements at the intersection of Marriott Road and the Perth–Bunbury Highway in 1991 were 503 movements each day. Total traffic movements at the intersection of Marriott Road and the South-Western Highway in 1992 were 228 movements each day.

Average daily heavy vehicle movements to and from the expanded Kemerton operations are expected to be as follows:

- 10-15 loads of finished pigment to Fremantle
- 12 loads of raw pigment slurry to Australind
- 24 loads of residue slurry to Dalyellup
- 10 loads of rutile from Capel
- 6 loads of coke from coke store to plant
- 3 loads of general raw materials.

Although the proposed expansion would result in a significant increase in traffic movements, a dual carriageway, with turning pockets for ingress and egress, has recently been constructed at the intersection of Marriott Road and the Perth–Bunbury Highway. This intersection has rendered the road network capable of accommodating the additional number of traffic movements without affecting existing traffic flows or safety levels.

7.8.3 VISUAL IMPACTS

The expansion of the plant would result in an increase in the number of large structures on the site. This would result in the plant being more prominent, but only from Marriott Road and not from the Perth-Bunbury Highway. Since Marriott Road would have little general traffic, visual impacts on the general public would be negligible.

The tallest structure in the new plant would be the main process stack, which would be about 90m high. The chosen height of the stack would be consistent with plume dispersion requirements.

SCM would use lighting at the proposed expanded plant in accordance with the requirements of the safe running of the plant and Occupational Health and Safety Regulations.

7.8.4 EMPLOYMENT AND COMMUNITY FACILITIES

The proposed expansion would result in increased employment, predominantly in the Preston census area. Based on the 200 new personnel required for SCM's expanded activity, and the fourfold multiplier effect of these jobs on the local economy, some additional 1,000 job opportunities would be created in the area (Section 2.3). It is anticipated that many of these new jobs would be filled by people already living near to the Kemerton plant. However, even if all new jobs were filled by people moving into the district, it is not expected that this would put an excessive strain on existing community facilities.

7.8.5 ABORIGINAL HERITAGE AND CULTURAL SITES

There are no known Aboriginal cultural or archaeological sites that would be affected by the proposed expansion. Similarly, no sites of European historical significance would be affected by the expansion at SCM's Kemerton plant.

7.9 CONSTRUCTION

During the twenty four-month construction phase, employment for up to 500 people would be provided. Western Australian contractors would be used where practical. The Kemerton plant would remain operational during the construction period.

The scale of this proposal would not place any significant additional demands on existing local community infrastructure.

The potential impacts of construction work for the proposed expansion are as follows:

- loss, or clearing, of vegetation
- noise and dust
- safety
- transport movements.

These issues are addressed in the following sections.

7.9.1 CLEARING

SCM's objectives with respect to vegetation during construction are as follows:

- to ensure Declared Rare Flora and Fauna are not disturbed as a consequence of construction;

- to retain and re-establish vegetation and conserve topsoil in order to maintain biological diversity.

The proposal would require clearing of approximately 13.5 ha of scrub, including 3 ha for a contractor's lay-down or temporary storage area. With an existing cleared area of some 7.5 ha, the expanded Kemerton facility would effectively occupy only half of the 55 ha lot. The undeveloped areas that would remain are to the south and west of the lot. The existing vegetation would be retained as native bushland to act as a buffer and visual screen. Topsoil cleared during the construction phase would be stored on site and used for rehabilitation of the contractor's lay-down areas.

SCM has an existing landscaping plan and this would be revised to include the entire area. Where possible, local species grown by SCM's nursery would be used. Landscaping would be completed in a manner that takes account of the development concepts described in the Kemerton Industrial Park landscape study (Churchill 1992).

The vegetation that would be cleared for the plant expansion is not unique and does not have significant conservation value. However, replanting and rehabilitation in, and around, the plant site would use species native to the area to maintain existing conservation values and biodiversity.

7.9.2 NOISE AND DUST

SCM's objective with respect to noise and dust during construction is to ensure no noise or dust nuisance is created.

All construction machinery would be fitted with appropriate noise suppression devices. Construction noise levels would comply with the requirements of the

Occupational Health, Safety and Welfare Act. In addition, the combined noise generated by plant operation and construction activities would be monitored by SCM.

Generation of dust would only occur in areas of site preparation involving earthworks. Dust emission would be controlled by standard suppression measures, including water sprays and minimising the area cleared of vegetation during the construction process. The focus of dust control would be on material stockpiles and areas subject to traffic.

7.9.3 SAFETY

SCM's objective with respect to safety during construction is to maximise the safety of the workforce.

Safety issues arising during construction include those arising from construction activities, as well as interaction with continued plant operations.

SCM would prepare a specific construction safety plan to ensure safety levels are maintained during construction. This plan would cover the following issues:

- contractor selection, monitoring and assessment;
- joint pre-job safety meeting;
- construction safety plan;
- safety induction for constructors' work force;
- monitoring contractors' safety performance;
- security arrangements.

The construction site would be fenced off to separate construction and operational activities wherever possible. All construction personnel would be required to use SCM's security arrangements. Where interface with the existing plant did occur, SCM safety procedures, including work permits and tags, would be adopted.

The layout of the proposed plant, and its construction work, would be designed to ensure that the risks and hazards of the operating plant were not increased.

7.9.4 TRANSPORT

SCM's objective with respect to traffic during construction is to minimise any impact on the local and regional community resulting from traffic movements.

Construction would require mobilisation of plant and machinery and employment of a construction work force. As a result, it is expected that there could be some disruption to local traffic associated with movement of plant components to the site. SCM would aim to minimise the effect of construction traffic by transporting large prefabricated components of the plant during periods of low traffic volume.

7.10 DECOMMISSIONING AND FINAL LAND USE

This CER is concerned with the chloride process titanium dioxide plant and the finishing plant at Kemerton. The existing finishing plant at Australind and the solid residue disposal area at Dalyellup are the subject of separate approvals and ministerial commitments.

No definite project life has been proposed for the plants at Kemerton. Should the plants be decommissioned, the sites would be rehabilitated according to guidelines laid down for the Kemerton Industrial Park. Future land use would almost certainly be an alternate heavy industry.

Decommissioning of the process operations would be carried out in accordance with the requirements of any relevant government authority and include the preparation and approval of decommissioning Management Plan(s), decommissioning Radiation Mangagement Plan(s), and Rehabilitation and Monitoring Plan(s).

Established programmes to monitor groundwater and the receiving marine environment would be continued as long as the DEP considered it to be necessary. Similarly, environmental radiation surveys would continue to be conducted as required by the DEP.

7.11 MANAGEMENT PLANS

A management framework for operation and construction of the expanded Kemerton pigment plant would be proposed for the development of management plans. The framework would includes the following:

- a management strategy;
- management objectives;
- a series of management actions where these can be described.

The management framework has been divided into operational and construction elements as shown in Tables 7.6 and 7.7 respectively.

Table 7.6 **Management framework–operations**

Issue	Management objective	Management strategy	Management actions
Atmospheric emissions	Ensure that atmospheric emissions comply with current standards and do not adversely affect the environment, or the health, welfare or amenity of nearby land users; Maintain or reduce stack emissions and ground level concentrations of licensed gases; Ensure there is no unacceptable odour impact outside the boundary of the Kemerton Industrial Park; Minimise dust emissions during operation.	Reduce the level of carbon monoxide, carbonyl sulphide, hydrogen sulphide and sulphur dioxide emitted from the process	Install a thermal converter to oxidise carbon monoxide, carbonyl sulphide and hydrogen sulphide to carbon dioxide and sulphur dioxide Install a scrubber to remove 95% of the resultant sulphur dioxide Discharge gaseous emissions and black smoke through the chlorinator stack only under start up conditions on the chlorinator units Ensure emergency discharges would only occur through vent stacks Install chlorine detectors in main process stack Undertake stack and ambient air quality monitoring and report to the DEP in accordance with licence conditions
		Maintain ground level concentrations of licensed gases at levels equivalent to existing levels after commissioning of the expansion	Improve scrubbing efficiencies within the process stack Construct the main process stack with sufficient height to ensure adequate dispersion
		Reduce the overall level of emissions to the atmosphere	Hydrolyse any chlorine to hydrochloric acid Scrub the exit gases to remove hydrochloric acid Review total gaseous emissions and reduce these emissions as part of SCM's continuous improvement programme

Table 7.6 **Management framework–operations**

Issue	Management objective	Management strategy	Management actions
Atmospheric emissions	Minimise emissions of greenhouse gases	Reduce emissions of carbon dioxide and nitrogen oxides	Utilise hot waste gases from the thermal converter to produce steam Optimise process and thermal converter efficiency to reduce emissions Install low NOx emitting burners to gas fired systems
	Reduce fugitive emissions within the plant	Collect and treat fugitive emissions	Extend the existing suction vent system to remove fugitive emissions and direct them to the current 66 m stack and scrubbing them with caustic soda before release
	Minimise dust emissions during operation	Collect dust from finishing plant stacks	Install bag filters on finishing plant stack Monitor bag filter integrity
Saline water	Reduce overall water usage and saline water production	Continue recycling of process water and seek further opportunities to reduce water usage Identify opportunities for treatment of saline water to enable reuse and recycling	Investigate potential for reuse and recycling within expanded Kemerton pigment plant
	Minimise impact of saline water disposal on the marine environment	Maintain ocean water quality within the levels specified in the draft Western Australian Water Quality Guidelines for Fresh and Marine Waters (EPA Bulletin 711)	Develop a new outfall diffusion system to maintain or improve dispersion of the saline water into the marine environment Maintain current sampling program of saline water discharge Maintain current sampling programme of water and sediment quality Establish an environmental monitoring programme to investigate the effect of the saline water on marine life around the ocean outfall

Table 7.6 **Management framework–operations**

Issue	Management objective	Management strategy	Management actions
Saline water	Minimise impact of saline water disposal on the marine environment	Report findings of investigations to the DEP	Continue current programme of reporting to the DEP
	Minimise impact of saline water disposal on the terrestrial environment	Construct pipeline on land or offshore with minimal clearing and construction	Construct expanded or duplicate pipeline in same alignment Bury and mark pipe and rehabilitate any disturbed areas
Solid residue	Dispose of solid residue by utilising methods that minimise environmental impact	Continue disposal at the Dalyellup site which has an expected life of 10 years at current rates	Fully neutralise, treat and wash solid residue Use pond management techniques to minimise leaching Continue disposal of the solid residue as a slurry Continue research into suitable rehabilitation techniques for the Dalyellup site
		Ensure the integrity of the disposal site by continuing the current monitoring and audit programme	Continue radiation and groundwater monitoring in accordance with Environmental Management Plan, Radiation Management Plan and systems manual Undertake and submit an annual audit report for the Dalyellup disposal site and associated processes to the DEP
	Dispose of solid residue by utilising methods that minimise environmental impact	Identify alternative sites and options for disposal of solid residue	Investigate the capability of the Dalyellup site to accommodate future solid residue disposal needs Establish the suitability of alternative solid residue disposal sites in consultation with the Government task force Locate and seek approval for alternative disposal sites in consultation with the Government task force

Table 7.6 **Management framework–operations**

Issue	Management objective	Management strategy	Management actions
Solid residue	Reduce the amount of solid residue produced per tonne of product	Continue to pursue residue minimisation programme	
	Find alternative uses for the solid residue	Use solid residue as a resource in building and road construction, soil amendment and other potential uses	Identify suitable market opportunities for proven potential uses of solid residue Pursue the competitive opportunity for the product
		Explore options for beneficial use of the solid residue	Continue the research and development programme to establish viable alternative uses for solid residue Seek approvals from the relevant authorities to use the solid residue for identified beneficial uses
Groundwater	No groundwater contamination beneath process areas	Prevent groundwater contamination from process areas	Seal and bund process area Direct all process area drainage to wastewater treatment plant Direct stormwater to infiltration ponds Continue groundwater monitoring near the process plant Prepare and submit an annual report to the DEP and Water and Rivers Commission
Noise	Ensure that noise levels due to SCM's operations meet acceptable criteria at residential areas adjacent to the Kemerton Industrial Park	Reduce noise emissions	Consider noise emission factors during design phase Enclose noisy machinery, position equipment or fit suppression devices where required Model the noise emission contours to establish the current and future zones of influence Undertake regular ambient and source noise monitoring

Table 7.6 **Management framework–operations**

Issue	Management objective	Management strategy	Management actions
Radiation	Ensure that all radiological impacts are in accordance with the ALARA (as low as reasonably achievable) principle and comply with currently accepted standards and Codes of Practice	Ensure radioactive materials introduced into the pigment plant are contained within the pigment plant and its solid waste at a level that does not compromise public or personnel safety	Maintain an up-to-date Radiation Management Plan and ensure personnel are aware of its content and responsibilities Revise the Radiation Management Plan to include changes resulting from the expansion of the Kemerton pigment plant Advise all personnel of changes Provide training to all personnel with specific responsibilities to allow those changes to be implemented
		Comply with all the appropriate regulations	Undertake sampling of solid and liquid wastes to establish gross alpha and beta activity Report findings to the Department of Environmental Protection Dispose of waste material in accordance with the Code of Practice on the Management of Radioactive Waste from the Mining and Milling of Radioactive Ores (1982)
	Ensure that all radiological impacts are in accordance with the ALARA (as low as reasonably achievable) principle and comply with currently accepted standards and Codes of Practice	Ensure personnel will not be exposed to unacceptable radiation levels	Install warning signs and control employee exposure to the public limit Measure radiation levels on all process vessels Monitor radiation levels and personnel radiation exposure in accordance with the Radiation Management Plan Implement decontamination procedures

Table 7.6 **Management framework–operations**

Issue	Management objective	Management strategy	Management actions
Risks and hazards	Ensure off-site risk is as low as reasonably achievable and complies with EPA Bulletin 611 which establishes levels of individual and cumulative risk which is considered acceptable by the EPA	Operate plant in accordance with Total Hazard Control Plan	Prepare and maintain Total Hazard Control Plan Maintain high plant safety rating through plant design and maintenance planning Undertake regular internal and external audits to ensure Total Hazard Control Plan remains effective
		Reduce risks and hazards	Undertake Quantitative Risk Analysis (QRA) to confirm the results of the Preliminary Risk Analysis to the satisfaction of the Department of Minerals and Energy and to meet EPA criteria
Social impacts	Create positive links with the community	Provide assistance to schools with environmental management initiatives	Provide sponsorship of environmental education resources for local schools that focus on the local environment Provide resource materials to students to assist with student projects Provide work experience opportunities for students with an interest in environmental management
		Increase community interest and knowledge about their environment	Provide resources to increase community awareness of their local environment Give the community the opportunity to participate in environmental care programmes initiated by SCM Fulfil the Responsible Care commitments to involve and inform the community on all relevant company activities

Table 7.6 **Management framework–operations**

Issue	Management objective	Management strategy	Management actions
Social impacts		Ensure the community understands the place SCM has within the community, the benefits it offers and the environmental commitment it has undertaken	Seek opportunities to work with the community to address their broader concerns Provide information to the community on the value SCM contributes to the community Offer opportunities for the community to visit and review SCM's operation and provide feedback on it's perception of SCM's performance

Table 7.7 **Management framework–construction**

Issue	Management objective	Management strategy	Management actions
Clearing	Retain and re-establish native vegetation and conserve topsoil to maintain the biological diversity of the Kemerton site	Retain existing vegetation outside the construction area as a site buffer and visual screen	Define the extent of the construction area with clear markings Fence the construction site when definition and initial clearing is completed
		Use local native species in landscaping to maintain the natural bio-diversity of the plant site	Select plants for use in landscaping by survey of the areas surrounding the plant site and reference to documentation of the flora of the Kemerton Industrial Park Select place of plants in landscaping having consideration for the form the plants adopt in the surrounding vegetation
Noise and Dust	Minimise noise and dust generation to within acceptable community and regulatory standards	Comply with the requirements of occupational health, safety and welfare legislation	Undertake routine noise monitoring identify noisy workplace environments
		Ensure noise emissions do not exceed licence limits	Fit noise suppression devices to construction machinery
		Suppress dust generation during site preparation	Minimise surface area exposed Use water sprays/trucks as required
		Ensure dust generation within the construction site does not exceed occupational health and environmental limits	Keep all trafficked areas of soil surface moist Keep all operating stockpiles surface moist

Table 7.7 **Management framework–construction**

Issue	Management objective	Management strategy	Management actions
Safety	Minimise incidents relating to safety in the workplace	Clearly define construction zones within the plant site	Provide barrier fencing between construction and operations zones Clearly describe delineation of zones in site and training literature
		Provide a site induction safety training seminar for all employees and contractors prior to commencement of work on the site	Develop a training course for existing and new employees and contractors that describes changes to conditions on the site, their definition and demarcation Ensure each new employee or contractor receives induction training prior to commencement of work Establish methods for identification of work site hazards within induction training Identify those hazards and their management in induction training
		Clearly define areas of hazard using standard definition devices	Establish a marking/barrier system to delineate hazards and their severity and apply the system on the site Use work permits/tags to identify potential hazards
Transport	Minimise the effect of construction traffic on local road use	Ensure disruption to local traffic associated with movement of plant components to the site is minimal	Arrange all movements of large prefabricated components to occur during periods of low traffic
		Reduce the effect of construction traffic on local and regional traffic movements	Arrange conditions of engagement to reduce effect of transport on local and regional road networks

8 ENVIRONMENTAL MONITORING

This section describes the proposed environmental monitoring and reporting programmes associated with the proposed plant expansion. The programmes would be similar to the established procedures outlined in SCM's Environmental Monitoring and Reporting Procedures Manual, M054-1.

