Staged expansion of Tiwest Pigment Plant to 180,000 tpa, Kwinana

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Tiwest Joint Venture Pty Ltd

Report and recommendationsof the Environmental Protection Authority

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Summary

This report is to provide the Environmental Protection Authority's (EPA) advice and recommendations to the Minister for the Environment on the environmental factors relevant to the proposal to increase production capacity of Tiwest's existing pigment plant located in the Kwinana industrial area, from 80,000 tonne per annum (tpa) to 180,00 tpa of titanium dioxide pigment.

The proponent, Tiwest Joint Venture Pty Ltd proposes to modify/expand its existing plant to allow increase in the pigment production capacity in three notional stages: (i) Stage 1: increase to 120,000 tpa, (ii) Stage 2: increase to 165,000 tpa and (iii) Stage 3: increase to nominally 180,000 tpa.

It is the EPA's opinion that the following are the environmental factors relevant to the proposal:

(a) sulphur dioxide (SO_2) gas;

(b) chlorine gas;

(c) other gases including oxides of nitrogen (NOx), titanium tetrachloride ($TiCl_4$), carbon monoxide (CO) and carbon dioxide (CO_2, a green house gas);

(d) dust;

(f) odours (reduced sulphur compounds);

(g) marine discharge;

(h) solid wastes;

(i) ground water quality;

(j) noise; and

(k) public safety (risk).

The conditions and procedures, in the EPA's opinion, to which the proposal should be subject if implemented are in summary:

(a) the proponent's commitments should be made enforceable;

(b) the proponent should be required to revise its environmental management system; and

(c) the timely redetermination of the Maximum Permissible Quantities for SO_2 for the pigment plant, and the documentation of "best practice" requirements for SO_2 emissions for the titanium dioxide industry should be required.

The EPA submits the following recommendations:

Recommendation 1

That the Minister for the Environment notes the relevant environmental factors and EPA objectives set for each factor (Section 3).

Recommendation 2

That subject to the satisfactory implementation of the EPA's recommended conditions and procedures (Section 4), including the proponent's environmental management commitments, the proposal can be managed to meet the EPA's objectives.

Recommendation 3

That the Minister for the Environment imposes the conditions and procedures set out in Section 4 of this report. The implementation of the Minister's conditions and procedures are to be audited by the DEP.

Recommendation 4

That the Minister for the Environment notes that the EPA considers that a redetermination of the Maximum Permissible Quantities for SO_2 in the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1992 for Tiwest should be undertaken. It is the EPA's opinion that this is a significant change, and that the Minister should initiate action for the Policy to be reviewed under s36 of the *Environmental Protection Act 1986,* and that such a redetermination should be undertaken in a timely fashion. The EPA considers that the review should be completed by April 30, 1998.

Recommendation 5

That the Minister for the Environment notes that the EPA intends to work with the DEP and titanium dioxide industry in Western Australia, to jointly define and document "best practice" requirements in relation to SO_2 emissions for the industry.

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1. Introduction and background

This report is to provide the Environmental Protection Authority's (EPA) advice and recommendations to the Minister for the Environment on the environmental factors relevant to the proposal to increase production capacity of Tiwest's existing pigment plant located in the Kwinana industrial area, in stages from 80,000 tonne per annum (tpa) to 180,00 tpa of titanium dioxide pigment.

The Definition Study Document for the staged expansion proposal was referred to the EPA in August 1996 (Woodward-Clyde, 1996a) and the level of assessment was set at Consultative Environmental Review (CER). The CER report (Woodward-Clyde, 1996b) hereafter called the CER, was made available for public review between 7 October 1996 to 4 November 1996.

Further details on the proposal are given in Section 2 of this report. Section 3 discusses environmental factors relevant to the proposal.

Conditions and procedures to which the proposal should be subject if the Minister determines that it may be implemented are set out in Section 4. Section 5 presents the EPA's recommendations to the Minister for the Environment. Summary of the relevant factors, EPA's objectives, proponent's commitments and the EPA's opinion is presented in Table 1.

Appendix 1 provides figures and tables relating to the proposal. A list of people and organisations that made submissions is included in Appendix 2. A consolidated list of proponent's environmental management commitments is provided in Appendix 3 and references are listed in Appendix 4.

2. The proposal

The proposal to increase the production capacity of Tiwest's titanium dioxide plant at Kwinana is described in the CER.

The proposal is to modify/expand the existing plant to allow an increase in production capacity from 80,000 tonne per annum (tpa) to 180,00 tpa of titanium dioxide pigment in three notional stages: (i) Stage 1: increase to 120,000 tpa, (ii) Stage 2: increase to 165,000 tpa and (iii) Stage 3: increase to nominally 180,000 tpa. The first and second stages of the expansion will require major modifications to the plant (plant infrastructure to achieve 180,000 tpa capacity will be developed during Stage 1 construction and approximately 85% of the mechanical process equipment will be installed in Stage 1). Stage 3 expansion will depend upon technological and commercial viabilities and will require minor modifications.

The location of the proposal is shown in Appendix 1: Figure 1 and Figure 2. Appendix 1: Figure 3 shows the existing plant layout and location of process unit and Appendix 1: Figure 4 shows the process flow diagram. Appendix 1: Figure 5 shows the layout of the proposed expansion. The proposed plant modifications and the proposal characteristics are summarised in Tables 1 and 2 of Appendix 1.

The expansion will include the following:

- separation of coke and ore receiving facilities (Unit 100);
- duplication of existing facilities in the Unit 200 (Chlorination, Condensation and Purification);
- additional oxidation line facilities in Unit 300 (Oxidation);
- new Unit 400 (Finishing) allowing the simultaneous production of a second pigment grade with its own finished product packaging capability; and
- expansion and/or duplication of Unit 500 (Utilities and Chemical Storage) and Unit 600 (Waste Treatment).

The expansion will result in a proportionally increase in energy and water consumption, and in liquid and solid wastes, with the exception of natural gas consumption and gaseous waste emissions. The small increase in natural gas consumption and emissions of carbon dioxide (CO_2) and oxides of nitrogen (NOx) is mainly due to the co-generation facility operating (by a third party). The large increase in emissions of sulphur dioxide (SO_2) is due to current waste gas incineration and SO_2 scrubbing system having reserved capacity.

Commissioning of stages 1 and 2 are anticipated to commence in 1998 and 2000 respectively.

Whilst no changes were made to the proposal during the assessment process, the projected SO_2 emissions for the expansion (Appendix 1: Table 3 (a)) was revised by the proponent and is included in Appendix 1: Table 3 (b).

3. Environmental factors

3.1 Relevant environmental factors

It is the EPA's opinion, giving appropriate consideration to the submissions and material referenced in Appendices 2 and 3, that the following are the environmental factors relevant to the proposal:

Pollution:

(a) sulphur dioxide (SO_2) gas;

(b) chlorine gas;

(c) other gases including oxides of nitrogen (NOx), titanium tetrachloride ($TiCl_4$), carbon monoxide (CO) and carbon dioxide (CO_2, a green house gas);

(d) dust;

(f) odours (reduced sulphur compounds);

(g) marine discharge;

(h) solid wastes;

(i) ground water quality;

(j) noise; and

Social surrounds:

(k) public safety (risk).

These relevant environmental factors are discussed in Sections 3.2 to 3.11 of this report.

3.2 Sulphur dioxide (SO_2) gas

Aspects of sulphur dioxide (SO_2) gas

SO_2 gas and other sulphur compounds are produced as waste gases by the chlorination of synthetic rutile in the presence of petroleum coke in the chlorinators. SO_2 emissions occur at waste gas incineration and SO_2 scrubbing system (or Waste Gas Incinerator, WGI) stacks and the Standby Thermal Oxidiser (STO) stack. The WGI and STO convert sulphur compounds in the waste gases to odourless SO_2. The current DEP's licence conditions require that waste gases are directed to the STO only when the WGIs are unavailable, as the STO is a back-up equipment and does not have SO_2 scrubbing facilities.

The proposed SO_2 emissions, with an average emission of 28g/sec, constitute a small percentage (about 2.2%) of the total licensed SO_2 emissions from industries in the Kwinana industrial area, and the significant increase (1440%)in SO_2 emissions associated with the

expansion (Appendix1: Table 2) is due to the current waste gas incineration and SO_2 scrubbing system having reserved capacity.

Projected SO_2 emissions for the expansion as described in Appendix C of the CER have been revised by the proponent and are included in Appendix 1: Table 3. The main difference between Appendix C of the CER and the revised Table 3 is that in the revised Table 3, SO_2 emissions and their frequency from the WGIs for Stage 3 expansion were not calculated, as the Stage 3 expansion will be subject to technological and commercial viabilities.