SCM's expanded operations would still require the premises to be defined as prescribed premises under Section 5 of the *Environmental Protection Act, 1986*. The company would continue to operate under a number of licences issued by the DEP, Water Corporation, WRC, Health Department, RCWA and DOME. Environmental monitoring, reporting and auditing criteria would be in accordance with licences and the company's environmental system manuals.

8.1 ATMOSPHERIC EMISSIONS

The expanded plant would incorporate into its design advanced logic control systems linked to the upgraded central computer to ensure process control and provide advanced warning of any abnormal operation conditions that could result in equipment failure. Regular inspections, preventative maintenance and replacement of vulnerable equipment would continue to be undertaken.

Atmospheric emissions from the raw pigment plant would result from the controlled releases of specified substances through the main process stack, the suction vent stack, the boiler stack, heater stacks and the ore/coke recovery stack. Atmospheric emissions from the finishing plant would be generated from the drier vent stacks and bag filter vents and from fugitive dust emissions.

The main process stack would be monitored weekly, using the established procedure, to measure the licence parameters. The chlorine emissions from the main process stack would be monitored continuously by chlorine detectors with a manual backup. Carbonyl sulfide would be monitored three times per week, while hydrogen sulphide would be monitored continuously. Sulphur dioxide would be monitored continuously. During the initial stages of the expanded plant operation, carbonyl sulphide, carbon monoxide and carbon dioxide would also be measured.

Dark smoke emissions are only predicted to occur at chlorinator 'start up'. These, and any other dark smoke emissions, would be monitored by visual inspection.

The finishing plant drier vent stack and bag filter vents would be monitored to ensure particulate emissions comply with the statutory emission levels of 250 mg/m^3 by the following procedures:

- regular, documented, physical inspections of the filter socks and the plenum chamber;
- regular, documented, sampling of particulate emissions in the spray drier stacks;
- immediate replacement of filter socks on detection of pigment leakage;
- scheduled maintenance recording and replacement of filter socks
- visual inspection of stack appearance;
- visual inspection of condensing water colour to identify Hot Bag Filter replacement.

Any emissions resulting from emergency venting would be recorded.

8.2 GROUNDWATER

A series of groundwater monitoring bores has been established around the Kemerton site. This network would be extended to include the new finishing plant site.

The established groundwater monitoring programmes would be continued. The parameters listed below would be measured quarterly and annual reports would be prepared for the DEP and the WRC.

The monitored groundwater parameters are:

- Static water level
- pH
- Electrical conductivity
- Total Dissolved Solids
- Total Suspended Solids
- Sodium
- Potassium
- Calcium
- Magnesium
- Chloride
- Bicarbonate
- Sulphate
- Nitrate
- Fluoride
- Silica
- Total iron
- Oil and grease
- Gross alpha and beta activity
- Trace heavy metals

This monitoring would continue to be undertaken by person(s) approved by the DEP. Reports and data analysis would be done by a qualified hydrologist.

SCM would continue monitoring and reporting of the production water bores in accordance with the conditions of the WRC Well Licence. Monthly usage, quarterly bore water levels and monthly salinity monitoring would continue. Biannually water samples would be chemically analysed as required in the licence.

The following parameters would continue to be measured and reported to the regulatory authorities:

- Static water level
- pH
- Electrical conductivity
- Total Dissolved Solids
- Total Suspended Solids
- Sodium
- Potassium
- Calcium
- Magnesium
- Chloride
- Bicarbonate
- Sulphate
- Nitrate
- Fluoride
- Silica
- Total iron
- Oil and grease
- Gross alpha and beta activity
- Trace heavy metals

8.3 TREATED SALINE WATER

The saline water would continue to be monitored at the discharge point from the neutralisation plant in accordance with the established programmes. The monitoring results are reported quarterly to the DEP.

The following parameters are continuously monitored with summaries provided of the daily average, maximum and minimum recorded value:

- flow rate in cubic metres per hour
- temperature in degrees Celsius
- pH

Daily composite samples are analysed for:

- pH
- total suspended solids
- total dissolved solids
- chromium
- iron
- manganese
- vanadium

Six monthly samples are taken and analysed for:

- cadmium
- chromium
- copper
- lead
- magnesium
- manganese
- mercury
- nickel
- selenium
- vanadium
- zinc
- radium 226
- radium 228
- thorium 228

The receiving marine environment is monitored twice a year by an approved marine environmental consultant. Annual reports are presented to the DEP summarising the results. Water samples, pre and post pipe scouring events, are taken from the ocean near the diffuser and analysed for the following parameters:

- water temperature
- salinity
- dissolved oxygen as percentage of saturation
- pH
- total suspended solids.

Sediment samples are also taken and analysed for the following parameters;

- loss of ignition as a percentage;
- cadmium
- chromium
- copper
- lead
- manganese
- mercury
- selenium
- vanadium
- zinc
- radium 226.

Due to the high energy nature and lack of suitable habitat of the receiving ocean at the ocean outfall, no naturally occurring sensitive fauna exist around the outfall or the mixing zone.

8.4 RADIATION

In accordance with the ALARA Principle, all Kemerton and Australind plant personnel are non-designated employees. Therefore, the annual effective dose equivalent limit for employees is the general public limit of 1 mSv/yr. To limit radiation exposures, those areas of the plant where radiation levels may be above 7.5 μGy/hr are classified as controlled areas. These controlled areas, mainly process tanks, are clearly signposted and access times limited.

Radiation surveys of the neutralisation plant area are conducted annually. Environmental radiation surveys are also conducted at the solid waste disposal site. Analyses of the treated saline water and groundwater at both Kemerton and Australind for radionuclides are carried out in accordance with DEP licence conditions. Solid residues are monitored for uranium and thorium levels as detailed in the RMP and operational radiation monitoring plan (Terry 1989).

The results of the surveys and analyses are reported annually to the statutory authorities In addition to the routine surveys and audits, all company Occupational Health and Safety procedures, including radiation procedures, are subject to an annual audit by the SCM Group Occupational Health and Safety Department (USA).

Monitoring programmes have been established for both the discharge saline water and the receiving environment.

8.5 NOISE

Monitoring of noise emissions and ambient noise levels would be undertaken as required.

9 SUMMARY OF ENVIRONMENTAL COMMITMENTS

This section summarises the environmental commitments made in this CER. It also shows the obligations detailed in the ERMP and ministerial conditions for the existing plant at Kemerton.

9.1 LIST OF COMMITMENTS

9.1.1 MANAGEMENT PLANS

SCM will ensure that the company's operations and management programme for the expanded Kemerton Plant are compatible with the management objectives developed for the Kemerton Community Park concept.

SCM will amend procedures manuals (Standard Operating, Process Control, Maintenance and Safety Procedures) to reflect any changes to the operations.

SCM will amend and implement changes to management plans and system manuals to reflect any changes to the operation.

SCM will continue to implement the company's Environmental Systems Manuals and audit their effectiveness.

SCM will amend and facilitate training programmes for safety, environmental awareness and operational procedures to reflect changes to the operations.

SCM will continue to carry out regular preventative maintenance.

SCM will continue the current monitoring programmes and expand monitoring where appropriate.

9.1.2 ATMOSPHERIC EMISSIONS

SCM will install an integrated thermal converter system to reduce the volume of carbonyl sulphide, hydrogen sulphide and carbon monoxide emissions and recycle waste heat.

SCM will install a scrubber system capable of removing about 95 percent of sulphur dioxide emissions.

Design of the new stack will ensure that ground level concentrations of licence emissions from the expanded operation will not exceed current levels, even with bypassing of the thermal converter.

The appropriate computer modelling techniques will be used at the works approval stage to confirm that ground level concentrations of licenced emissions meet DEP requirements.

9.1.3 SALINE WATER

SCM will continue to explore opportunities to further recycle and reuse process water within the expanded Kemerton Plant.

SCM will continue to control surface runoff from the plant site.

SCM will continue to operate, and monitor, the neutralisation plant and discharge wastewater to the ocean.

SCM will develop the ocean outfall diffusion system to maintain or improve dispersion of the wastewater into the marine environment.

SCM will continue to monitor the receiving environment to the satisfaction of the DEP.

9.1.4 SOLID RESIDUE

SCM will continue to investigate and operate residue minimisation programmes.

SCM will continue to undertake investigations into the beneficial use and options for alternative disposal of the solid residue.

SCM will continue to liaise with the Government Task Force to establish alternative solid residue disposal options or sites.

SCM will continue to monitor and undertake environmental audits of the solid residue storage area at Dalyellup in accordance with their Environmental Management Plan.

9.1.5 SAFETY

SCM will amend and continue to conduct regular safety audits.

SCM will ensure safe plant layout and operate the plant in a safe manner.

9.1.6 RADIATION

SCM will continue to implement the company's Radiation Management Plan and audit its effectiveness.

9.1.7 RISKS AND HAZARDS

SCM will undertake technical and hazard reviews at all significant process changes and continue to implement the centralised control policy regarding changes to plant detail.

SCM will amend and implement the company's Total Hazard Control Plan to reflect any changes to the operation and audit its effectiveness.

9.1.8 NOISE

The proposed plant expansion will be designed so no significant contributions to current noise levels, resulting in a breach of existing conditions, will occur.

9.1.9 SOCIAL IMPACTS

Western Australian contractors will be used where practical.

9.1.10 CONSTRUCTION IMPACTS

SCM will adhere to codes for construction materials and construction practices.

9.1.11 REHABILITATION

SCM will carry out rehabilitation and landscaping following commissioning of the expanded plant to create an aesthetically pleasing operation that is complimentary to and maintains the integrity of the surrounding environs and meets the requirement of the KIP.

9.1.12 REPORTING PROCEDURES

SCM will prepare and issue reports on monitoring results to the appropriate government agencies in accordance with conditions specified in any licence.

SCM will provide written advice of any analytical results or measurement taken in accordance with any condition of licence that is shown to be in contravention of a condition of the licence to the appropriate government agency.

9.2 SUMMARY OF PREVIOUS COMMITMENTS MADE BY SCM CHEMICALS LTD

The following commitments were detailed in the ERMP submitted to the Environmental Protection Authority prior to construction of the existing titanium dioxide plant at Kemerton (Kinhill Stearns 1986). Table 9.1 summarises the current status of the commitments and the full list is included in Appendix H.

Table 9.1 **Summary of previous management commitments made by the SCM Chemicals in reference to the existing titanium dioxide plant**

Subject	Existing Status
1. Construction	
Noise, dust and traffic to be minimised during construction	Cleared
Construction in accordance with Australian or International codes	Cleared, replaced in CER
2. Operation	
2.1 Wastewater	
Monitoring vegetation on banks of Collie R.	Old, no discharge to Collie R.
Control of surface runoff	Current
Monitoring discharge to Collie R.	Old
Wastewaters can be discharged to Wellesley and Collie Rivers	Old
No infiltration of wastewater on site, disposal of wastewater from thickener underflow	Current
Reduction of manganese levels in wastewater	Old, treatment process changed
pH of wastewater	Old, treatment process changed
Lime treatment of wastewater	Old, treatment process changed
Monitoring sediments of Collie R. for radionuclides	Old, now applies to ocean
Impact of temperature on aquatic organisms	Old
Commitment to alter wastewater disposal if problems detected	Current
Monitoring vegetation on banks of Wellesley R.	Old, no discharge to Wellesley R.
Regular monitoring of wastewater discharge from Kemerton site	Current
2.2 Aesthetics/Noise/Odour	
Control of dust	Current
Noise within statutory requirements	Current
Design and landscaping of plant site	Cleared, landscaping is ongoing
Negligible odour impact on residential areas	Current
No odours to originate from plant during normal operation	Current
2.3 General	
Regular preventative maintenance of plant	Current
Disposal of waste products in environmentally safe manner in accordance with statutory requirements	Current
Risk analysis to be completed	Cleared, new risk analysis in place
Hazards and operability study to be commissioned and personnel trained in safe operating practices and emergency procedures	Cleared, with ongoing training
Wastes monitored for radio-nuclides	Current
Central Control Policy	Current, since upgraded
Groundwater extraction not to impact on wetlands	Current
Need to advise EPA about chlor-alkali production	Cleared
3. Safety Features	
Design of titanium tetrachloride vaporiser	Cleared

Subject	Existing Status
Pressure sensing instrumentation in chlorination section	Cleared
Process control, temperature and pressure monitoring, water-cooling of chlorinator and solids build-up in overhead mains	Cleared
Maintenance of heat exchangers	Old
Replacement of sensors in oxidation section	Current
Logic system to control reactor trip system	Cleared
Isolation of chlorine pumps	Cleared
On-line scrubbing for 'hygiene snake' system	Cleared
3.2 Chlor-alkali Plant	Nufarm now responsible
3.3 Storage on SCM Site	
14 Commitments relating to storage of chlorine and other chemicals, some related to design of storage vessels	Cleared.
3.4 Layout	
Location of air separation plant, hydrogen, liquid chlorine and hydrogen tetrachloride pipelines	Cleared
Cranes not to lift over storage vessels	Cleared
Design of plant to minimise chlorine inventory	Cleared
3.5 Maintenance	
Preventative maintenance scheme	Current
Clearing and testing of the chlorine sensor in the tail gas line	Current
Maintenance and testing of all sensors	Current
3.6 General	
Use of a non-explosive grade of coke	Cleared
Corrosion monitoring techniques	Cleared
Design of fuel management system	Cleared
Shut-down of plant from control room	Cleared
Chlorine detectors	Cleared
4. Emergency Plan	
Emergency plan and procedures	Old
Formulation of public emergency and contingency plans	Cleared
5. Monitoring and Auditing	
Regular safety audits	Current
Hazard and risk management programmes	Cleared
Interchange of personnel with Baltimore during development of programmes, followed by auditing from Baltimore	Cleared
External audit via 'Permission for Change' system	Cleared
6. Training	
Overseas training	Cleared
Senior Operator and Shift Supervisor training courses	Cleared
Development of procedure manuals	Cleared
7. Decommissioning	
Planned operational life and need for another environmental impact statement should plant be used for another purpose	Current

Source: Environmental Protection Authority Bulletin 283, July 1987

9.3 SUMMARY OF PREVIOUS MINISTERIAL CONDITIONS

The following recommendations and conclusions have been extracted from the report and recommendations of the Environmental Protection Authority, made in response to a proposal by SCM Chemicals Ltd to construct a titanium dioxide plant at Kemerton (EPA 1987b). Table 9.2 summarises the current status of the recommendations and conclusions and the full list is included in Appendix I.