The *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1992* (referred to in this report as the Kwinana EPP) establishes air quality standards and limits for SO_2 to protect the environment (including human health) in the municipalities of Cockburn, Kwinana and Rockingham. As part of the Kwinana EPP, Maximum Permissible Quantities (EPA, 1992a) were determined for the Kwinana industries to ensure that these standards and limits can be achieved. The Maximum Permissible Quantities stipulate the maximum permissible emission of SO_2, in grams per second (g/sec), for each industry. The current Maximum Permissible Quantity for Tiwest is 77 g/sec from the Bypass Incinerator Stack (referred to as the Standby Thermal Oxidiser (STO) in the CER).

The Department of Environmental Protection (DEP) is in the process of redetermining the Maximum Permissible Quantities for Kwinana industries. The DEP has conducted air dispersion modelling exercises using a statistical treatment of sulphur dioxide emission rates. The modelling runs illustrated that statistically there can be infrequent emissions which exceed the Maximum Permissible Quantities for particular industries without exceeding the Kwinana EPP ambient standards. The DEP is pursuing a statistical approach to determination of Maximum Permissible Quantities in consultation with Kwinana industries.

The DEP advised that in order to comply with Section 51 of the *Environmental Protection Act 1986*, which requires all reasonable and practicable measures to be taken by Tiwest (as occupier of a licensed premises) to minimise SO_2 discharge, the waste gas incineration and SO_2 scrubbing system must have sufficient installed capacity to ensure that SO_2 emissions per tonne of pigment for all stages of the expansion to be lower or the same as those for 75,000 tpa production rate.

The current DEP's licence conditions for the plant stipulate SO_2 discharge limits and frequencies for the WGI stacks and the STO stack, to reflect the requirements of the Kwinana EPP and the *Environmental Protection Act 1986.*

Assessment

The area considered for assessment of this relevant environmental factor is the area defined in the Kwinana EPP, which is in the municipalities of Cockburn, Kwinana and Rockingham (Appendix 1: Figure 6). This is the area within which SO_2 emissions must be controlled to meet the Kwinana EPP standards and limits.

The EPA's objective in regard to this environmental factor is to ensure that SO_2 emissions meet the air quality standards and limits (within reasons) stated in the Kwinana EPP, and the requirements of Section 51 of the *Environmental Protection Act 1986* (all reasonable and practicable measures to be taken to minimise SO_2 discharge).

The EPA notes that the proposed SO_2 emissions, with an average emissions of 28g/sec, is less than the current fixed limit of 77g/sec. Verification of Tiwest's air dispersion modelling (Sinclair Knight Merz, 1996) by the DEP indicates that the expected emission profile, even with infrequent exceedance of 77g/sec (about 1% of the time), generally has lower ground level concentrations than those previously modelled for a fixed discharge of 77g/sec and that the proposed emissions can be accommodated within the Kwinana EPP's standards and limits, through a re-determination of the Maximum Permissible Quantities for SO_2 discharged from the Kwinana industries. The requirement for a redetermination was identified in recommendation 5.8 of the Towards Optimising Kwinana Final Report (Dames & Moore for the Kwinana Industries Co-ordinating Committee, 1996).

For consistency with the outcome of this assessment, the EPA considers that a re-determination for all industries including Tiwest should be completed by the time Tiwest expects to commission Stage 1 of the expansion (scheduled for April 1998). If this is not achievable then a re-determination of Maximum Permissible Quantities for Tiwest's expansion, to allow emissions up to but not greater than those provided in Appendix 1: Table 3 of this report, should be undertaken and completed by April 1998. The Maximum Permissible Quantities should reflect the EPA's objectives as stated above and should be incorporated in the licence conditions for Tiwest following the Works Approval process.

The EPA notes that the reserved capacity of the existing waste gas incineration and SO_2 scrubbing system will allow SO_2 emissions per tonne of pigment for Stage 1 and Stage 2 expansion to be lower or the same as those for the 75,000 tpa production rate. Tiwest has made commitments to investigate means to further reduce SO_2 emissions and to ensure sufficient SO_2 scrubbing capacity for the Stage 3 expansion through the Works Approval process. The EPA considers that subject to the redetermination, sufficient SO_2 scrubbing capacity for the Stage 3 expansion can be achieved through the installation of additional waste gas incinerator (s) and/or other operational and process control mechanisms. In this regard, the proposed SO_2 emissions can be managed to meet the requirements of Section 51 of the *Environmental Protection Act 1986*.

Although the requirement of Section 51 of the *Environmental Protection Act 1986* is consistent with the "best practice" principle supported by the EPA, the EPA considers that there is a need for the DEP and the titanium dioxide industry in Western Australia (ie. Tiwest and SCM Chemicals) to define and document "best practice" requirements in relation to SO_2 emissions for this industry.

Having particular regard to:

(a) the air quality standards and limits stated in the Kwinana EPP for SO_2;

(b) the requirements of Section 51 of the *Environmental Protection Act 1986*;

(c) Tiwest 's commitments to ensure sufficient SO_2 scrubbing capacity for all stages of the expansion (particularly Stage 3) and to investigate means to further reduce SO_2 emissions;

(d) the proposed SO_2 emissions being accommodated through the re-determination of Maximum Permissible Quantities, based on a statistical approach, planned for 1997;

(e) the ability to confirm sufficient SO_2 scrubbing capacity for the Stage 3 expansion through the Works Approval process; and

(f) the "best practice" requirements in relation to SO_2 emissions for titanium dioxide industry being defined and documented by the DEP and the industry,

it is the EPA's opinion that its objective for SO_2 emissions is unlikely to be compromised by the expansion.

3.3 Chlorine gas

Aspects of chlorine gas

Chlorine emissions mainly occur from the Snake Scrubber stack. The Snake Scrubber system collects low to large volumes of chlorine from the oxidiser lines during normal maintenance, rupture disc failure, controlled and unplanned plant shutdowns.

The DEP advised that, as a result of a compliance audit of Tiwest's Snake Scrubber system relating to the environmental conditions issued for the 80,000 tpa production (under Part IV of the *Environmental Protection Act 1986*), the following interim guidelines for chlorine emissions should be applied to the expansion:

- design ground level concentration (3 minute average) for continuous chlorine emissions should not exceed 0.03 mg/m^3 or 0.01 ppm at nearest residence; and

- design ground level concentrations for intermittent discharge of chlorine the (3-minute average) should not exceed 0.1 ppm within area C (residential area), 0.3 ppm within area B (buffer area), and 0.5 ppm within area A (industrial area) of Kwinana EPP.

The CER details the existing and proposed management measures for chlorine emissions, including fugitive emissions from leaking of compressors during an emergency shutdown.

Estimated ground level concentrations for the existing plant and proposed expansion are also detailed in the CER (Table 6-4). The estimated ground level concentrations for chlorine, from the Snake Scrubbing system under the worst case scenario (total unplanned and uncontrolled shutdown), currently meet the DEP's guidelines for intermittent discharge.

Assessment

The area considered for assessment of this relevant environmental factor is the area defined in the Kwinana EPP. This is the area within which chlorine emissions must be controlled to meet acceptable standards.

The EPA's objective in regard to this environmental factor is to ensure that chlorine emissions meet acceptable standards, so that they do not adversely affect the health, welfare and amenity of nearby land users. The EPA considers that the above interim guidelines recommended by the DEP for chlorine emissions are acceptable standards for this assessment.

The EPA notes that the Snake Scrubbing system has the potential for the largest emissions of chlorine. The predicted chlorine emissions and ground level concentrations associated with the expansion for this system, under the worst case scenario, will be approximately half of the current levels, as a result of the installation of passive caustic scrubbers. In this regard and on the basis that the releases from the plant are intermittent, the chlorine emissions from the expansion can be managed to meet the DEP's guidelines.

The EPA also notes that the proposed replacement of exiting NASH compressors with Garo compressors which have better seals, will significantly reduce fugitive emissions of chlorine.

Having particular regard to:

(a) the proponent's proposed management to reduce chlorine emissions from the Snake Scrubbing system stack;

(b) the DEP's interim guidelines on ground level concentrations for chlorine emissions; and

(c) the proponent's commitment to demonstrate satisfactory performance of the Snake Scrubbing system, as part of the Works Approval process for each stage of the expansion,

it is the EPA's opinion that chlorine emissions associated with the expansion can be managed to meet the above stated objective.