Table 9.2 **Summary of previous recommendations and conclusions made by the EPA in reference to the existing titanium dioxide plant**

No.	Subject	Existing Status
1	Acceptability of original proposal	Ongoing
2	Acceptability of Kemerton site	Cleared
3	Need for risk assessment strategy	Cleared, replaced in CER
4	Restrictions on chlorine storage at Kemerton	
5	Restrictions on sale and transport of chlorine from Kemerton	Nufarm now responsible
6	Safeguards for chlor-alkali production	Nufarm now responsible
7	Overall responsibility for chlor-alkali production	Nufarm now responsible
8	Need to integrate emergency plans with local agencies	Cleared
9	Prevention of groundwater contamination	Current
10	Discharge of wastewater into Wellesley R.	Old, no longer applies
	Need for assessment of alternatives for wastewater discharge	Cleared
11	Scrubbing system on chlor-alkali plant	Nufarm now responsible
12	Need for assessment of solid waste management and disposal	Cleared
13	Need for approval of solid waste disposal sites by Government agencies	Cleared
14	Need to develop radiation management programme	Cleared
15	Need for a detailed water supply proposal	Cleared
16	Need for contingency plan for transport of reagents	Cleared
17	Need for approval for titanium tetrachloride transport by Government agencies	Cleared
18	Wastewater discharge into Collie R.	Old, no longer applies
19	Wastewater monitoring for Collie R.	Old, now applies to ocean
	Need for monitoring programme for Leschenault Inlet	Cleared
20	Need for contingency plan for spills of effluent or chemicals into Collie R., Leschenault Inlet or ocean	Old or cleared
21	Maintenance of pipeline across Leschenault Inlet	Old, no longer applies
22	Closure of sulphuric acid and sulphate-process plants at Australind	Old, no longer applies
23	Liquid effluent disposal at Australind	Old, no longer applies
24	Australind plant site inappropriate for heavy industry	Old, no longer applies
25	Need to liaise with CALM re management of Kemerton site	Old, no longer applies
26	Need to meet costs of monitoring environmental performance of Australind and Kemerton plants	Cleared

Source: *Environmental Protection Authority Bulletin 283, July 1987*

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Appendix A

ABBREVIATIONS

Appendix A
ABBREVIATIONS

ACIC	Australian Chemical Industry Council
AHD	Australian Height Datum
ALARA	As Low As Reasonably Achievable
AS	Australian Standard
AS/NZS ISO	Australian Standard and New Zealand Standard International Standard Organisation
BOC	BOC Gases of Australia Ltd
C	Carbon
CALM	Department of Conservation and Land Management
CER	Consultative Environmental Review
CFC	Chlorofluorocarbon
Cl	Chlorine
CO	Carbon monoxide
CO_2	Carbon dioxide
Cwlth	Commonwealth
DCE	Department of Conservation and Environment
DEP	Department of Environmental Protection
DOME	Department of Minerals and Energy
DRD	Department of Resources Development
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
ERMP	Environmental Review and Management Plan
Hanson PLC	Hanson Proprietary Limited Company
HCl	Hydrogen chloride
HDWA	Health Department of Western Australia
ISRS	International Safety Rating System
KIP	Kemerton Industrial Park
LIMA	Leschenault Inlet Management Authority
NOI	Notice of Intent
NOx	Nitrogen oxides
PACIA	Plastics and Chemical Industry Association
QRA	Quantitative Risk Assessment
RCWA	Radiological Council of Western Australia
RGC	RGC Mineral Sands Limited
RMP	Radiation Management Plan
RMS	Radiation Management Strategy
SCM	SCM Chemicals Ltd - Asia/Pacific
SCM Chemicals Inc	SCM Chemicals Inc - USA
THCP	Total Hazard Control Plan
$TiCl_4$	Titanium tetrachloride
TiO_2	Titanium dioxide
WRC	Water and Rivers Commission

Appendix B

WEIGHTS AND MEASURES

Appendix B

WEIGHTS AND MEASURES

%	percent
°C	degrees Celsius
µGy/hr	microgray per hour
Bq/m^2	becqueral per square metre
dB(A)	decibel
g/m^3	gram per cubic metre
ha	hectare
kBq/m^3	kilobecquerel per cubic metre
kg	kilogram
km	kilometre
kPa	kilopascal
m	metre
m/s	metres per second
m^3	cubic metre
m^3/h	cubic metres per hour
mg/m^3	milligram per cubic metre
mm	millimetres
Mm^3/a	mega cubic metre per annum
mSv/yr	millisievert per year
Nm^3	normal cubic metres
ppm	parts per million
t	tonne
t/a	tonnes per annum
t/d	tonnes per day

Appendix C

GLOSSARY

Appendix C
GLOSSARY

aeolian	air-deposited
alkaline	basic, the opposite of acidic
alpha particle	a positively charged, sub atomic particle
aquifer	a layer of rock or soil capable of holding or transmitting water
artesian basin	a geological structural feature or combination of such features in which water is confined under pressure
carbonyl sulphide	a compound containing a carbon, oxygen and sulphur
cathode	a negative electrode
caustic soda	sodium hydroxide; a white, deliquescent solid that dissolves in water to give an alkaline solution
chlor-alkali plant	a plant which produces sodium hydroxide and chlorine through the electrolysis of a salt solution
chlorate	a salt of chloric acid
chlorine	a greenish-yellow, poisonous gas of pungent odour, with a strong bleaching, oxidising and disinfecting action
chromium	a hard, white metal used in heat-resistant alloys and corrosion-resistant plating
coke	a fuel derived from distilling coal
combustion	the burning of an organic substance yielding energy
Cretaceous	the third and latest period included in the Mesozoic era
diffuser	a mechanism that enhances the natural spread of a liquid stream into the environment
effluent	wastewater stream
electrolysis	the chemical decomposition of substances (electrolytes) by an electrical current passed through the substance in a dissolved state
feedstock	the raw material(s) supplied to a plant
fissile	capable of being split or divided
ilmenite	natural ferrous titanate, an ore of titanium
in situ	an action that is occurs 'on site' rather than within a laboratory
ion	an electrically charged atom, radical or molecule resulting from the loss or gain of electrons
Jurassic	the period within the Mesozoic era preceding the Cretaceous period and following the Triassic period
leachate	impurities carried by water and percolating through the earth
lime	calcium oxide, an alkaline solid

mica	any member of a group of minerals, hydrous disilicates of aluminium, that separate readily into thin layers
micronising	to break up into very small particles
rutile	a naturally occurring form of titanium dioxide
natural gas	a gaseous mixture of hydrocarbons, primarily methane, extracted from the earth
neutralisation	the addition of an acid to an alkali, or vice versa, so as to render each ineffective
nuclide	the nucleus of an atom
oxide	a compound of oxygen with one other element
pH	measure of acidity
pneumatic	operated by air
radiation	the emission and propagation of subatomic particles
radionuclide	a nuclide that is radioactive
radium	a naturally occurring radioactive metallic element. Radium 226 and radium 228 are isotopes of radium.
radon	a rare chemically inert, radioactive gaseous element produced by the disintegration of radium
refractory lined	lined with a heat resistant material
rutile	titanium dioxide pigment in rutile crystal form
shale	a layered rock consisting of fine silt or clay particles
silicate	compound of silicon and oxygen
sluice	to flush or cleanse with a rush of water
slurry	a fluid mixture of fine solids and water
sodium carbonate	a white, crystalline, soluble, alkaline salt
synthetic rutile	ilmenite that has been chemically upgraded to a higher titanium dioxide content
thorium	a silvery white, naturally occurring radioactive metallic element. Thorium 228 and thorium are isotopes of thorium
thoron	a rare chemically inert, radioactive gaseous element produced by the disintegration of thorium
titanium	a white, metallic element found in nature only in combined form
titanium dioxide	a white, insoluble powder used as a white pigment in the production of paints, paper and many other products
titanium tetrachloride	a colourless liquid consisting of titanium and chlorine that is used in the manufacture of titanium metal and many other pigments
vanadium	a very hard, white metallic element used mainly in producing vanadium steel
volatile	passing off readily from water solution in the form of vapour

Appendix D

RESULTS OF NOISE MODELLING

Project:

Noise Predicitons for the Kemerton Plant Expansion

Prepared for:

SCM Chemicals Pty Ltd
Bunbury
Western Australia

Report details:

Report 9637 Rev 2
Engineering Dynamics Consultants Pty Ltd
21st March, 1997

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Executive Summary

SCM Chemicals Pty Ltd is planning an extension of its Kemerton Plant. This includes a new Finishing Plant and expansion of the current process plant. Engineering Dynamics Consultants Pty. Ltd. was commissioned to determine the noise contours from this plant enlargement.

The results show the following

1. The <u>sound power</u> levels will increase by approximately 7 dBA with the expansion of the Kemerton Plant.
2. For most of the conditions modelled, the noise level outside the Industrial Park from the plant expansion will only exceed 38dBA in small areas.
3. If the sound power levels of the microniser, surface treatment and spray drying areas are reduced by 6 dBA using further noise control measures then, with the exception of a very small area east of the Brunswick River during an extreme temperature inversion condition, the predicted noise level outside the Industrial Park will be below 38 dBA for all modelled meteorological conditions.

1. Introduction

SCM Chemicals Pty Ltd is planning an extension of its Kemerton Plant. This includes a new Finishing Plant and expansion of the current plant. Engineering Dynamics were commissioned to determine the change in noise levels from this plant enlargement.

To determine the change in noise levels, the total Sound Power Levels (PWL) of the current plant were determined. Also, the PWL of individual items and sections which are to be added, had to be determined by

a. Site measurement for items currently at Kemerton and

b. Calculation from previous measurements for items currently at Australind.

2. Methodology

Previous noise measurements at the Australind Plant were used to determine the PWL of the new Finishing Plant.

No such study had been conducted at the Kemerton Plant. The sound power levels of items of equipment and buildings containing equipment were ascertained by using sound level meter with a directional microphone. This method is ideally suited for this plant as each section of the plant is reasonably well separated from other sections. This method involves taking numerous sound pressure readings over fixed areas. The calculated total sound power level was then correlated with readings at a distance from the plant.

The sound power levels presented in this report are A-weighted.

3. Results

3.1 Finishing Plant

The proposed new Finishing Plant includes the following significant noise sources;

- Surface Treatment (external heated tanks and pumps)
- Filtration Building (vacuum Pumps external)
- Spray Drying (external)
- Microniser Building
- Packing
- Water Treatment

The sound power levels for these items as measured at Australind are tabulated in Table 1.

3.2 Extension of Current Process Plant

The extension of the current process plant includes the following significant noise sources;

1. Duplication of;

    - Sand milling
    - Condensation
    - Purification

2. Expansion of:

    - Chlorination
    - Cooling towers
    - Oxidation
    - Boilers
    - Filtration
    - Refrigeration
    - Gas scrubber

The sound power levels for these items are tabulated in Table 1 along with the sound power levels measured at the current Process Plant. The proposed Waste Gas Incinerator has not been included as no data on its sound power levels has been received.

3.3 Expanded Kemerton Plant

The total predicted sound power level from the expanded plant including the finishing plant is presented in Table 1. These results show that there will be approximately a 7 dBA increase in sound power levels with expansion of the Kemerton Plant.

To produce the noise contours for this plant, the noise sources were input into the noise computer modelling program ENM. The ground contours were digitised using maps provided by Kinhill Engineers. ENM predicts the noise contours based on the meteorology, ground type and barriers resulting from the ground contours.

Meteorological conditions have a significant impact on the transmission of noise. Figure 11 shows a wind rose for Kemerton and indicates the dominant wind directions are from 120° (East / South East) and 255° (West / South West). These wind directions were modelled along with wind from 45° (North East) because it would have the most impact on local residences.

Temperature inversion conditions cause a downward refraction of sound waves, hence, higher noise levels at ground level. The Dames and Moore study (provided by Kinhill Engineers) of the Kemerton Industrial Park reported a 2 degree per 100 metre temperature gradient during worst case propagation conditions. This gradient was modelled with a wind velocity of 2.5 m/s in the above wind directions.

It should be noted that higher wind velocities result in higher noise levels further downwind, however, this also results in higher background noise, particularly in areas with significant flora.

Higher temperature gradients have been experienced, generally but not always, in combination with low wind velocities. Figure 12 shows temperature gradients of up to 7 degrees per 100 metres under almost stagnant wind conditions. This situation has also been modelled. It should be noted that higher temperature gradients also result in higher background noise due to better transmission of general noise such as traffic, machines, animals etc.

An air temperature of 10^0C and 50% humidity was used in the modelling and the resultant noise contours are presented in Figures 1 to 5.

These maps show the following;

1. For a 2.5 m/s wind velocity from the <u>North East</u> direction and typical temperature inversion conditions, the predicted noise level outside the Industrial Park, from the expanded plant, is only above 38 dBA in a small area near the Australind by-pass.
2. For a 2.5 m/s wind velocity from the <u>East / South East</u> direction and typical temperature inversion conditions, the predicted noise level outside the Industrial Park, from the expanded plant, is predominantly below 38 dBA with only a small area north of the Australind by-pass exceeding 38 dBA.

3. For a 2.5 m/s wind velocity from the West / South West direction and typical temperature inversion conditions, the predicted noise level outside the Industrial Park, from the expanded plant is above 38 dBA in an area east of the Brunswick River.
4. The predicted noise level outside the Industrial Park, from the expanded plant, is below 38 dBA under zero wind and typical temperature inversion conditions. A small area east of the Brunswick River is above 38dBA.
5. For extreme temperature inversion and zero wind conditions, the predicted noise level outside the Industrial Park, from the expanded plant, exceeds 38 dBA both east and west sides of the Industrial Park.

To reduce these boundary noise levels various additional noise control measures were imposed in the model. Reduction of the microniser, surface treatment and spray drying areas by 6 dBA reduced the noise levels to an acceptable level. The overall sound power level was reduced by 2.5 dBA.

The above contours were recalculated using this lower sound power level and the resultant noise contours are presented in Figures 6 to 10. The results show, with exception of a very small area east of the Brunswick River during an extreme temperature inversion condition, the predicted noise level outside the Industrial Park is below 38 dBA for all modelled conditions.

Octave Band Hz	31.5	63	125	250	500	1000	2000	4000	8000	**Overall**
New Finishing Plant										**dBA**
Surface Treatment	54	78	98	107	108	108	100	101	96	**113**
Filtration Building	65	78	93	100	103	105	103	98	91	**109**
Spray Drying External	69	92	104	106	105	110	104	96	84	**114**
Microniser Building	78	91	101	107	111	111	107	106	94	**116**
Packaging	51	72	87	95	95	95	91	85	72	**100**
Water Treatment	49	71	85	96	105	106	104	96	87	**110**
PWL New Finishing Plant	**79**	**95**	**107**	**112**	**114**	**116**	**111**	**108**	**99**	**120**
Process Plant Extension										
Sandmill	72	79	89	98	105	102	96	88	77	**108**
Oxidation	71	78	84	95	99	98	96	95	85	**104**
Cooling tower	78	96	99	104	103	103	101	95	85	**110**
Gas Scrubber	51	70	88	91	94	98	91	93	75	**101**
Purification	62	79	88	98	102	109	104	95	85	**111**
Filter	61	79	88	96	97	98	97	92	83	**104**
Boiler Plant	67	82	95	99	105	105	104	101	93	**110**
Refrigeration	48	62	75	89	95	95	92	89	80	**100**
PWL Extension of Process Plant	**80**	**97**	**101**	**107**	**111**	**112**	**109**	**104**	**95**	**117**
PWL Current Kemerton Plant	**80**	**96**	**101**	**107**	**110**	**112**	**108**	**103**	**92**	**116**
PWL Expanded Kemerton Plant	**84**	**101**	**109**	**114**	**117**	**118**	**114**	**110**	**101**	**123**