3.4 Other gases including oxides of nitrogen (NOx), titanium tetrachloride ($TiCl_4$), carbon monoxide (CO) and carbon dioxide (CO_2, a greenhouse gas)

Aspects of other gases

Oxides of nitrogen (NOx) are produced by the combustion of natural gas in the boilers and dryers, and the oxidation of titanium tetrachloride ($TiCl_4$) in the oxidisers. About 93.5 tpa of NOx is produced from the plant currently (about 0.5% of the NOx emissions from the Kwinana region). The expansion will result in a 24% increase in NOx emissions. This increase is less than the production capacity increase (125%), as a result of the Co-generation plant (Appendix 1: Table 2).

$TiCl_4$ is an intermediate product, produced by chlorination of synthetic rutile in the chlorinators. There is no stack emission of $TiCl_4$ from the plant but fugitive emissions of $TiCl_4$, caused by accidental releases during normal maintenance or equipment failures, can have off-site impact.

Any accidental release of $TiCl_4$ would be evident by a white cloud as $TiCl_4$ hydrolyses to titanium oxide and hydrochloric acid. The expansion will potentially increase the rate of occurrence of $TiCl_4$ fugitive emissions, due to more items of plant equipment.

Carbon monoxide (CO) is present in the waste gas stream generated by the chlorination of synthetic rutile. CO gas is normally oxidised to carbon dioxide (CO_2) by the WGIs or STO before venting to atmosphere. In the event that both the WGIs and STO fail, CO is then vented through the emergency stack, at concentrations of 21 to 41% (CER, Table 5-1) and a typical mass emission rate of 1071 g/sec (Sinclair Knight Merz, 1996). Assuming that the expansion will proportionally increase the mass emissions of CO from emergency venting (125% increase), acceptable ground level concentrations can be achieved through sufficient emergency stack height. The rate of occurrence of CO fugitive emissions, due to leaks in equipment, will also be potentially increased.

Carbon dioxide (CO_2), a greenhouse gas, is produced in combustion processes. About 222,200 tpa of CO_2 is produced from the plant currently. The expansion will only result in a 54% increase in CO_2 emissions. This increase is less than the production capacity increase (125%), due to the Co-generation plant (Appendix 1: Table 2).

The CER details existing and proposed management measures for emissions of the above gases, the predicted emissions of NOx and CO_2 (Table 6-5), and predicted ground level concentrations of CO (Table 6-2).

The DEP considers that the emissions should comply with the following guidelines and requirements:

- the Australian Environment Council/National Health and Medical Research Council (AEC/NHMRC, 1986) guideline of 320 ug/m^3 or 0.16 ppm (one hour average ground level concentration not to be exceeded more than once per month) at the most affected residence for NO_X;
- the World Health Organisation (WHO) guideline of 31,200 ug/m^3 or 25ppm (one hour average ground level concentration at the most affected residence for CO emissions;
- Section 51 of the *Environmental Protection Act 1986*, which requires all reasonable and practicable measures to be taken to minimise the discharge of $TiCl_4$; and
- EPA's provisional policy on greenhouse gases.

In regard to greenhouse gases, the EPA has adopted the following provisional policy:

- proponents should calculate the greenhouse gas emissions associated with their proposal (preferably using methodology developed for Australia);
- proponents should indicate specific measures adopted to limit greenhouse gas emissions for their proposal;
- proponents are encouraged to enter into the C21 'Greenhouse Challenge' voluntary agreement programme for the estimation, reporting and auditing of greenhouse gas emissions, whether on a project-specific basis, company-wide arrangement or within an industrial grouping, as appropriate; and
- proponents should estimate the global emission credit (greenhouse gas offsets) achieved through implementation of the proposal.

Assessment

The area considered for assessment of this relevant environmental factor is the plant site and surrounding premises and properties. This is the area that gaseous emissions must be controlled to meet acceptable standards and air quality guidelines.

The EPA's objective in regard to this environmental factor is to ensure emissions do not adversely affect the environment or health, welfare and amenity of nearby land users, by meeting statutory requirements (including Section 51 of the *Environmental Protection Act 1986*) and appropriate standards.

The EPA notes that NOx emissions per tonne of pigment will be reduced as a result of an independent Co-generation plant and the use of state-of-the art combustion burners for the expansion (CER, page 6-10), and that Tiwest only contributes to about 0.5% of NO_X emissions from the Kwinana region. The DEP's monitoring results at Hope Valley show that ambient air quality resulting from NO_X emissions from the Kwinana region have been meeting the AEC/NHMRC guideline.

In regard to emergency venting of CO associated with the expansion, the EPA notes that dispersion modelling shows that the predicted ground level concentration is 10,650 ug/m^3 in the residential area and the nearest affected residence lies outside the 31,200 ug/m^3 contour (Sinclair Knight Merz, 1996), for a stack height as low as 40m. The alarm network will be expanded to detect fugitive emissions of CO more effectively.

The EPA notes that there has been a decreasing trend in the frequency and severity of Level 2 and Level 3 $TiCl_4$ releases since 1991. Although the rate of occurrence of $TiCl_4$ fugitive emissions could be expected to increase as a result of the plant expansion, this can be managed through equipment design and operational procedures. The Department of Minerals and Energy considers that Tiwest's current safety performance, in general and in regard to management of $TiCl_4$ releases, is acceptable.

The EPA notes that whilst there will be a small increase in the overall CO_2 emissions associated with the expansion, CO_2 emissions per tonne of pigment will be reduced, primarily as a result of an independent Co-generation plant. The EPA considers that the pigment plant is a small green house gas emitter (342,000 tpa of CO_2 or approximately less than 0.1% of the total emissions in Australia), and that Tiwest's commitment to consider entering into the C21 'Greenhouse Challenge' voluntary agreement programme for the estimation, reporting and auditing of greenhouse gas emissions is appropriate.

Having particular regard to:

(a) the proponent's proposed management to reduce emissions of the gases, either in terms of an overall reduction or a reduction per tonne of pigment produced;

(b) the requirements of Section 51 of the *Environmental Protection Act 1986* and acceptable standards and guidelines; and

(c) the proponent's commitments on emergency stack height and greenhouse gas emissions,

it is the EPA's opinion that emissions of the above gases can be managed to meet the stated objective for this factor.

3.5 Dust

Aspects of dust

Dust and particulates are generated from various stacks in the plant and from fugitive sources such as material handling and vehicular movement.

Dust management measures are outlined by the proponent in the CER, which include sealing trafficable areas, proper inspection and maintenance of baghouse filters, and a change to alternative dryers.

Although the Kwinana EPP establishes air quality standards and limits for total suspended particulates to protect the environment (including human health) in the EPP area, the current licence conditions for the pigment plant do not require stack sampling of dust, due to the small size of the dust sources. The potential dust emissions are considered to be below the threshold to warrant the setting of discharge limits.

Assessment

The area considered for assessment of this relevant environmental factor is the area defined in the Kwinana EPP. This is the area within which dust emissions must be controlled to meet the Kwinana EPP standards and limits.

The EPA's objective in regard to this environmental factor is to ensure that the dust levels from the expansion meet the air quality standards and limits stated in the Kwinana EPP.

The EPA notes that dust emissions from the existing operation are only small sources and are not likely to exceed the EPP standards and limits. The concentration of particulates is not likely to be increased with the expansion, and may even be reduced if a new system of hot bag filters can be installed (which will reduce the frequency of failure). Fugitive dust emissions per tonne pigment will also be reduced by a change to alternative pigment dryers (which are fully enclosed and operated under a negative pressure). Hence the dust emissions from the expansion will meet the EPP standards and limits.

Having particular regard to:

(a) the proposed management to reduce dust emissions; and

(b) the small dust sources which are highly unlikely to exceed air quality standards and limits stated in the Kwinana EPP for total suspended particulates,

it is the EPA's opinion that its objective for dust is unlikely to be compromised by the expansion.

3.6 Odours (reduced sulphur compounds)

Aspects of odours

Odorous reduced sulphur compounds (predominantly hydrogen sulphide, H_2S and carbonyl sulphide, COS) are present in the waste gas stream generated by the chlorination process. Like CO gas, these compounds are normally oxidised to form SO_2 and CO_2 by the WGIs or STO before venting to atmosphere. In the event that both the WGIs and STO fail, the compounds are then vented through the emergency stack.

Venting of waste gases through the emergency stack is predicted to remain at the current frequency of around 10 hours per year. The current DEP's licence conditions restrict the use of emergency stack to less than 6 hours in any 24 hours, and less than 70 hours total per calendar year.