Table 1: A-weighted Sound Power Levels (PWL) in dBA

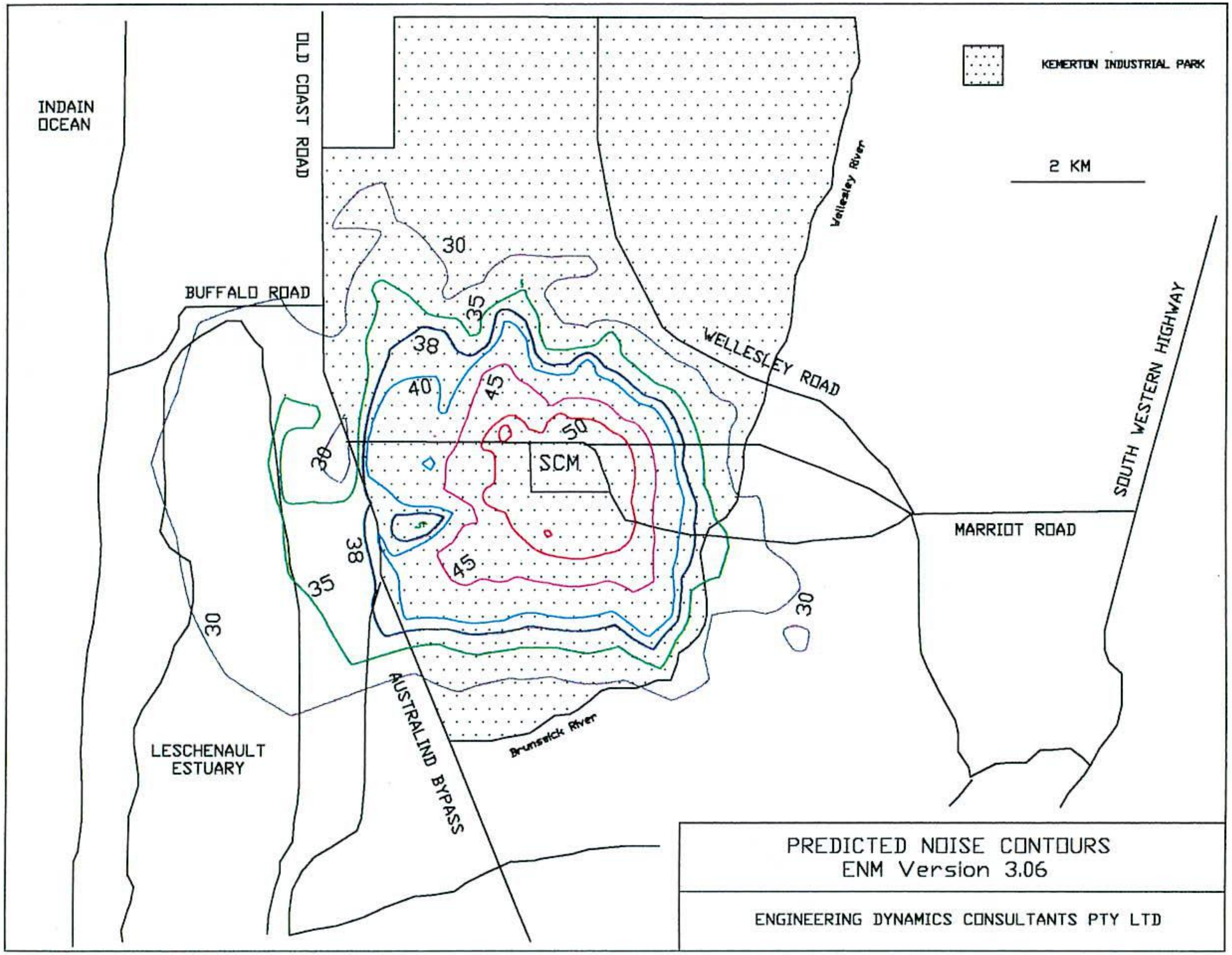


FIGURE 1

Predicted noise contours for SCM Kemerton Plant Expansion

Wind direction: 45° NE

Wind velocity: 2.5 m/s

Temperature gradient: 2°/100m

Temperature: 10°C

Humidity: 50%

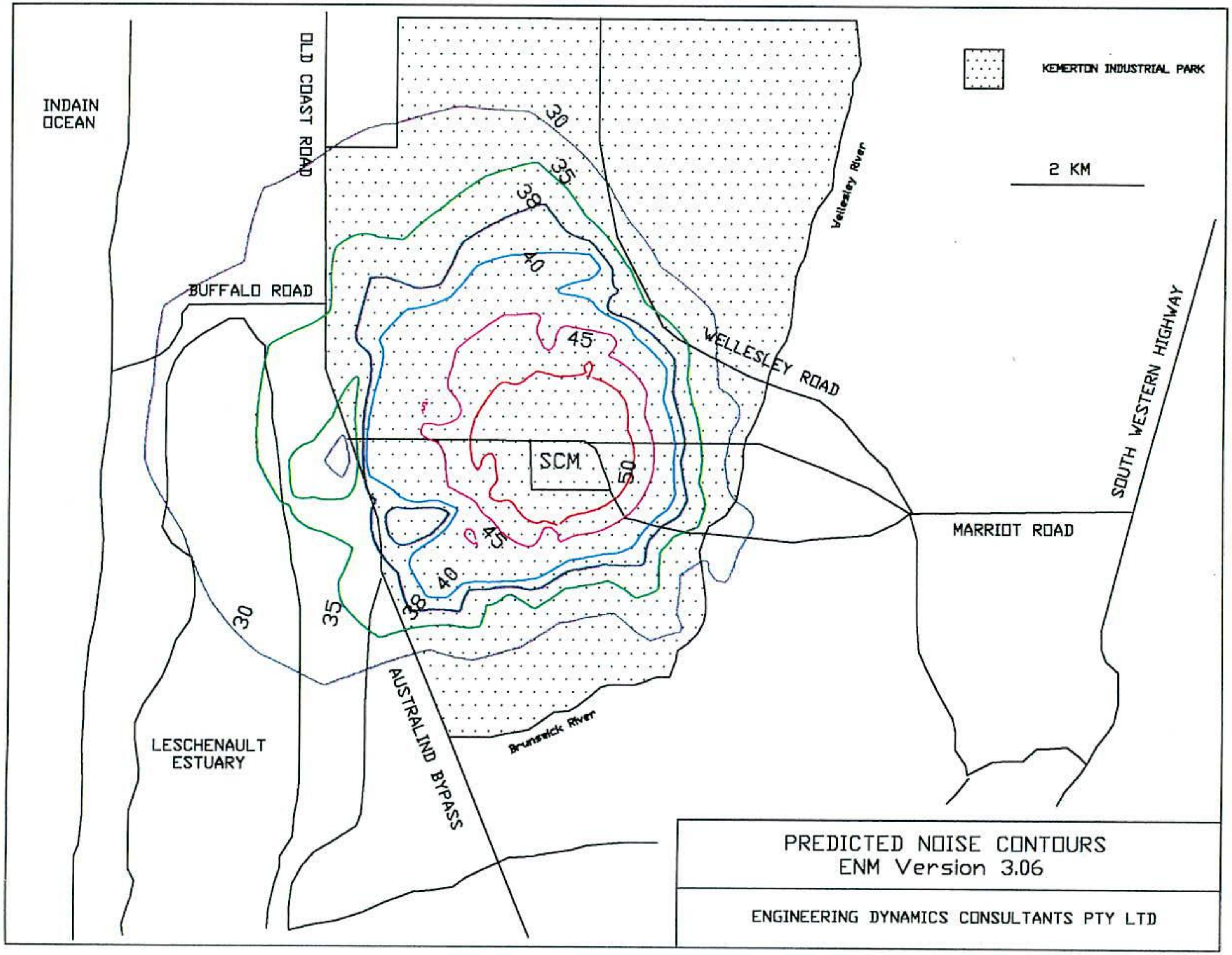


FIGURE 2

Predicted noise contours for SCM Kemerton Plant Expansion

Wind direction: 120^0 E/SE

Wind velocity: 2.5 m/s

Temperature gradient: 2^0/100m

Temperature: 10^{0}C

Humidity: 50%

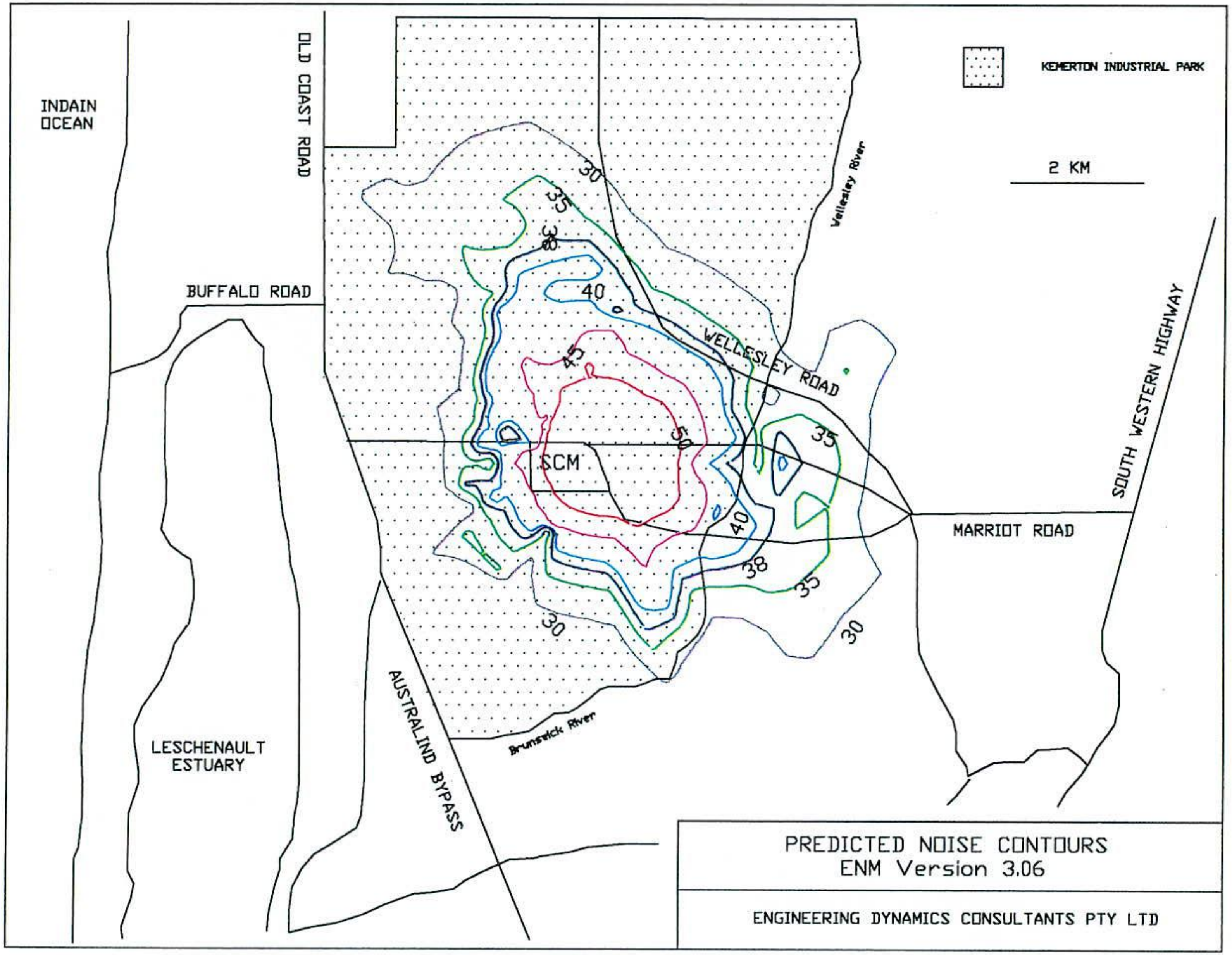


FIGURE 3

Predicted noise contours for SCM Kemerton Plant Expansion

Wind direction:
255^{0} W/SW

Wind velocity:
2.5 m/s

Temperature gradient:
$2^{0}/100m$

Temperature:
$10^{0}C$

Humidity:
50%

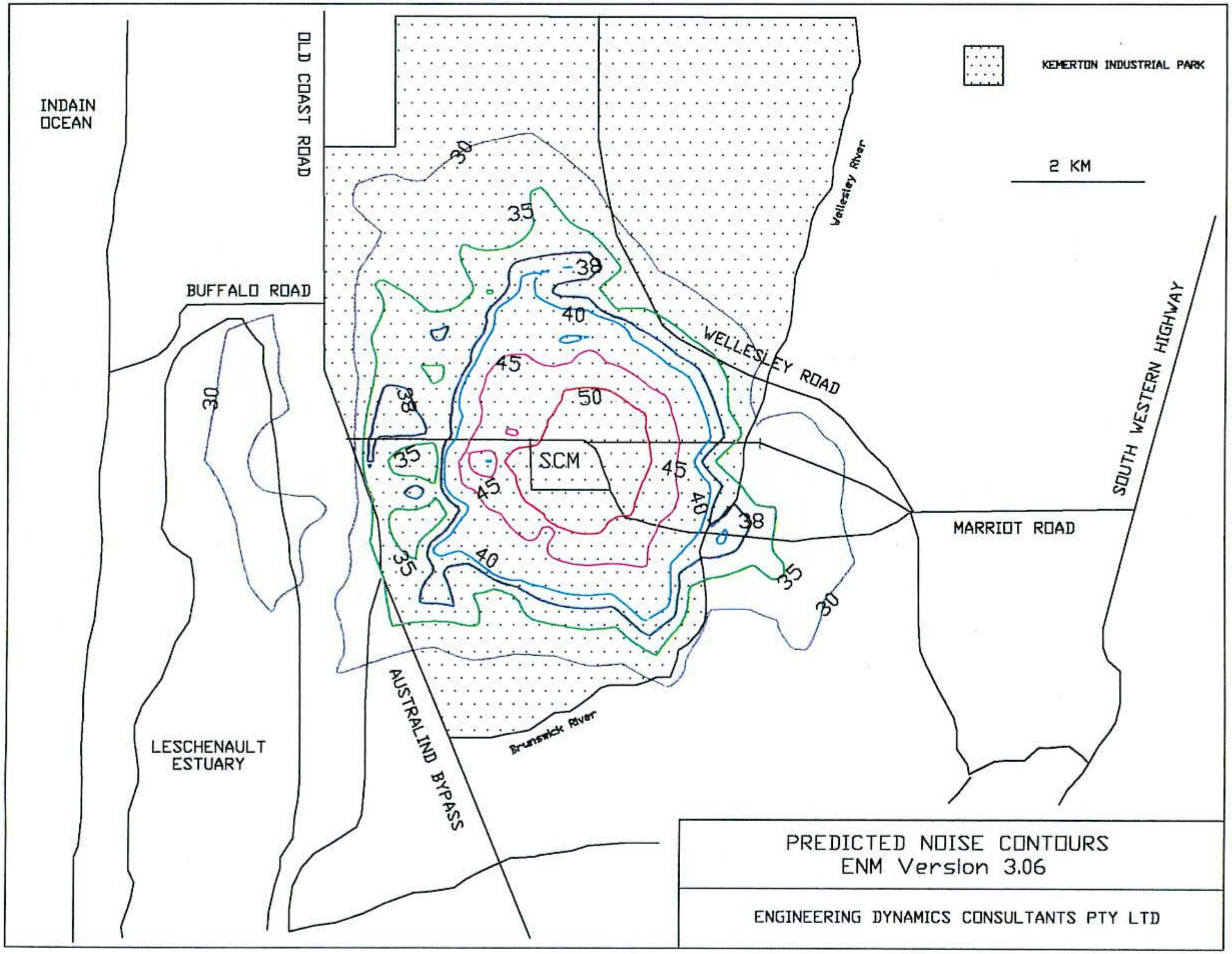


FIGURE 4

Predicted noise contours for SCM Kemerton Plant Expansion

Wind velocity: zero

Temperature gradient: $2^0/100m$

Temperature: 10^0C

Humidity: 50%

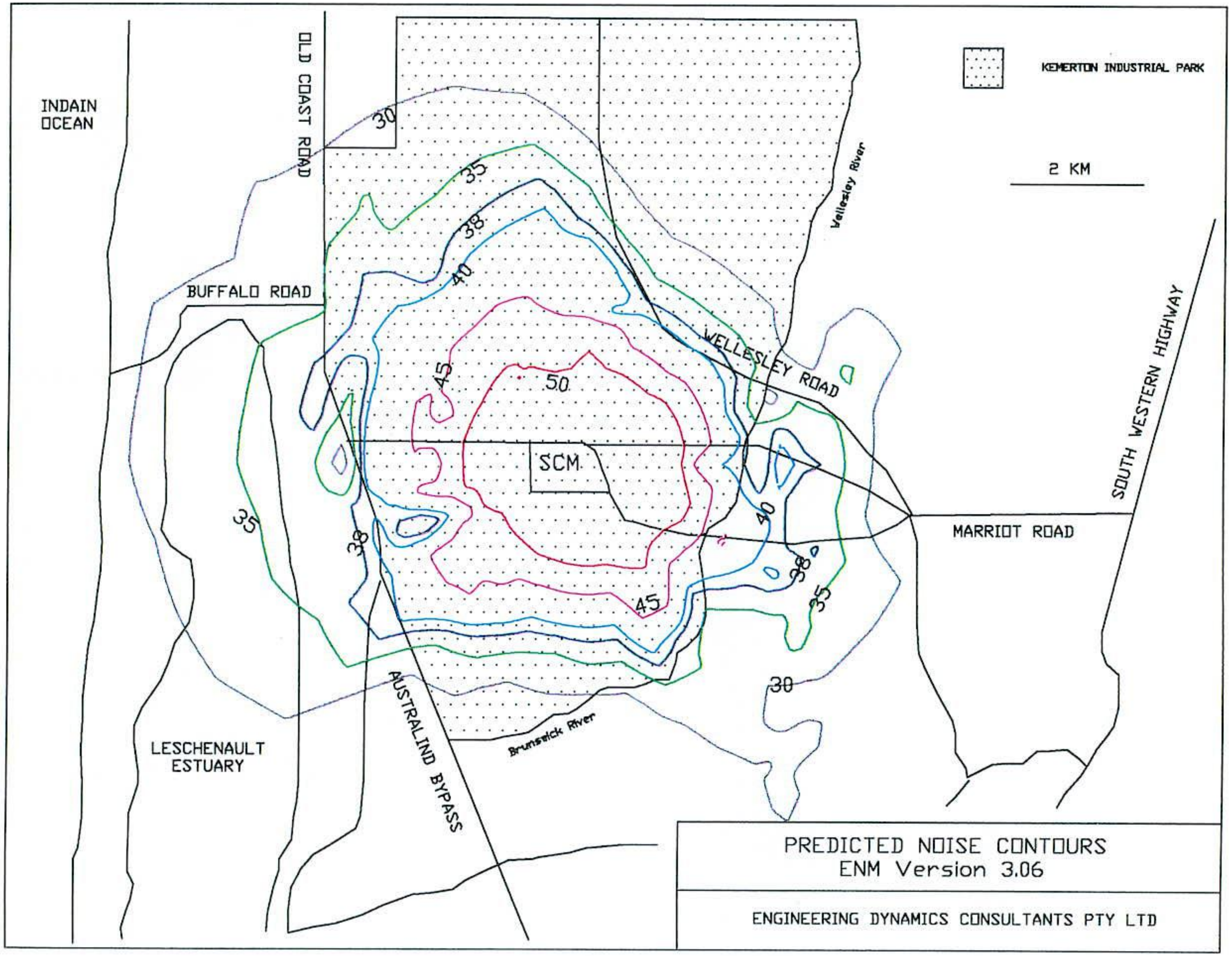


FIGURE 5

Predicted noise contours for SCM Kemerton Plant Expansion

Wind velocity:
zero
Temperature gradient:
$7^0/100m$
Temperature:
10^0C
Humidity:
50%

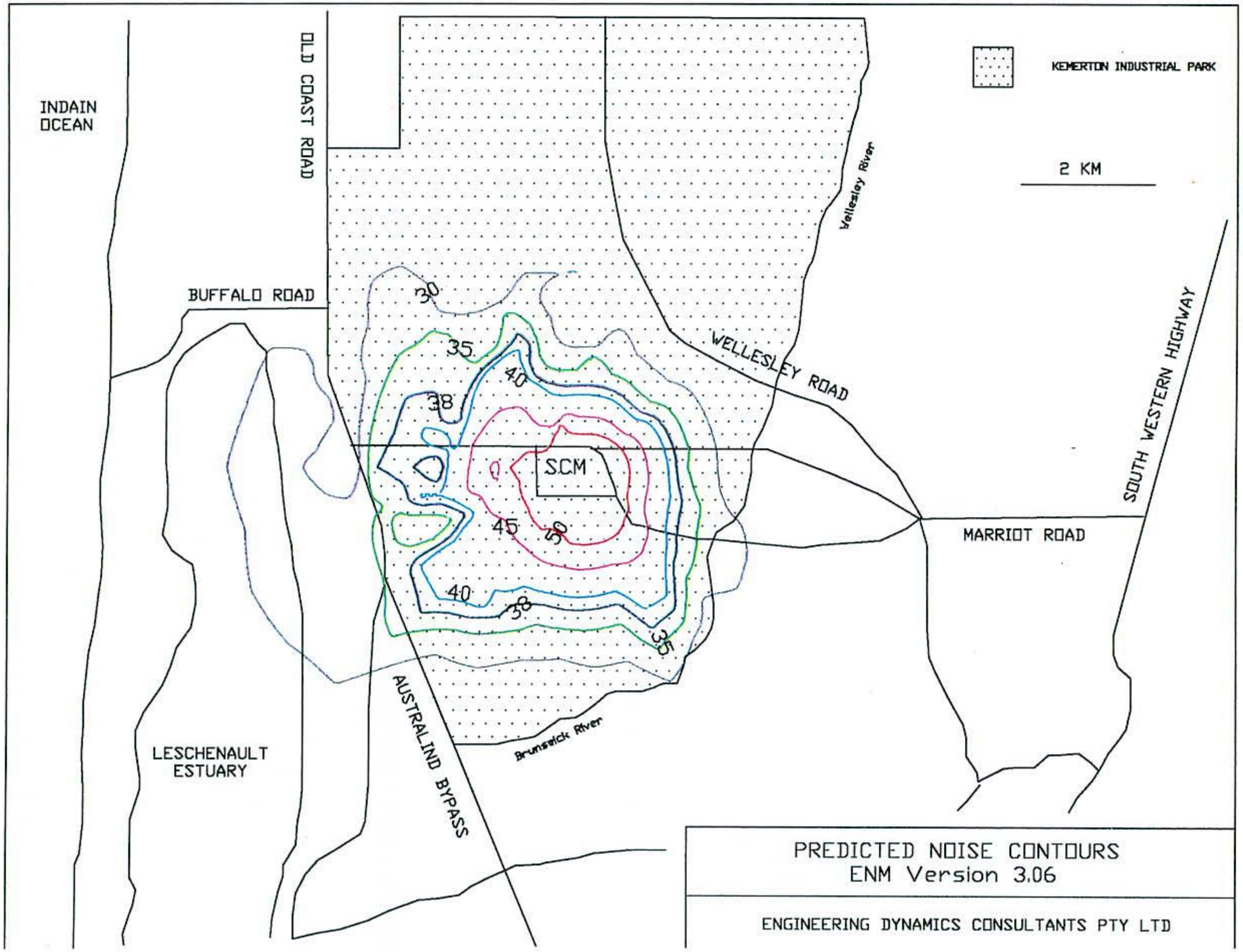


FIGURE 6

Predicted noise contours for SCM Kemerton Plant Expansion with noise control.

Wind direction: 45^0 NE

Wind velocity: 2.5 m/s

Temperature gradient: $2^0/100$m

Temperature: 10^0C

Humidity: 50%

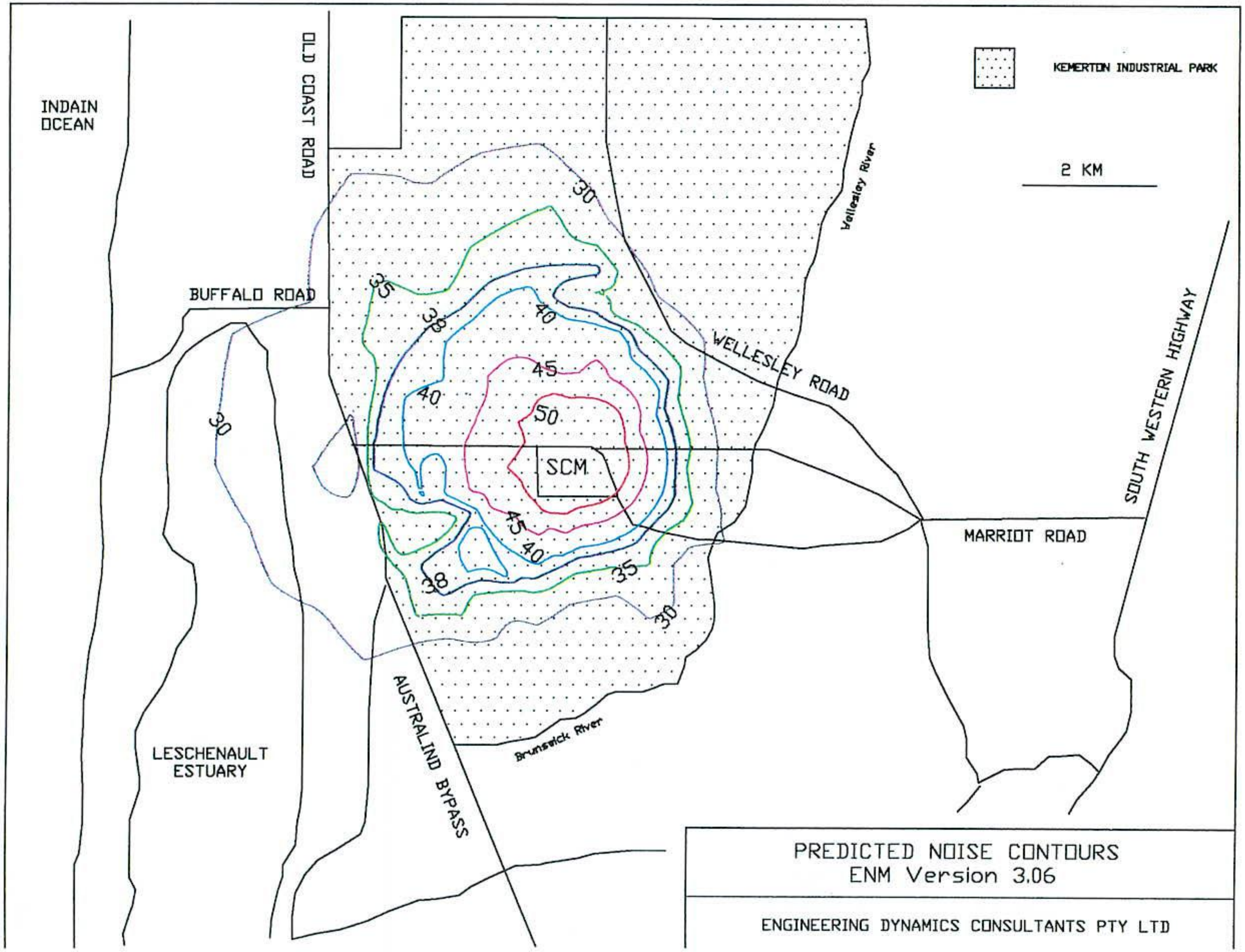


FIGURE 7

Predicted noise contours for SCM Kemerton Plant Expansion with noise control.

Wind direction: 120° E/SE

Wind velocity: 2.5 m/s

Temperature gradient: 2°/100m

Temperature: 10°C

Humidity: 50%

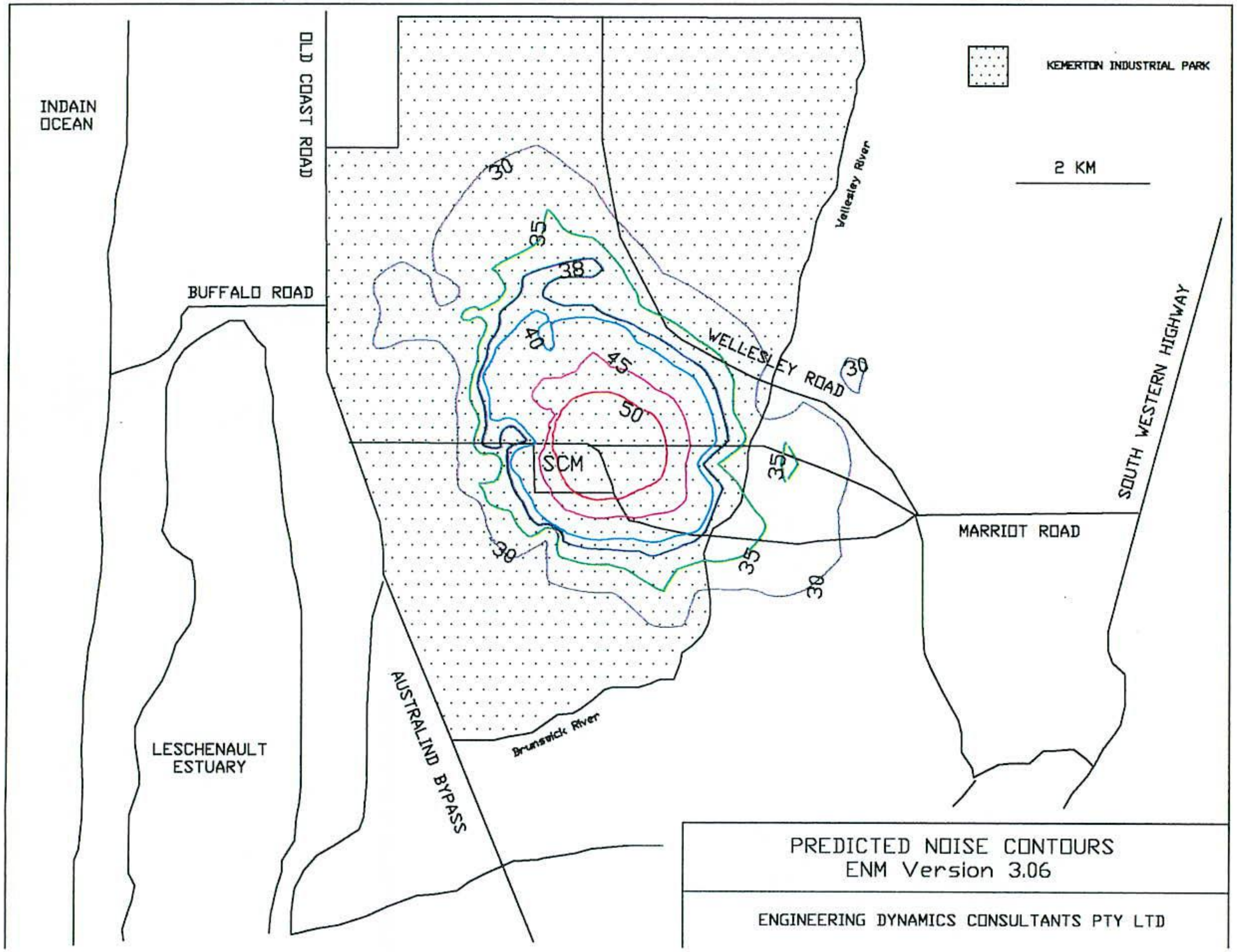


FIGURE 8

Predicted noise contours for SCM Kemerton Plant Expansion with noise control.