Proposed management measures to minimise releases of odorous compounds are outlined in the CER, which include installation of a second STO, and upgrading existing stack or installation of a new stack. Predicted maximum 3-minute ground level concentrations of H_2S and COS on an individual basis, for a 180,000 tpa plant with a 65m replacement stack, meet acceptable ground level concentrations for these gases in residential area (using the DEP's preliminary advice and Tiwest's own information on odour threshold) (Table 6-1, CER). The maximum 3-minute COS concentration would be 1,000ug/m^3 at Kwinana (2.5km due east of Tiwest) and 700ug/m^3 at Hope Valley (3.5km north-northeast of Tiwest. However, at the request of the DEP, Tiwest has provided further information on a determination of the ground level concentration of the waste gas mixture in odour units (or OUs), using dynamic olfactometry method.

The DEP considers that acceptable criteria for odour impacts in terms of design ground level concentration OUs are most appropriate for a gas mixture with potential cumulative impacts, such as Tiwest's waste gas stream. As interim criteria, the DEP will accept either the Queensland or New South Wales odour criteria. Where meteorological data are not available or comprehensive modelling is not warranted, a guideline value (3 minute averaging time) of 5 OUs (for a conservative screening model such as MAXMOD) or 2.5 OUs (for a non-conservative screening model such as AUSPLUME) will also be accepted by the DEP.

Section 51 of the *Environmental Protection Act 1986* requires that Tiwest takes all reasonable and practicable measures to prevent or minimise discharge of odorous gases.

Assessment

The area considered for assessment of this relevant environmental factor is the plant site and surrounding premises and properties. This is the area that odour emission must be controlled to minimise its impact.

The EPA's objective in regard to this environmental factor is to ensure compliance with acceptable standards and that all reasonable and practicable measures are taken to minimise adverse impact of odorous gases. The EPA considers that the DEP's interim odour impact guidelines can be used as acceptable standards for this assessment.

The EPA notes that the expansion is not anticipated to increase the current frequency of odorous gas releases, through the installation of a second STO.

The results of the dynamic olfactometry analysis on a sample of the waste gas and subsequent dispersion modelling for existing operations meet the 2.5 OUs criteria at the most affected residence at Wells Park (Appendix 1: Fig 7). The DEP considers that acceptable odour impacts for the expansion can be achieved with sufficient stack height (by upgrading existing stack or installation of a new stack). The final height of the stack can be determined through the Works Approval process when more detailed engineering design information is available.

Accordingly, Tiwest has made a commitment to design and install an emergency stack with sufficient height to ensure acceptable odour impacts at the nearest affected residence.

Having particular regard to:

(a) the proponent's proposed management and commitment to ensure that odours do not unreasonably interfere with the health, welfare, convenience or amenity of the nearest affected residence, which will be confirmed through the Works Approval process;

(b) the standards for odorous gases stipulated in the DEP's draft air quality guidelines,

it is the EPA's opinion that its objective for odours can be met.

3.7 Marine discharge

Aspects of marine discharge

All liquid waste from the plant is treated on-site prior to disposal via a pipeline and diffuser into Cockburn Sound. The wastewater treatment includes removal of dissolved heavy metals and suspended solids in the Effluent Treatment Plant (Unit 600), and cooling and final clarification in two treatment ponds.

The CER summarises and discusses the results of monitoring to date for effluent, ambient water, sediments and mussels. The presence of low levels of radionuclides in the synthetic rutile feedstock for pigment production requires monitoring of treated wastewater for radionuclide levels. The CER also sets out concentrations and predicted daily load of significant contaminants discharged into Cockburn Sound and proposed management to maintain effluent quality.

The current DEP's licence conditions for the plant stipulate effluent discharge limits for suspended solids, pH and manganese (previously chromium) and radionuclides, and monitoring requirements for a range of substances. Under the Radiation Safety Act 1975 and Regulations, the Radiological Council also requires monitoring of radionuclides in the effluent discharge.

Water quality outside the mixing zone should meet acceptable standards including the Draft Western Australian (WA) Guidelines for Fresh and Marine Waters (EPA, 1993). The Draft WA guidelines are largely drawn from the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, 1992). It should be mentioned that and the Draft environmental quality

criteria recommended in the recently released Southern Metropolitan Coastal Waters Study (1991-1994) report (DEP, 1996) are largely drawn from both the WA Draft guidelines and the ANZECC guidelines.

It should be noted that in the previous assessment of the 80,000 tpa expansion for the pigment plant (EPA, 1995), the EPA expressed a concern about the large volume of scheme water used by Tiwest, which is discharged as effluent into Cockburn Sound. Consequently, Tiwest has conducted and implemented a water usage reduction programme (Minproc, 1996), which has resulted in a 20% reduction. This effort was recognised by the Water Corporation. With the expansion, the Water Corporation considers that the required water for the expansion can be supplied (but at a reduced pressure for stage 3). Tiwest has indicated that it will continue to investigate and implement viable options to further reduce the water consumption per tonne of pigment.

Assessment

The area considered for assessment of this relevant environmental factor is the plant site, the effluent discharge pipelines and diffuser, and the marine environment at the boundary of the mixing zone of the diffuser in Cockburn Sound (Appendix 1: Figure 8). A mixing zone of 4,000 m^3 (804 m^2 at the surface) has been defined around the existing diffuser, which was designed for a flow rate of 300 m^3/hr and an initial dilution of 1:120. Effluent quality must be managed so that ambient water quality meet statutory requirements and acceptable standards at the boundary of the mixing zone.

The EPA's objective in regard to this environmental factor is to ensure that marine water quality in Cockburn Sound is maintained or improved, and where possible, impacts upon locally significant marine flora and fauna communities are avoided, by ensuring that the effluent quality and water quality in the vicinity of the defined mixing zone comply with the following statutory and acceptable standards:

- the *Radiation Safety Act 1975* and the *Radiation Safety (General) Regulations 1983*;
- the DEP's licence limits for effluent discharge; and
- acceptable standards including the Draft WA Water Quality Guidelines for Fresh and Marine Waters.

The EPA notes that the concentrations of effluent discharge to date comply with the licence limits. The radiation levels in effluent discharge are well below the Draft Drinking Water Guidelines (NHMRC, 1994), thus meeting the Radiological Council's requirements for marine discharge.

The five years of post commissioning (to mid 1996) monitoring of water, sediments and mussels in the vicinity of outfall in Cockburn Sound (Kinhill, 1996a) found minimal impact of the discharge on the environment that is spatially restricted to elevated levels of some metals in sediments immediately adjacent to the diffuser. Temperature, salinity, dissolved oxygen and pH profiles of the waters surrounding the outfall plume have shown no impact of the outfall discharge. Monitoring of heavy metals (aluminium, chromium, manganese, niobium, vanadium and zirconium) in the receiving waters in the vicinity of Tiwest's outfall are either below available guideline/ criteria values for the protection of aquatic ecosystems, or show no discernible impact on the environment. The monitoring results of heavy metals and radionuclides in the sediments surrounding the outfall are summarised in Appendix 1: Table 4. Although the concentrations of chromium and aluminium in sediments meet the available criteria (Long et al, 1995 and DEP, 1996), there is a gradual enrichment of certain metals (chromium, manganese, titanium and vanadium) in the sediments since the baseline study, primarily to the west of the outfall. While alternative sources of heavy metals may contribute to the observed gradual enrichment, Tiwest will carry out further investigation to better define the extent for enrichment, particularly as a result of increased discharge after the plant expansion. The results of the monitoring of mussels show no accumulation of metals or radionuclides in the tissues of mussels surrounding the outfall.

The EPA also notes that whilst the effluent flow rate will be increased proportionally (125%) as a result of the expansion (Appendix 1: Table 2) the quality of the effluent discharge, including radioactive levels, will be maintained by upgrading current wastewater treatment plant (CER, Table 6-6). The increase in the ocean outfall flow rate will be accommodated by a second pipeline and modifications to the diffuser (ie. increasing the port diameters). Although modelling of the discharge indicates that dilution will be about half of that currently achieved, the concentrations outside the mixing zone will still be within acceptable standards (Kinhill, 1996b). As part of its environmental management, Tiwest is committed to take appropriate action including investigation and, if necessary, corrective measures, in the event of monitoring results indicating an increasing trend with potential to cause unacceptable impact to the marine environment.

Having particular regard to:

(a) the proponent's proposed management to maintain the current quality of effluent for the expansion, and commitment to take appropriate action in the event of monitoring results indicating an increasing trend with potential to cause unacceptable impact to the marine environment;

(b) the requirements of the DEP's licence conditions and the *Radiation Safety Act 1975* and the *Radiation Safety (General) Regulations 1983*, administered by the Radiological Council; and

(c) acceptable marine water quality standards, including the Draft environmental quality criteria recommended in the recently released Southern Metropolitan Coastal Waters Study (1991-1994) report.

it is the EPA's opinion that its objective for marine discharge is unlikely to be compromised by the proposal.