Wind direction:
255° W/SW

Wind velocity:
2.5 m/s

Temperature gradient:
2°/100m

Temperature:
10°C

Humidity:
50%

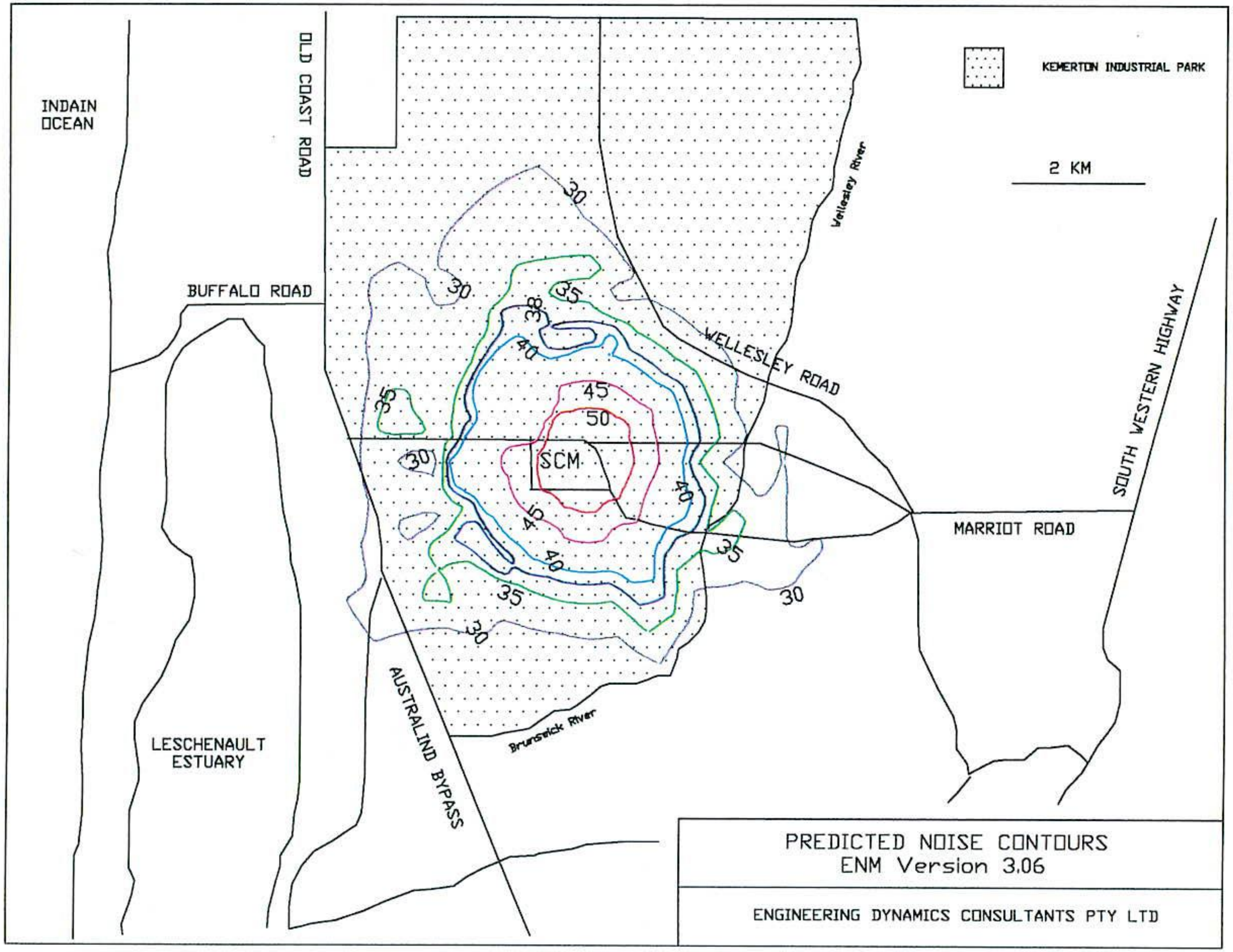


FIGURE 9

Predicted noise contours for SCM Kemerton Plant Expansion with noise control.

Wind velocity: zero

Temperature gradient: $2^{0}/100m$

Temperature: $10^{0}C$

Humidity: 50%

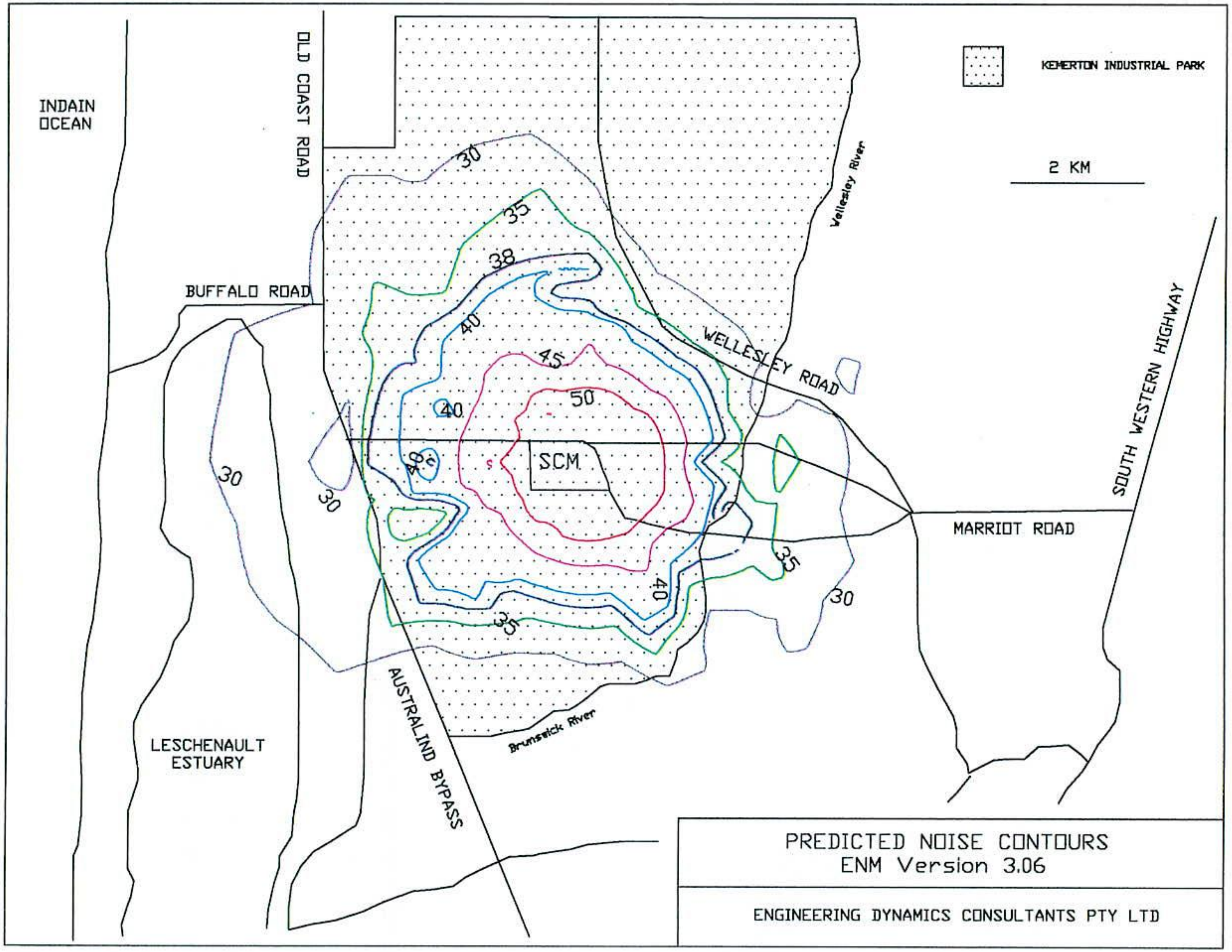


FIGURE 10

Predicted noise contours for SCM Kemerton Plant Expansion with noise control.

Wind velocity: zero

Temperature gradient: $7^0/100m$

Temperature: 10^0C

Humidity: 50%

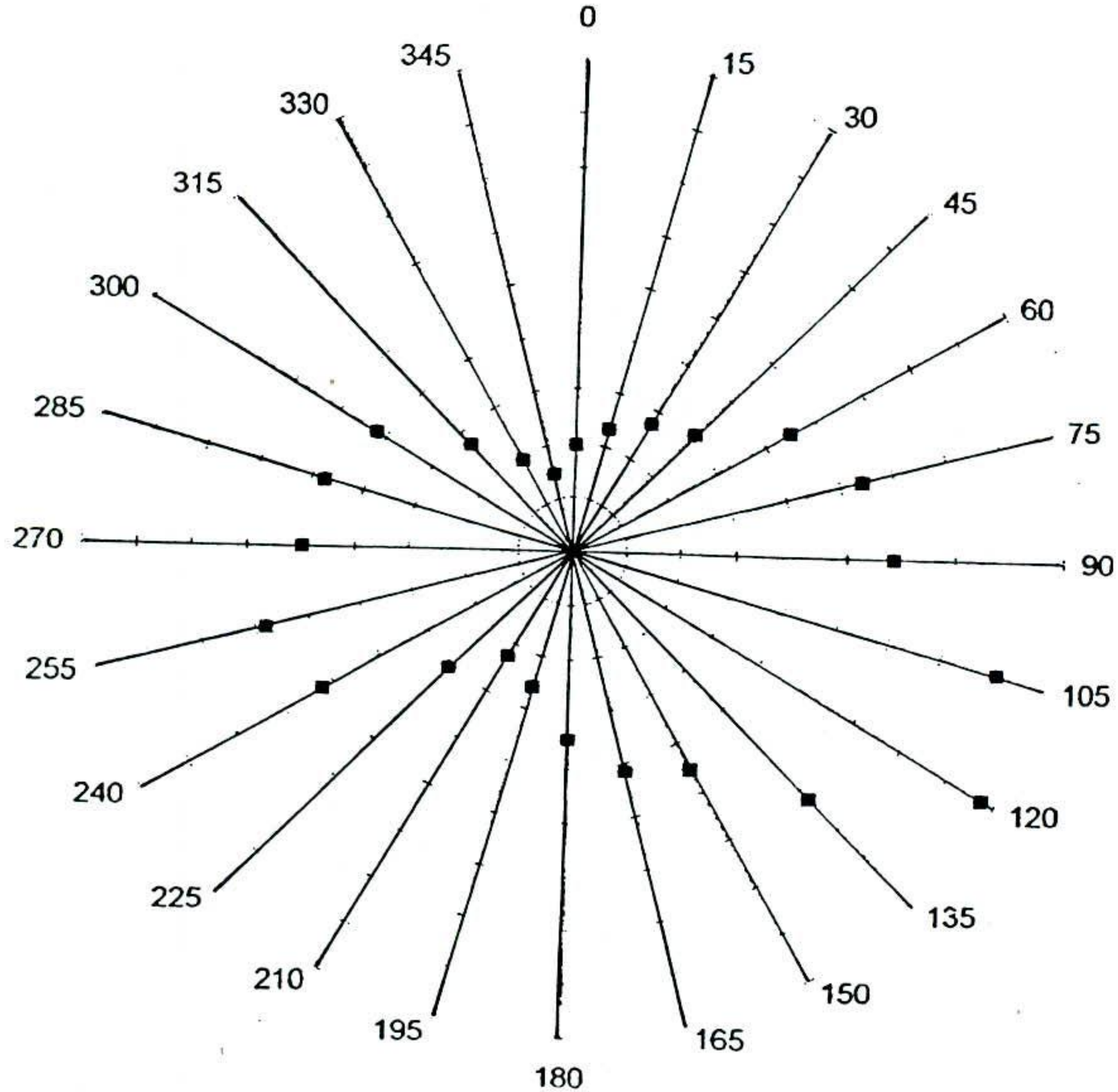


FIGURE 11

Wind rose for Kemerton July 1995 to June 1996

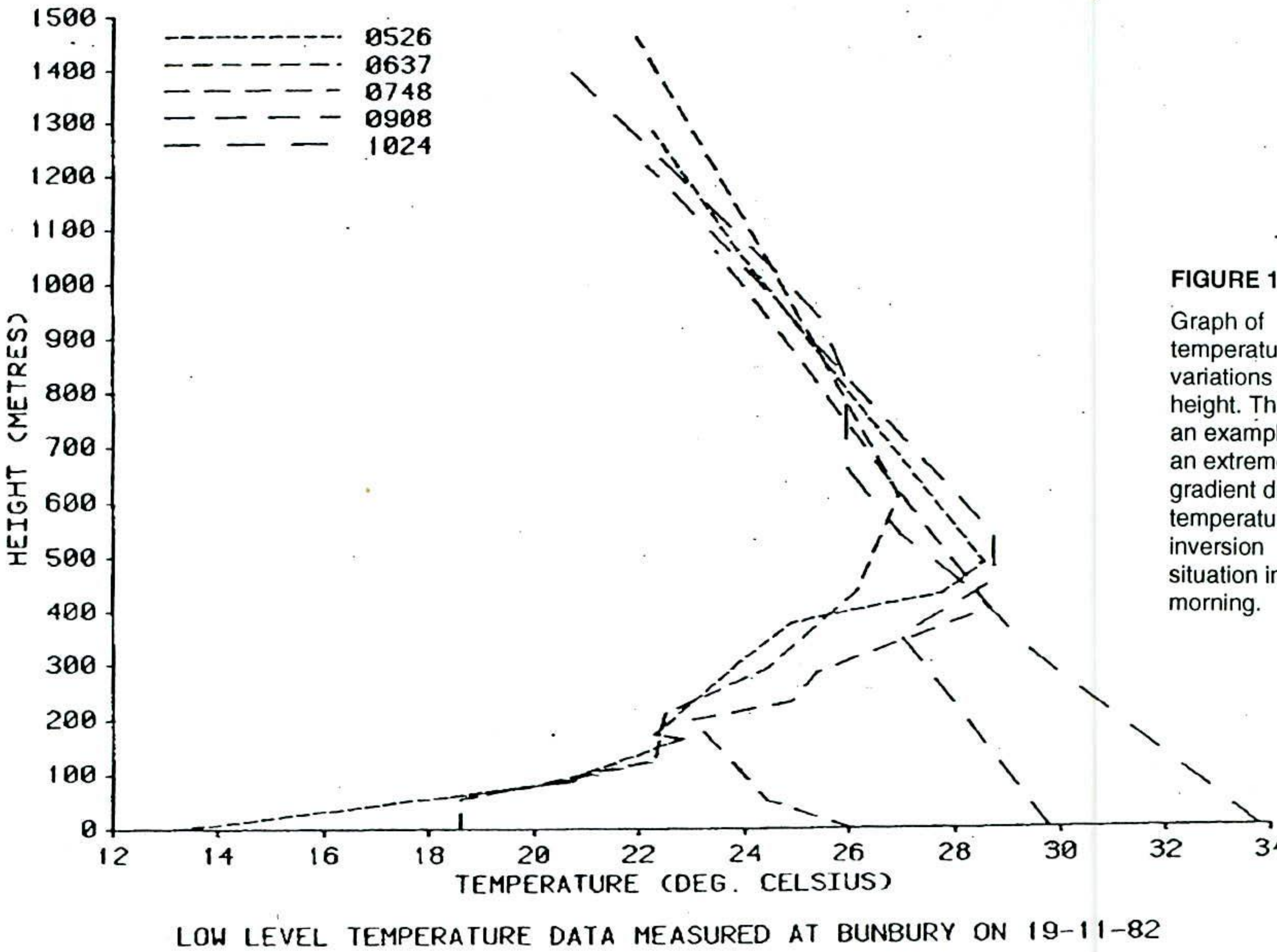


FIGURE 12

Graph of temperature variations with height. This is an example of an extreme gradient during temperature inversion situation in early morning.

Addendum to Report 9637

1. Wind Statistics

The easterly wind condition is considered the predominant direction likely to cause annoyance. The predicted noise levels analysed were at a maximum wind velocity of 2.5 m/s. Levels above 2.5 m/s are considered to be of less annoyance as the background noise levels significantly increase. To determine the statistical data, we analysed the wind data from the weather station at Kemerton in the following range:

Wind direction	45° to 135°
Wind Velocity	2 to 3 m/s
Period	1/7/95 to 30/6/96

The results indicated that the wind velocity and wind direction were in this range for 6.2% of the total period as detailed in the following table:

Period	Percentage of time the wind velocity is 2 – 3 m/s and in sector 45° to 135°
July to September 1995	8.1%
October to December 1995	4.8%
January to March 1996	3.3%
April to June 1996	8.7%
July 1995 to June 1996 (1 year)	6.2%

Table 1: Percentage of time the wind velocity is between 2 to 3 m/s and in sector 45° to 135°

2. Neighbourhood Noise Levels

The soon to be enacted environmental noise regulations require the noise levels at the adjacent industrial properties to be a maximum of 65 dBA. The noise levels at the boundary of the Simcoa plant were determined for an easterly wind velocity of 2.5 m/s, temperature inversion of 2°C/100m and a temperature of 10°C. The noise level at the Simcoa boundary is predicted to be 62 dBA. With noise control measures outlined in the report, this level reduces to 57 dBA.

Appendix E

PRELIMINARY RISK ASSESSMENT

SCM CHEMICALS LTD

PRELIMINARY RISK ASSESSMENT OF THE PROPOSED EXPANSION OF THE SCM CHEMICALS, KEMERTON FACILITY

SUMMARY

SCM Chemicals Ltd currently operates a facility at Kemerton, Western Australia, for the production of titanium dioxide. The existing facilities were designed to produce a nominal 70,000 tonnes per annum of titanium dioxide (TiO_2), which were recently upgraded to 79,000 tonnes per annum. A proposed expansion of the facility will increase the nominal production to 190,000 tonnes per annum.

The risks associated with the proposed expansion to the titanium dioxide production facility at the SCM Chemicals Ltd Kemerton site, are to be assessed as part of the Consultative Environmental Review (CER) for the proposed expansion. Submission of the CER to the Department of Environmental Protection (DEP) requires that such a Preliminary Risk Assessment (PRA) is undertaken. If the CER submission is acceptable and the proposed expansion sanctioned, then a full Quantitative Risk Assessment will be undertaken at a later stage in the project when more detailed design information becomes available.

This PRA does not assess the risk associated with the existing Nufarm facilities, nor any increase in any chlorine production facility, to meet the increased chlorine requirements of the SCM Chemicals Ltd facility. The increase in import facilities from Nufarm, however, is covered. Risk contours for the Nufarm plant have been taken, by SCM Chemicals, from a separate assessment, and combined with the SCM risk contours to give overall contours for the area.

The PRA has assessed the risks to the public and other industrial sites and compared the risks levels predicted against the acceptable criteria stated in the DEP Bulletin 611.

This report predicts that:

- Maximum individual risk levels beyond the overall site boundary do not exceed 5×10^{-5} yr^{-1}. No housing falls within this area, and the risk contours are therefore within the criteria laid down in DEP 611.
- Maximum individual risk levels seen by SCMs neighbouring plants, eg BOC and Cockburn Cement do not exceed 1×10^{-6} yr^{-1}. The risk levels seen by Simcoa are less than 1×10^{-7} yr^{-1}. The risk levels at the Nufarm Chlor Alkali plant range between 5×10^{-7} and 1×10^{-5} fatalities per year. This is also within the criteria laid down in DEP 611.
- The addition of individual risks from Nufarm does not significantly alter the risks from SCM alone. The SCM and Nufarm combined risk map show that the risk contour of 1×10^{-7} per year is increased by about 200 m eastward. There is no effect on the risks in other areas of the site.
- There are no 'sensitive developments' within the predicted consequence contours, so the proposed expansion is acceptable in terms of this criteria.

- The societal risk associated with the development is considered acceptable, in comparison with the published guidelines.

Although the predicted risk levels fall within the EPA criteria, a number of recommendations have been made for further risk reduction. This is in line with SCM's policy of continuing improvement.

FIGURE 4. INDIVIDUAL RISK CONTOURS FOR THE SITE

(FATALITIES PER YEAR)

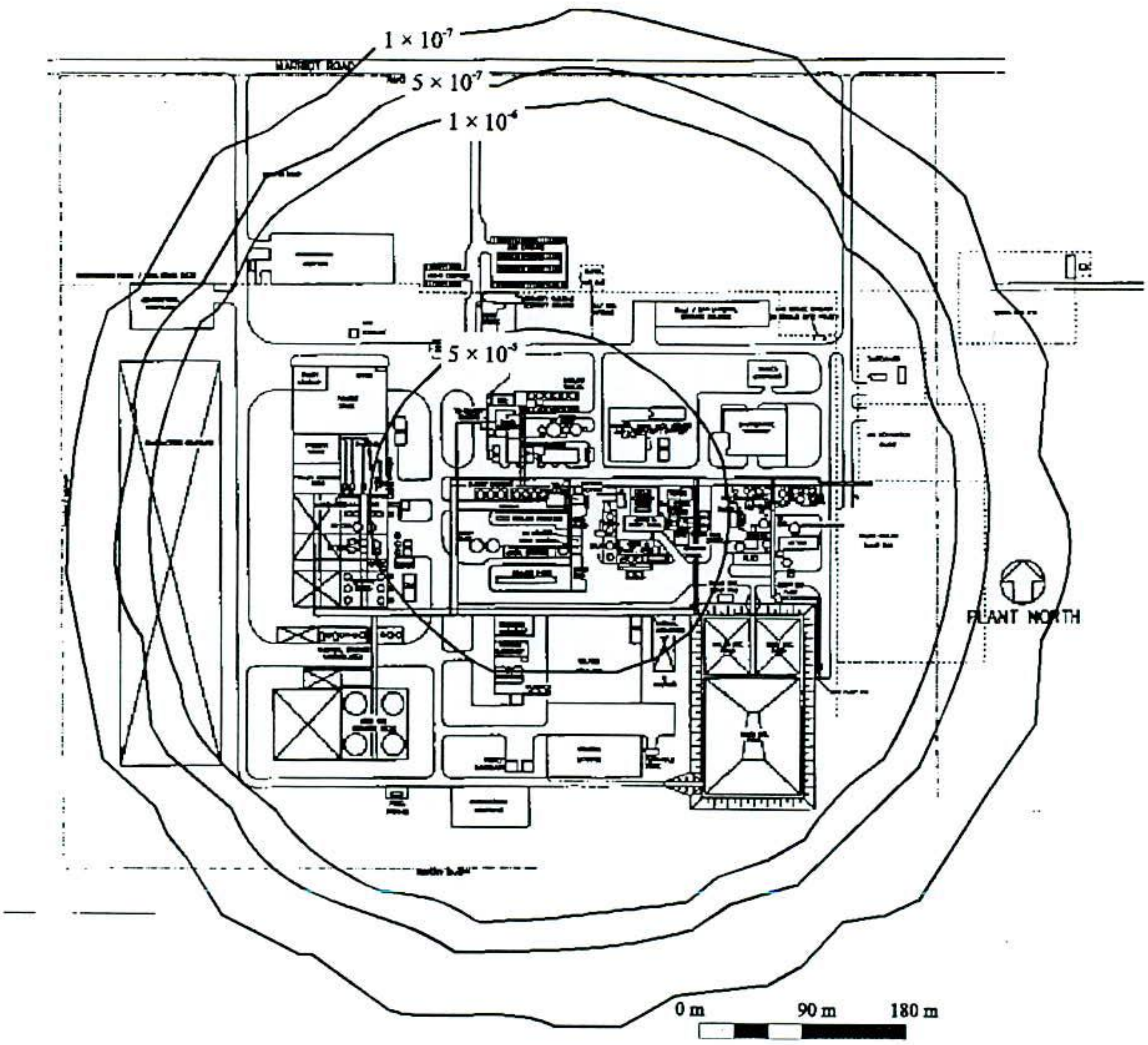
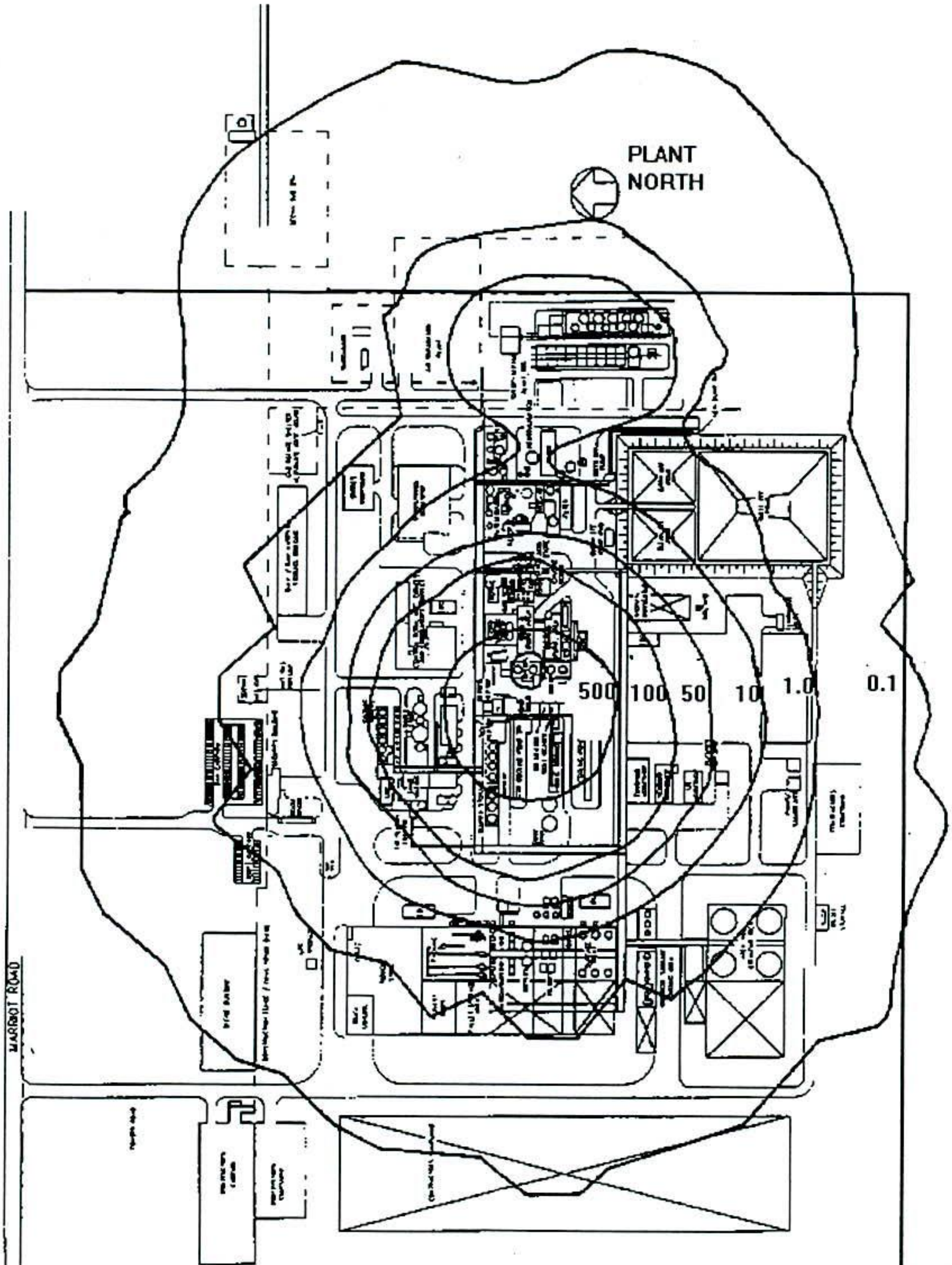


FIGURE 10. COMBINED SCM AND NUFARM INDIVIDUAL RISK CONTOURS



Contours are risk of fatality, per million years.

Appendix F

SCM CHEMICALS ENVIRONMENTAL POLICY

Appendix F

SCM CHEMICALS ENVIRONMENTAL POLICY

SCM Chemical's Environmental Policy is:

To be committed globally to the principles of Responsible Care. Employees throughout the company will be given the necessary training, instruction and information to be involved in and carry out this commitment.

To give customers, suppliers, the local community and statutory bodies relevant information on the measures employed by the company to protect the environment from any effects of our business.

To conduct company activities in full compliance with all applicable statutory and regulatory obligations. Assessment of environmental performance will be made regularly to monitor progress toward reduction and minimisation of wastes as well as compliance with environmental laws and regulations. Continuous improvement is the ongoing goal of this effort.

To involve all relevant outside parties in working toward continuous environmental improvement.

To include environmental considerations in investment and business decisions. SCM Chemicals will participate in actively contribute to the dialogue relating to the identification and development of pragmatic solutions to environmental issues.

The general manager of each SCM Chemicals business unit or subsidiary shall be responsible for implementing and managing all aspects of SCM Chemicals' environmental policy.

Appendix G

EPA GUIDELINES FOR CER

PROPOSAL FOR EXPANSION OF EXISTING TITANIUM DIOXIDE PLANT TO 150,000 TPA AT KEMERTON INDUSTRIAL PARK, WESTERN AUSTRALIA (ASSESSMENT NO. 973)

GUIDELINES FOR THE CONSULTATIVE ENVIRONMENTAL REVIEW

Overview

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

If the proponent can demonstrate that the environment would be protected from unacceptable environmental impacts, then the proposal would be found environmentally acceptable; if the proponent cannot demonstrate this, then the Environmental Protection Authority (EPA) would recommend against the proposal.

Throughout the assessment process it is the objective of the Department of Environmental Protection (DEP) to assist the proponent to improve the proposal such that the environment is protected in the best manner possible. The DEP would co-ordinate relevant government agencies and the public in providing advice about environmental matters during the assessment of the Consultative Environmental Review (CER) for this proposal.

These guidelines have been prepared to assist the proponent in identifying key issues which should be addressed within the Consultative Environmental Review (CER) for the proposed expansion of the existing titanium dioxide plant to 190,000 tpa at Kemerton Industrial Park, Western Australia. They are not intended to be exhaustive and the proponent may consider that other issues should also be included in the document.

Purpose of the CER

The principal function of the CER is to facilitate a review of key environmental issues, by:

- communicating clearly with the public (including government agencies), so that the EPA can obtain informed public comment to assist in providing advice to government;
- describing the proposal adequately, so that the Minister for the Environment can consider approval of a well-defined project; and
- providing the basis of the proponent's environmental policy and principles, which show how the environmental issues resulting from the proposal will be approached and acceptably managed.

Objectives of the review

The CER should have the following objectives:

- to place this proposal in the context of the local and regional environment;
- to explain the issues, decisions and feasible alternatives which led to the choice of this proposal at this place and at this time;
- to set out the specific environmental impacts that the proposal may have; and
- for each impact, to describe how the proponent would avoid, mitigate or ameliorate that impact.

The CER should focus on the key environmental topics for the proposal and anticipate the questions that members of the public will raise. Data describing the environment should be directly related to the discussion of the potential impacts of the proposal. The discussion should then relate directly to the actions proposed to manage those impacts.

The document

The contents of the CER should be concise and accurate as well as being readily understood. Specialist information and technical description should be included only where it assists the understanding of the proposal. Where specific information has been requested by a government department or the local authority this should be included in the document.

It is not intended that the document be unduly lengthy. Rather it is intended that all relevant material should be succinctly presented in order that the key environmental issues may be assessed.

A copy of these guidelines should appear in the CER document.

The language used in the body of the CER should be kept simple and concise, considering the audience includes non-technical people, and any extensive, technical detail should either be referenced or appended to the CER. Remember that the CER would form the legal basis of the Minister for the Environment's approval of the proposal and, hence, should include a description of all the main and ancillary components of the proposal, including options if necessary.

The contents of the CER should include:

- a summary of the CER (*including a brief description of the proposal*);
- introduction of the proponent, the project and location;
- the legal framework, decision making authorities and involved agencies;
- description of the components of the proposal, particularly the difference between this proposal and the current, approved project, including:
    - a table summarising the mass balance of raw materials (inputs) and products and wastes (outputs) for the processing plant;
    - type and location of structures to be built at the plant site; and
    - provision of services and drainage;
- plans of the area to be affected by the proposal, showing:
    - the location of the proposal and associated infrastructure;
    - existing land uses and land status;
    - timing (staging) and location of areas for residue disposal; and
    - major traffic routes to be used.
- identification of the potential impacts, treating construction impacts separately from operational impacts;

- description of the receiving physical, biological and human environment which may be impacted by this project;

- discussion of the key issues, including an assessment of the significance as related to objectives or standards which may apply;

- discussion of the management of the issues, including commitments to appropriate action; and

- a summary of the environmental management programme, including the key commitments, monitoring work (frequency and location), strategies, audits and reviews that may be employed to rectify unacceptable environmental impacts.