3.8 Solid wastes

Aspects of solid wastes

Solid wastes generated from the plant include low level radionuclide containing wastes and other hazardous (hydrocarbon, aluminium chloride bags) and general wastes.

The process solid waste produced from the thickener discharge (35% moisture) contains about 25-35 ppm uranium and 255-300 ppm thorium, resulting from the concentration of the low levels of radionuclides present in the synthetic rutile feedstock. Other radionuclide contaminated wastes include chlorinator refractory bricks and effluent pipework.

The Radiological Council of Western Australia and the Department of Minerals and Energy (DME), which have statutory control on radioactive wastes, have approved the current transport and disposal of the process solid waste and refractory bricks at Tiwest's Cooljarloo Minesite. Tiwest is currently investigating the suitability of disposing of the contaminated pipework at the Cooljarloo Minesite, as well as options to prevent future build-up of radionuclide scaling in the pipework.

Current management of radioactive wastes are in accordance with the Radiation Management Plan approved by the Radiological Council of Western Australia and DME. The management measures include:

- on-site storage of all radionuclide containing wastes in designated stores before transporting off-site for disposal;
- maintaining the moisture content of the process solid waste during on-site storage to prevent dust generation;
- collection of process waste spillages to the Effluent Treatment Plant;
- transport of the process solid waste (and contaminated refractory bricks) to the Cooljarloo Minesite in accordance with the Radiological Council's requirements;

- storage of the process solid waste (and contaminated refractory bricks) at the Cooljarloo Minesite in specifically engineered clay-lined cells several metres above water table, which are finally encapsulated with about 5m thick layer of clay overburden from the minesite and surface rehabilitated.

Other hazardous (hydrocarbon, aluminium chloride bags) and general wastes from the plant are collected by licensed contractors for disposal at approved landfill sites or for recycling.

The current DEP's licence conditions requires the process solid waste to be disposed of at the Cooljarloo Minesite, and all solid wastes with potential to cause pollution to be disposed of in accordance with the requirements of the DEP's Waste Management Division.

Details on solid wastes, their current management and proposed management for the expansion are outlined in the CER.

Assessment

The area considered for assessment of this relevant environmental factor is the plant site and the waste transport route. This is the area that solid wastes must be managed to meet statutory requirements and acceptable standards.

The EPA's objective in regard to this environmental factor is to ensure that solid wastes are handled and disposed of in an acceptable manner to avoid potential contamination of soil, surface and ground water, and to keep radiological impacts as low as reasonably achievable, by:

- complying with statutory requirements including the DEP's licence conditions, the *Radiation Safety Act 1975*, *Radiation Safety (General) Regulations 1983, and Radiation Safety (Transport of Radioactive Substances) Regulations 1991* (administered by the Radiological Council), *Dangerous Goods Regulations*, and the Mine *Safety and Inspection Act 1994* and *Mine Safety and Regulations 1995* (administered by the DME); and
- meeting acceptable environmental quality standards including the Draft WA Guidelines for Fresh and Marine Waters (EPA, 1993).

The EPA notes that whilst the quantity of the process solid waste will be increased proportionally with the expansion, the composition of solid waste (containing low level radionuclides) will be maintained.

The EPA notes that the current management of radionuclide containing wastes, which complies with the statutory requirements of the Radiological Council and DME, will continue for the expansion.

The results of the groundwater monitoring at Cooljarloo to date indicate no contamination.

The EPA notes that investigation is currently carried out on the suitability of disposal of the contaminated pipework at the Cooljarloo Minesite. Management measures such as the use of dispersants are being implemented to prevent future scale build-up.

The EPA also notes Tiwest's commitments to manage the radionuclide containing wastes to the requirements of the DME and Radiological Council.

Other hazardous and general wastes are considered to be disposed of in an acceptable manner.

Having particular regard to:

(a) the statutory requirements of the Radiological Council and DME relating to the management of the radioactive wastes;

(b) the requirements of the DEP's licence conditions relating to disposal of solid wastes; and

(c) Tiwest's commitment to continue to manage the radionuclide containing wastes in accordance with the requirements of the Radiological Council and DME,

it is the EPA's opinion that its objective for solid wastes is unlikely to be compromised by the expansion.

3.9 Groundwater quality

Aspects of groundwater quality

Regionally, groundwater moves from east to west. Groundwater beneath the pigment plant site has already been contaminated with nitrogen compounds, sulphate, sodium, herbicides and phenols, by the former Chemical Industries Kwinana (CIK) plant operations. Hence, no groundwater abstraction occurs on-site except for monitoring purposes.

Monitoring of groundwater is currently carried out by Tiwest to monitor the migration of the contaminated plume and to ensure no further contamination of groundwater from the effluent ponds and from the process areas of the plant.

Details of the current groundwater monitoring and its results, the current and proposed management of ground water are outlined in the CER.

Management measures should ensure a reduction in or at least no further contamination of ground water and no disturbance of the existing contaminated plume.

Assessment

The area considered for assessment of this relevant environmental factor is the groundwater beneath the site and down-gradient of the site. This is the area where groundwater quality could be affected by the operations of the pigment plant, which subsequently can impact the water quality of Cockburn Sound.

The EPA's objective in regard to this environmental factor is to ensure that Tiwest implements sound design and management practice to avoid contamination of groundwater from the plant operations. The Draft WA Guidelines for Fresh and Marine Waters (EPA, 1993) or the DEP's recommended groundwater criteria for contaminated site assessment based on the Dutch and Victorian EPA criteria can be used as criteria for groundwater assessment if applicable.

The EPA notes that for the expansion, stormwater runoff and spillages will continue to be collected and directed to the Effluent Treatment Plant, and the current groundwater monitoring to detect contamination from the effluent ponds and from the process areas will continue.

The results of groundwater monitoring in the vicinity of effluent ponds (CER, Table 5-13) for Total Dissolved Solids (TDS), chloride and sulphate ions and pH, show discernible changes in groundwater quality to date (most likely due to seasonal variations), with the exception of an increasing trend for TDS and soluble salts in bore TI3I . Investigation by Tiwest's consultant (Rockwater, 1995) concluded that the effluent ponds were not the cause of this contamination. Subsequent investigation by Tiwest in 1996 suggested that an unsealed low lying area hydrologically upstream of bore 3I which, under infrequent conditions, experienced overflow from the adjacent sealed waste treatment plant apron, could be a possible source of TDS contamination. Action was taken by Tiwest to prevent further overflows from the treatment area. The results of groundwater monitoring to detect contamination from the site process area have indicated elevated levels of sodium and sulphate, with no on-site source being identified (Rockwater, 1995). Further investigations are being carried out to determine the source of this contamination.

The EPA also notes that there will be minimal or no disturbance of the underlying contaminated groundwater during construction, and Tiwest's commitment to develop and implement acceptable procedures for the safe handling and disposal of potentially contaminated groundwater, if disturbance of groundwater is necessary during the expansion construction.

Having particular regard to:

(a) Tiwest's current management practice to avoid further contamination of groundwater; and

(b) Tiwest's commitment to manage potentially contaminated groundwater, if disturbance of ground water is necessary during the expansion construction,

it is the EPA's opinion that its objective for ground water is not likely to be compromised by the proposal.

3.10 Noise

Aspects of noise

There has not been a noise problem associated with the operations of the pigment plant to date, since the nearest residence is about 2.3 km from the plant boundary. Existing plant noise emissions meet the DEP's current licence conditions for noise, which are based on the requirements of the *Noise Abatement (Neighbourhood Annoyance) Regulations 1979* .

Current noise management and predicted noise levels (Herring Storer Acoustic, 1996) for the expansion are outlined in the CER. The predicted noise levels for the expansion indicate compliance with the existing Noise Regulations, and largely meet the assigned noise levels in the proposed Noise Regulations, apart from the north-west corner of Nufarm plant.

Tiwest has also implemented an on-going noise control programme, to reduce noise levels generated from equipment items in the plant with typically high noise emission levels, such as air compressors and blowers, and pigment micronisers.

Noise management for the expansion must meet with the requirements of the *Noise Abatement (Neighbourhood Annoyance) Regulations 1979* , and, as far as reasonable and practical, meet the assigned levels of the proposed *Environmental Protection (Noise) Regulations.*

Assessment

The area considered for assessment of this relevant environmental factor is the pigment plant site and surrounding premises and properties. This is the area within which noise levels must be controlled to meet statutory requirements and acceptable standards.

The EPA's objective in regard to this environmental factor is to ensure that noise emissions from the plant operations comply with the requirements of the *Noise Abatement (Neighbourhood Annoyance) Regulations 1979* and, as far as reasonable and practical, meet acceptable standards. The EPA considers that the assigned levels of the proposed *Environmental Protection (Noise) Regulations* are acceptable standards for noise emissions.