Key environmental topics

The key topics can be determined from the potential impacts from the various components of the proposal on a receiving environment, including social surroundings. The CER should focus on the key topics for the proposal, and it is recommended that these be agreed in consultation with the DEP and relevant public and government agencies. A description of the project component and the receiving environment should be directly included with, or referenced to, the discussion of the issue. The technical basis for measuring the impact and any objectives or standards for assessing and managing the issue should be provided.

The CER should provide sufficient information for the environmental impacts of the proposal to be placed in the context of what is happening with the existing approved operations. Certification of compliance with existing environmental approvals should be demonstrated. Where necessary, the proponent may refer to publicly available information associated with previous approvals.

Emphasis should be placed on the proponent's performance to date in managing environmental impacts associated with the existing operations, and how the incremental effects associated with this proposed expansion would affect the environment.

In this case the key environmental topics include:

- flora and fauna impacts resulting from plant construction, operation and residue disposal, including overburden, topsoil and dewatering management;

- solid waste generation (nature, analysis, quantity), minimisation, disposal and utilisation;

- long term management of the solid wastes including liability;

- liquid waste generation (nature, analysis, quantity), minimisation, recycling, treatment and disposal;

- marine impacts from liquid waste disposal;

- risks and hazards (see below);

- impacts from transport of raw materials and products, particularly hazardous chemicals;

- radiation issues:

    the CER should account for all radionuclides, by showing a mass balance of radionuclides entering the plant (in feed stock) and leaving the plant (via the solid and liquid waste streams);

radiation issues should be addressed in solid and liquid waste disposal; and

plans should be put in place to check and control radioactive build-up in pipes and tanks.

- requirements for and provision of buffer zones around the project site based on predicted impacts which cross the property boundary (including noise, dust, air quality, risk);
- monitoring and management of:

  ground and surface water impacts;

  dust and gaseous emissions (chlorine, carbon oxysulphides, NOx, SO2, Greenhouse gases inventory);

  noise levels at nearest residences and other sensitive human environments;

  contaminants and radiation levels at waste disposal sites, particularly in sediments and sensitive fauna (mussels) near the outlet pipe of the liquid waste stream;

- visual impacts;
- any other impacts which might be apparent to the proponent; and
- rehabilitation/decommissioning and final land use.

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

Predicted environmental impacts and proposed measures to overcome or minimise these problems should be discussed in sufficient detail so as to allow an adequate assessment to be made.

Risk management

Quantitative Risk Assessment (QRA):

The QRA should provide a detailed assessment of the risks associated with the proposal to the satisfaction of the DEP on advice from the Department of Minerals and Energy (DOME). The QRA needs to provide risk contours for individual fatality and societal F/N curves, and should provide advice on compliance with risk criteria. Key issues include:

- identification and management of risks and hazards for the new plant;
- potential for impact on surrounding industries and adjoining premises (off-site chlorine and titanium tetrachloride releases);
- potential cumulative impacts of risks and hazards of the total plant on existing developments in the Kemerton area; and

- impacts of existing plant operations upon construction phase safety.

Total Hazards Control Plan (THCP):

The existing site THCP should be amended prior to commissioning to incorporate the proposed changes to the plant, to the requirements of DEP on advice of DOME.

Environmental management

The EPA considers that the proponent should approach environmental management in terms of best practise. Best practice environmental management includes:

- development of an environmental policy;
- agreed environmental objectives;
- management of the environmental objectives;
- involve the public as appropriate;
- audit environmental performance against agreed indicators;
- regular reporting to the DEP and/or nominated agencies;
- commitment to a quality assured management system and continuous improvement; and
- periodic (for example 5 yearly) review in conjunction with the DEP and/or nominated agencies.

The proponent should provide a table which describes the following:

(a) the present state of the environment;

(b) potential impacts of the proposal on the environment

(c) nominate environmental management objective(s) for those aspects which require management;

(d) environmental management response to manage impacts to meet the above objective(s); and

(e) envisaged resultant state of the environment.

under three major headings:

- biophysical environment;
- pollution potential; and
- social surroundings.

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

Public participation and consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent in preparing the CER. Cross reference should be made with the description of environmental management for the proposal which should clearly indicate how community concerns have been addressed. Where these concerns are dealt with via other departments or procedures out side the Environmental Protection Authority process, these can be noted and referenced in this section.

Commitments

Where a social or bio-physical environmental problem has the potential to occur, the proponent should consider addressing this potential problem with a commitment to rectify it. Where appropriate, the commitments should include:

- who is responsible for the commitment and who will do the work,
- what is the nature of the work,
- when and where the work will be carried out, and
- to whose satisfaction will the work be carried out.

A summary of commitments in numbered form should be given. A set of well written concise commitments covering the key issues of the proposal and its effects will help to expedite assessment of the proposal.

Appendix H

PREVIOUS ENVIRONMENTAL MANAGEMENT COMMITMENTS MADE BY SCM CHEMICALS

APPENDIX 2

Management Commitments made by the Proponent in the ERMP, in the proponent's response to issues raised in submissions and to issues raised by the EPA, and in the Notice of Intent (June 1987).

ENVIRONMENTAL COMMITMENTS

NB * indicates modifications or additions proposed in Notice of Intent (June 1987).

* Owing to the changed scope of the plant and split location, all the management commitments made in the Stage II ERMP are not necessarily relevant. There also need to be further commitments made for the management of the environment in the Kemerton area.

1. CONSTRUCTION (S 10.2, ERMP)

- 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.

2. OPERATION (S 10.3, ERMP)

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

2.1 <u>Wastewater:</u>

- 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.

- Regular monitoring of the discharge to the Collie River would be implemented to ensure that the system operated as predicted.

- * Waste waters can be appropriately discharged, after suitable treatment, to the (Wellesley and) Collie River(s).

- 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 proponent gave a commitment to alter the wastewater treatment process to reduce manganese levels to concentration of the order of parts per million.

- 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 lime treatment used to neutralise 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.

- The proponent will regularly monitor the wastewater discharge and bed sediments in the Collie River for radionuclides; to assure the relevant authorities that the proposed disposal practice does not cause an unacceptable accumulation of radionuclides.

- Special consideration will be given to controlling the impact of temperature upon marine (aquatic) organisms.

- 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 vegetation on the banks of the Wellesley River, adjacent to the confluence of the wastewater drain, would be regularly monitored.

* • Regular monitoring of the wastewater discharge from the Kemerton site would be implemented to ensure that the system operated as predicted.

2.2 Aesthetics/Noise/Odour :

- On-going 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.

- There would be negligible odour impact to surrounding residential areas arising from the proposed development.

- Odours would not originate from the proposed plant during normal operation.

2.3 General:

- 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.
- 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) (see also Sections 4 and 5).
- 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 (see also Sections 5 and 6).
- All wastes would be regularly monitored for radio-nuclides.
- 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.

* • Groundwater extraction from any surficial aquifiers would be conducted in such manner to avoid significant environmental impact on wetlands an their associated vegetation.

- The proponent will advise the EPA of their decision on a chlor-alkali plant operator as soon as this is decided.

3. SAFETY FEATURES (S 10.4, ERMP)

* The newly proposed plant will still contain tried and proven control technology and will still remain a very modern safe plant, equivalent to the latest installations effected elsewhere in the world by SCM.

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

3.1 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).

- 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 will be done in a well ventilated open area on a concrete pad whose run-off is directed to the wastewater treatment plant.

- Duplication and frequent routine replacement of sensors in the oxidation section.

- Reliable logic system to control reactor trip system.

- Provision of double remote acting block valves to isolate all chlorine pumps.

- Provision of an on-line scrubbing system for the 'hygiene snake' system (proprietary equipment), and scrubbing system stacks to be 46 metres high.

3.2 <u>Chlor-alkali plant</u>:

- 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 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.

- Provision of double remote acting block valves to isolate all chlorine pumps.

3.3 Storage

- Total storage capacity of approximately 100 tonnes of liquid chlorine as intermediate storage between the two process plants with average storage of 50 tonnes.

- 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.

- 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.

- 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).

* • Chlorine storage tanks will be individually bunded to full height with concrete bunds.

* • The bunds will be lined with insulating tiles to prevent rapid heat transfer from the bund to the liquid chlorine.

* • Foam suppression - foam generators will be installed in the titanium tetrachloride and chlorine storage areas to provide a stable insulating barrier on top of the chlorine to suppress gas evolution.

* • Isolating valves will be installed on the main storage tanks, as well as excess flow check valves.

- Provision of double remote acting block valves to isolate all chlorine pumps.

3.4 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.

3.5 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.

3.6 <u>General:</u>

- 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.

4. EMERGENCY PLAN

* • The proponent's emergency plan and procedures will be integrated with the proposed State Emergency Services' Bunbury Regional Counter Disaster plan.

- The proponent will afford all practical co-operation in the formulation of public emergency and contingency plans.

5. MONITORING AND AUDITING (S 10.5, ERMP)

- 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.

- Hazard and risk management programmes are in place at all sites and are monitored and audited 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.

- Significant interchange of appropriate personnel will be required during development of the programmes. Performance thereafter will be audited by Baltimore on a regular basis for hazard, safety and industrial hygiene management standards, as for existing sites.

- 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.

6. TRAINING

- Overseas training will take place at all levels down to, and including Supervisor/Foreman.
- 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.

7. DECOMMISSIONING (S 10.6, ERMP)

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 I

PREVIOUS RECOMMENDATIONS AND CONCLUSIONS MADE BY THE ENVIRONMENTAL PROTECTION AUTHORITY

PROPOSED CHLORIDE PROCESS TITANIUM DIOXIDE PLANT AT KEMERTON

SCM CHEMICALS LTD

Report and Recommendations of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 283 July 1987

The Authority has reiterated its earlier recommendation that the existing sulphuric acid and sulphate-process plants should not operate beyond 30 June 1990 (or at an extension of time under the Pigment Factory (Australind) Agreement Act 1986).

During the period of concurrent operations of the sulphate-process plant (Australind) and the chloride-process plant (Kemerton), the EPA has recommended environmental performance guidelines for air emissions at Australind. This will enable the Government, should it so wish, to consider the merits of operation of the sulphuric acid and the redundant sulphate process plants at Australind beyond 30 June 1990 in the context of the Company's overall environmental performance.

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, including the issue of titanium tetrachloride transportation from Kemerton to Australind. The general conclusion is that these can be managed in an environmentally acceptable manner.

The Authority would require regular reporting from the proponent or the Company's management and monitoring programme for both the Kemerton and Australind sites.

The Environmental Protection Authority has made the following recommendations and conclusions:

(1) The Environmental Protection Authority concludes that the proposal is environmentally acceptable and recommends that it could proceed subject to:

- the relevant commitments made by proponent for the titanium dioxide plant and listed in Appendix 2 of this Report;
- the EPA's conclusions and recommendations in this Assessment Report.

(2) The Environmental Protection Authority concludes that the Kemerton site is an acceptable area to locate the chloride-process titanium dioxide plant.

(3) 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 consists 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. This HAZOP study should especially discuss the risk effects of the safeguards removed due to the plant being located at Kemerton;

- a final risk analysis report incorporating the plant design after HAZOP and (taking into consideration any additional safeguards/modifications arising out of the HAZOP analysis), to be submitted soon after construction;

- a hazard analysis update (including a fire safety study, and a study detailing the management of the commissioning stage and a 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.

(4) The Environmental Protection Authority recommends that no more than 50 tonnes of chlorine should be stored at the Kemerton plant location in containers not exceeding 25 tonnes capacity.

(5) The Environmental Protection Authority recommends that there be no sale of chlorine from the Kemerton site without a further specific assessment by the EPA and that the management of the transport of chlorine for commissioning should be discussed with the relevant Government agencies prior to commissioning.

(6) The Environmental Protection Authority recommends that its requirements in terms of safeguards for the Kemerton proposal should be the same as those required for the chlor-alkali plant at Kwinana (EPA Bulletin 216). In addition the Authority endorses the commitment, made by the proponent, to install the following at Kemerton:

- full height concrete bunding;

- insulation tiles in the bunds;

- a foam suppression system; and

- isolating valves on the main storage tanks and process items. Storage tank isolation valves require two actuation points.

(7) 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.

(8) 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 Counter Disaster Plan will cover contingencies for chemical release emergencies as well as natural emergencies such as floods and fire.

In addition, the EPA recommends that the proponent participate in the development of a fire management strategy for the Kemerton region and contributes towards its implementation.

(9) The Environmental Protection Authority recommends that the underflow from the thickener at the Kemerton site be treated in such a manner so as to prevent the likelihood of groundwater contamination at the Kemerton site.

(10) The Environmental Protection Authority concludes that the proposal to discharge wastewater into the Wellesley River would be environmentally unacceptable.

The Authority recommends that the proponent investigates alternative approaches to the management of wastewater discharge (eg: ocean discharge or deepwell injection). In this regard the Authority considers that a properly designed and managed ocean outfall could be environmentally acceptable. The proposal for wastewater discharge would need to be submitted to the EPA for its assessment.

(11) 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.

(12) The Environmental Protection Authority recommends that the Company's proposal for solid waste management and disposal from both sites be submitted to the EPA for assessment prior to completion of construction of the Kemerton plant.

(13) 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.

(14) 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.

(15) The Environmental Protection Authority has been informed by the Water Authority of Western Australia (WAWA) that there is adequate fresh water available for the proposed plant at Kemerton.

However, the EPA concludes that insufficient detail has been provided to enable the Authority to provide advice and make recommendations on water supply.

Accordingly the EPA recommends that the detailed water supply proposal be referred to EPA for assessment.

(16) The Environmental Protection Authority concludes that the transport of reagents, especially titanium tetrachloride, should be undertaken in a safe manner and recommends that the proponent undertakes appropriate transport safeguards and prepares a contingency plan to the satisfaction of the relevant Government agencies.

(17) The Environmental Protection Authority recommends that the safeguards required for the storage of titanium tetrachloride at the Australind site should be discussed with the relevant Government agencies and be taken into consideration into the HAZOP analysis.

(18) 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.

(19) The Environmental Protection Authority recommends that the proponent undertakes periodic wastewater monitoring including:

- temperature of the wastewater discharge and of the surface waters of the Collie River an appropriate distance 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 in consultation with the Leschenault Inlet Management Authority and for the approval of the EPA.

(20) The Environmental Protection Authority recommends that the proponent prepare a contingency plan at both the Australind and the Kemerton sites in consultation with the Leschenault Inlet Management Authority and to the satisfaction of the EPA, 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, or the ocean.

(21) 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.

(22) The Environmental Protection Authority recommends that the existing sulphuric acid plant and the existing sulphate-process plant (as described redundant in the ERMP) at Australind should not operate beyond 30 June 1990 (or at an extension of time determined under the Pigment Factory (Australind) Agreement 1986). Up until this time the EPA recommends the following guidelines apply to these plants:

- Until 30 December 1987, the sulphur dioxide emissions from the Australind plant should not exceed 1 000 micrograms per cubic metres averaged hourly; and
- from the 1 January 1988, and until the cessation of the concurrent operating period, the sulphur dioxide emissions from the combined Australind plant should not exceed 1 000 micrograms per cubic metres at any time in any residential area.

(23) The Environmental Protection Authority recommends that the management strategy for liquid effluent disposal on the Peninsula until 30 June 1990 (or an extension of time determined under the Pigment Factory (Australind) Agreement Act 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.

(24) The Environmental Protection Authority concludes that the existing Australind plant site is an inappropriate location for heavy industry.

(25) The Environmental Protection Authority recommends that the proponent liaises with the Department of Conservation and Land Management to ensure that the Company's operation and Management Programme for the Kemerton plant site is compatible with the Management objectives developed for the Kemerton Community Park concept.

(26) The Environmental Protection Authority recommends that the proponent be required to meet the reasonable costs associated with monitoring the environmental performance of the construction and operational phases of the Australind and Kemerton plants.