The DEP considers that the noise predictions (Herring Storer Acoustic, 1996), based on duplication of existing plant and existing monitoring data, use the well accepted noise prediction method (using environmental noise modelling software, ENM) to compute noise levels from the Tiwest plant. Hence, these results are accepted as representative of the overall impact of the proposal.

The EPA notes that while the predicted noise levels for the expansion comply with the existing Noise Regulations, and largely meet the assigned noise levels in the proposed Noise Regulations, the predicted noise level of 69 dB(A) at the Nufarm boundary exceeds the proposed regulations by 4dB(A). This is because under the existing Noise regulations, the required noise levels for an "industrial" premises receiving noise in a neighbourhood which is "predominantly heavy industry" is 70 dB(A) at any time, whilst the proposed Noise regulations set an assigned levels of 65 dB(A) at any time for "industrial and utility" premises receiving noise, regardless of the neighbourhood in which it was located.

The DEP considers that as the noise predictions are based upon a physical duplication of the existing plant, in practice, with appropriate equipment choice and plant layout, the assigned levels under the proposed Noise regulations could be complied with. However, there is no data available at present, as the engineering design is not yet complete.

The EPA notes that the area of the Nufarm site where the proposed assigned noise level may be exceeded is normally not occupied by their staff, and Nufarm has provided a letter to Tiwest stating that the noise exceedance is not of concern to them.

The EPA also notes Tiwest's commitments to demonstrate compliance with the exiting Noise Regulations during the Works Approval process for each expansion phase, and to design the facility, as far as reasonable and practical, to meet the assigned noise levels of the proposed

Noise regulations. This is consistent with the requirement of the existing Noise regulations, and the intent of the proposed Noise regulations.

Having particular regard to:

(a) the requirements of the *Noise Abatement (Neighbourhood Annoyance) Regulations 1979* and the proposed *Environmental Protection (Noise) Regulations ;*

(b) the proponent's commitments on management noise emissions to meet the assigned noise levels of the proposed Noise regulations; and

(c) the letter from Nufarm stating that the potential noise exceedance is not of concern to them,

it is the EPA's opinion that its objective for noise is not likely to be compromised by the expansion.

3.11 Public safety (risk)

Aspects of public safety (risk)

The main hazards from the pigment plant are associated with toxic releases of chlorine and $TiCl_4$, and fire and explosion from the LPG storage.

The EPA has established a management principle and acceptable criteria for off-site individual fatality risk (EPA, 1992b and 1992c) for new industrial developments with a potentially hazardous nature, such as Tiwest's pigment plant. The criteria are as follows:

(a) a risk of fatality of one in a million per year or less in residential zones;

b) a risk of fatality between one half and one in a million per year in "sensitive developments", such as hospitals, schools, child care facilities and aged care housing developments;

(c) risk of fatality for industrial facilities not exceeding a target of fifty in a million per year at the site boundary for each individual industry, and the cumulative risk level imposed upon an industry not exceeding a target of fatality risk one hundred in a million per year; and

(d) a risk of fatality of ten in a million per year or lower for any non-industrial activity located in buffer zones between industrial facilities and residential zones.

Although the EPA has not yet established any criteria for societal risk, it recognises the need to develop these criteria in the near future.

The EPA's management principle is that risks should be reduced to a practicable minimum.

A number of hazard and risk analyses have been conducted through the life of the plant. The most recent quantitative risk assessment was conducted by an independent consultant for Tiwest's 80,000 tpa expansion (VJR Risk Engineers, 1994), and the calculated individual risk contour results comply with the EPA's criteria.

Details of the proposed risk management and the independent risk assessment for the expansion are outlined in the CER and the Quantitative Risk Assessment (QRA) reports (AEA, 1996a and 1996b).

For the expansion, the calculated risk levels must comply with the EPA risk criteria and the management principle. Management of risks and hazards must also comply with the requirements of the Explosives and Dangerous Division of the Department of Minerals and Energy (DME), since the DME has stipulated its requirements in the CER guidelines for the expansion, and has statutory responsibility for managing major hazardous industry in respect of public safety. The EPA also seeks technical advice from the DME on aspects of risks and hazards.

Assessment

The area considered for assessment of this relevant environmental factor is the plant site and surrounding premises and properties. This is the area within which risk levels must be controlled to meet the EPA's criteria and DME's requirements.

The EPA's objective in regard to this environmental factor is to ensure that risk is managed to meet the EPA's criteria for individual fatality risk off-site and the DME's requirements in respect of public safety.

As a result of its technical review of the QRA reports, the DME considers that the method used to compute the risk contours is acceptable and that the EPA's individual risk criteria will be met at the plant fence line and at residential areas, for all stages of the expansion. Cumulative risk levels from both Tiwest and Nufarm's expansion also meet the EPA's acceptable criteria. The societal risk levels for Tiwest's expansion and for a combined Tiwest and Nufarm's expansion are below the societal risk guidelines suggested for the Kwinana industrial area (AEA, 1995). However, the DME considers that Tiwest should be required to develop and implement a construction safety management plan and procedures to manage public risk during construction period, where construction activity is occurring around operating plant. Tiwest should also be required to review the Total Hazard Control Plan for the expanded plant.

The EPA notes that the individual risk contours for the expansion show a reduction in size comparing with those generated for the 80,000tpa. This reduction is due to a number of factors including the replacement of the NASH compressors with a smaller number of GARO compressors, reduction in size of the chlorine header, replacement of six small unprotected LPG vessels with a single vessel with water deluge protection, and optimisation of equipment locations and pipeline routing.

The EPA also notes Tiwest's commitments to implement risk mitigation measures, including those cited in the QRA reports, to further reduce the risk levels. Tiwest has committed to preparing and implementing a construction safety management plan and procedures, and revising the Total Hazard Control Plan for the expanded plant. These commitments are consistent with the EPA's risk minimisation principle and the DME's requirements.

Having particular regard to:

(a) the proponent's commitments to manage hazards and risk levels to meet the EPA's risk criteria and risk minimisation principle, and the requirements of the DME in regard to managing public risk during the construction period and revising the Total Hazard Control Plan;

(b) the requirements of the EPA's criteria for individual fatality risk off-site; and

(c) technical advice from the DME,

it is the EPA's opinion that its objective for public safety (risk) can be met by the expansion.

4. Conditions and procedures

In the EPA's opinion, the proposal should be subject to the following conditions and procedures if implemented.

4.1 Conditions

In the EPA's opinion, the proposal should be subject to the following conditions if implemented:

(a) the proponent's commitments set out in the CER and provided during the assessment process (Appendix 3), should be made enforceable;

(b) the proponent should be required to revise and implement the environmental management plan and environmental management procedures in order to implement the proposals, in

particular the management measures identified through the assessment process, and manage the relevant environmental factors to ensure the EPA's objectives (Section 3) are met. The plan should adopt quality assurance principles (such as those adopted in Australian Standards ISO 9000 series) and environmental management principles (such as those adopted in the voluntary Australian Standards ISO 14000 [draft] series), with appropriate monitoring and auditing to ensure compliance with this condition; and

(c) the proponent should be required to carry out satisfactory decommissioning of the project, removal of the plant and installations and rehabilitation of the site and its environs. A final decommissioning and rehabilitation plant should be submitted least six months prior to decommissioning.

These conditions should apply if the proposal is implemented, and their implementation audited by the Department of Environmental Protection.

4.2 Procedures

In the EPA's opinion, the proposal should be subject to the following procedures if implemented:

Sulphur dioxide emissions

(a) A re-determination of the Maximum Permissible Quantities for SO_2 in the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1992 for Tiwest should be completed by April 30, 1998;

(b) the Maximum Permissible Quantities should reflect the EPA's objective for SO_2 as stated in this report, and be incorporated in the licence conditions for Tiwest following the Works Approval process;

These procedures should apply if the proposal is implemented.

5. Recommendations

The EPA submits the following recommendations:

Recommendation 1

That the Minister for the Environment notes the relevant environmental factors and EPA objectives set for each factor (Section 3).

Recommendation 2

That subject to the satisfactory implementation of the EPA's recommended conditions and procedures (Section 4), including the proponent's environmental management commitments, the proposal can be managed to meet the EPA's objectives.

Recommendation 3

That the Minister for the Environment imposes the conditions and procedures set out in Section 4 of this report. The implementation of the Minister's conditions and procedures are to be audited by the DEP.

Recommendation 4

That the Minister for the Environment notes that the EPA considers that a redetermination of the Maximum Permissible Quantities for SO_2 in the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1992 for Tiwest should be undertaken. It is the EPA's opinion that this is a significant change, and that the Minister should initiate action for the Policy to be reviewed under s36 of the *Environmental Protection Act 1986,* and that such a redetermination should be undertaken in a timely fashion. The EPA considers that the review should be completed by April 30, 1998.

Recommendation 5

That the Minister for the Environment notes that the EPA intends to work with the DEP and titanium dioxide industry in Western Australia, to jointly define and document "best practice" requirements in relation to SO_2 emissions for the industry.

Table 1: Relevant environmental factors, objectives, proponent's commitments and EPA's opinion

Relevant Environmental Factors	Objective	Proponent's Commitments	EPA's Opinion
Pollution			
1. SO_2 gas.	SO_2 emissions to meet: • Air quality limits and standards stated in the Kwinana EPP. • EP Act, Section 51 which requires all reasonable and practicable measures to be taken to minimise discharge.	• Ensure sufficient installed capacity of SO_2 scrubbing equipment. • Demonstrate sufficient capacity of SO_2 scrubbing equipment for stage 3 expansion, as part of Works Approval process. • Investigate means of achieving reductions in SO_2 mass emissions as well as in value/frequency of peak emissions.	EPA's objective met through proponent's commitments, re-determination and Part V of Environmental Protection Act.
2. Chlorine gas.	Chlorine emissions do not adversely affect the health, welfare and amenity of nearby land users, by meeting the following guidelines: • Design ground level concentration (3 minute average) for continuous chlorine emissions should not exceed 0.03 mg/m^3 or 0.01 ppm at nearest residence (Victorian EPA 1981 SEPP Policy Schedule 3). • Design ground level concentrations for intermittent discharge of chlorine the (3-minute average) should not exceed 0.1 ppm within area C, 0.3 ppm within area B, and 0.5 ppm within area A of Kwinana EPP (DEP's guidelines to proponents).	• Ensure sufficient capacity of snake system scrubbers for each expansion stage, as part of Works Approval process.	EPA's objective met through through proponent's commitments and part V of Environmental Protection Act.
3. Other gases (NOx, $TiCl_4$, CO and CO_2).	Emissions do not adversely affect the environment or health, welfare and amenity of nearby land users, by meeting appropriate standards including: • AEC/NHMRC or WHO guidelines at most affected residence for NO_2 and CO continuous emissions . • EP Act, Section 51 which requires all reasonable and practicable measures to be taken to minimise the discharge of $TiCl_4$. • EPA 's provisional policy on greenhouse gases.	• Continue to improve engineering design and operational procedures for the expansion to reduce the frequency and severity of unplanned $TiCl_4$ emissions. • Design and install emergency stack facilities to ensure acceptable GLC of CO at at the nearest affected residence. • Investigate the environmental benefits of entering the C21 "Greenhouse Challenge" voluntary agreement programme for the estimation, reporting and auditing of greenhouse gas emissions.	EPA's objective met through proponent's commitments.
4. Dust	Total suspended particulates to meet air quality standards and limits stated in Kwinana EPP.		EPA's objective met.
5. Odours (reduced sulphur compounds)	All reasonable and practicable measures must be taken to minimise adverse impact of odorous gases (EP Act, Section 51).	• Design and install emergency stack facilities to ensure acceptable odour impact at the nearest affected residence.	EPA's objective met through proponent's commitments.
6. Marine discharge	Marine water quality in Cockburn Sound is maintained or improved, and where possible, impacts upon locally significant marine flora and fauna communities are avoided, by meeting acceptable standards including: • Draft WA Guidelines for Fresh and Marine Waters (EPA Bulletin 711, 1993); • Radiation Safety Act 1975 and Regulations; and • DEP's licence limits for effluent discharges.		EPA's objective met.

Solid wastes	Potential contamination of soil, surface and ground water is avoided, and radiological impacts are kept as low as reasonably achievable by: • complying with statutory requirements including the Radiation Safety Act 1975 and Regulations, Mine Safety and Inspection Act 1994 and Mine Safety and Regulations 1995; and • meeting Draft WA Guidelines for Fresh and Marine Waters (EPA Bulletin 711, 1993).	• Continue investigation and implementation of management measures to prevent future build-up of radioactive contaminated scaling in pipework, to the satisfaction of the Radiological Council. • Ensure that no radioactive contaminated equipment is removed from site without an approved disposal method, to the satisfaction of DME and Radiological Council.	EPA's objective met through proponent's commitments.
Ground water quality	Sound design and management practice are implemented to avoid contamination of ground water. Draft WA Guidelines for Fresh and Marine Waters (EPA Bulletin 711, 1993) can be used if applicable.	• Develop and implement procedures for the handling and disposal of potentially contaminated groundwater prior to disturbing ground water during construction, to the satisfaction of relevant regulatory authorities.	EPA's objective met through proponent's commitments.
Noise	Noise emissions to meet requirements of the Noise Abatement (Neighbourhood Annoyance) Regulations 1979 and acceptable standards.	• Provide model outputs to demonstrate compliance with appropriate noise regulations, as part of Works Approval for each expansion stage. • Design the plant, as far as reasonable and practical, to meet the proposed noise regulations. • Conduct noise surveys and assessments to confirm compliance within six months following commissioning of each expansion stage.	EPA's objectivesmet through proponent's commitments.
Social surrounds			
Public safety (risk).	Off-site risk to meet risk criteria in EPA Bulletins 611 and 627, and DME's requirements.	• Achieve EPA's risk criteria and minise risks through implementation of risk reduction measures. • Prepare and implement a construction safety management plan and procedures, before commencement of each construction phase. • Revise THCP for the expanded plant to the satisfaction of DME, before commissioning of each expansion stage.	EPA's objectivesmet through proponent's commitments.

Appendix 1

Figures and Tables

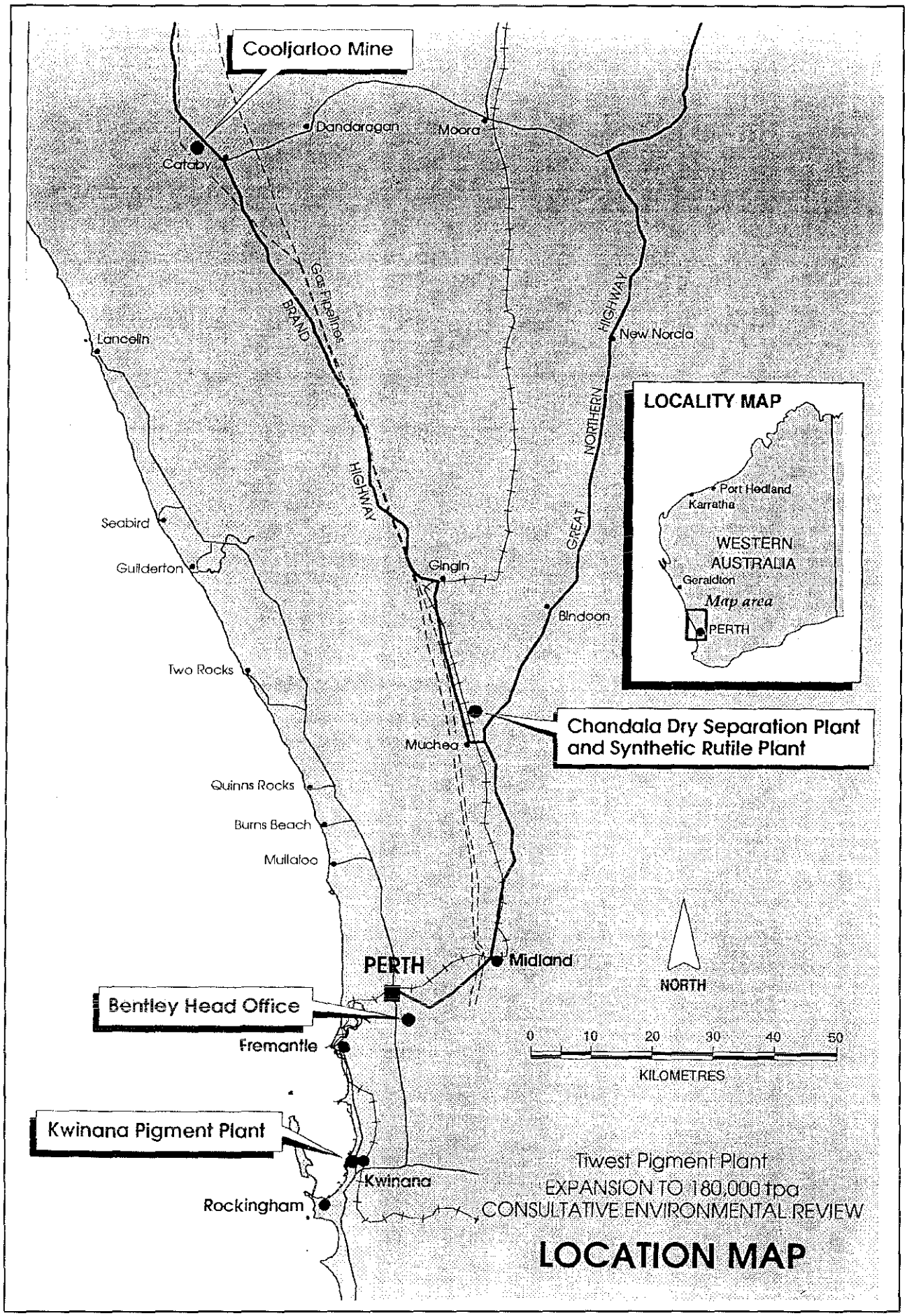

Figure 1. Location map (Source: CER, 1996).

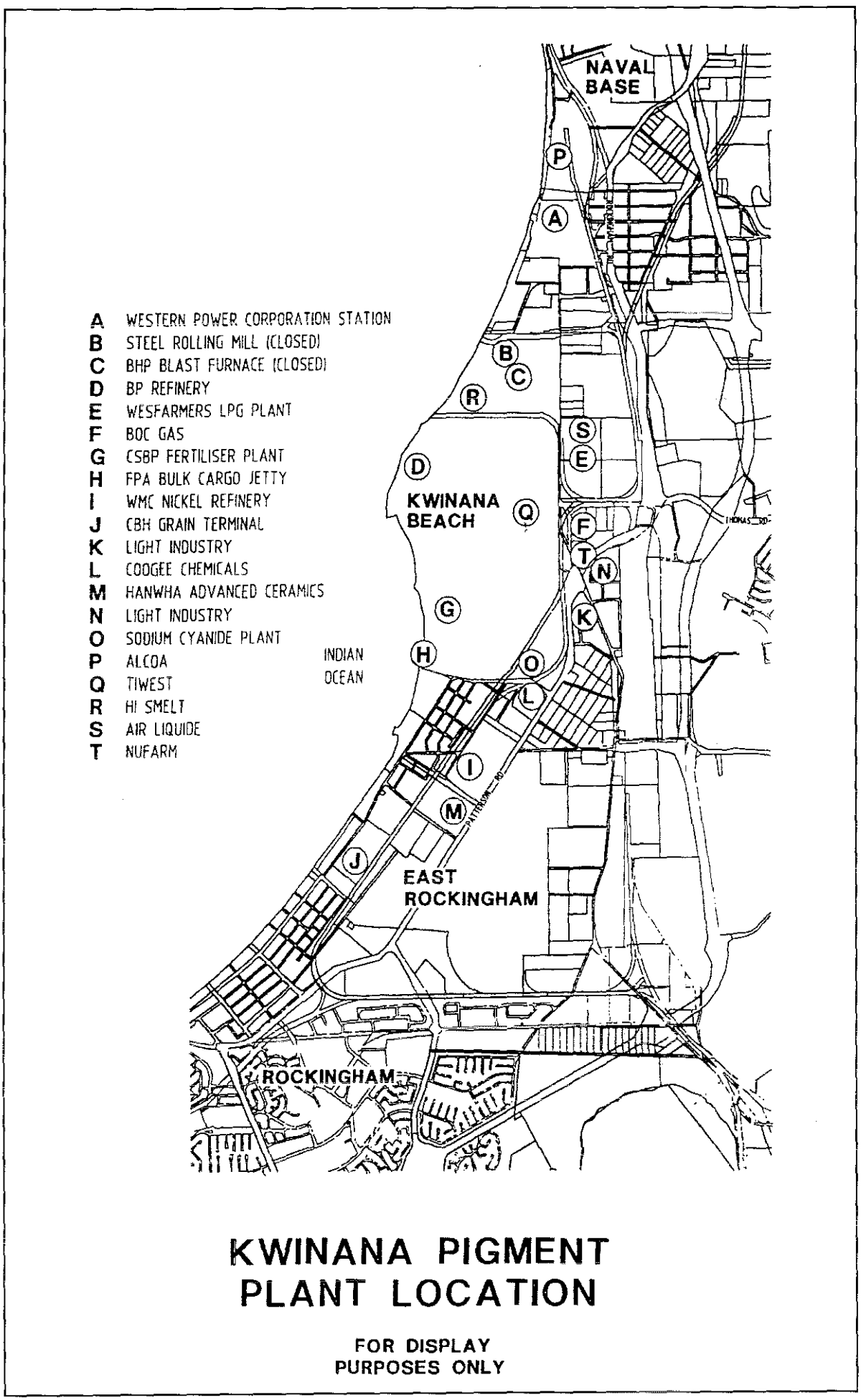

Figure 2. Kwinana pigment plant location (Source: CER, 1996)

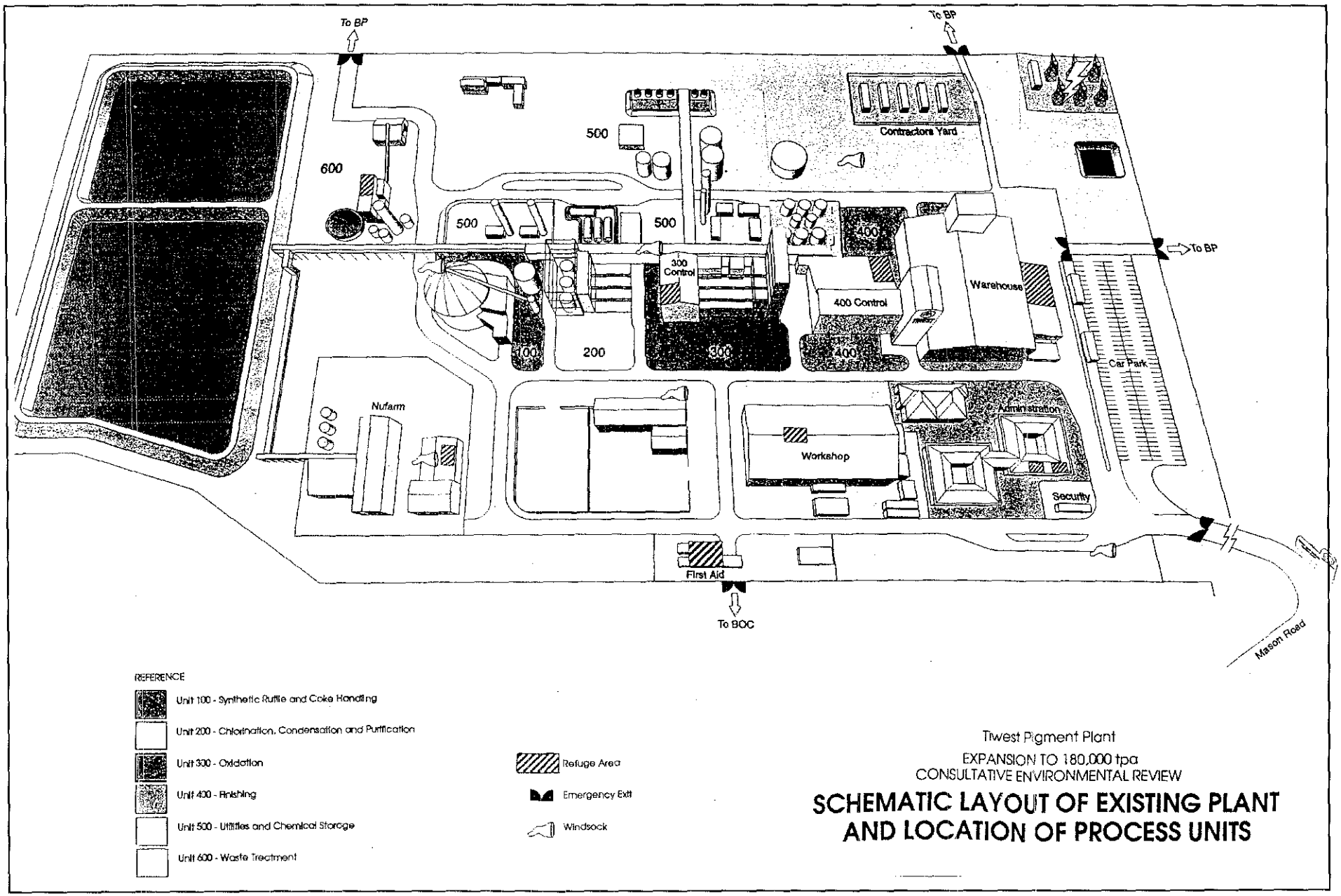

Figure 3. Existing plant layout (Source: CER, 1996).

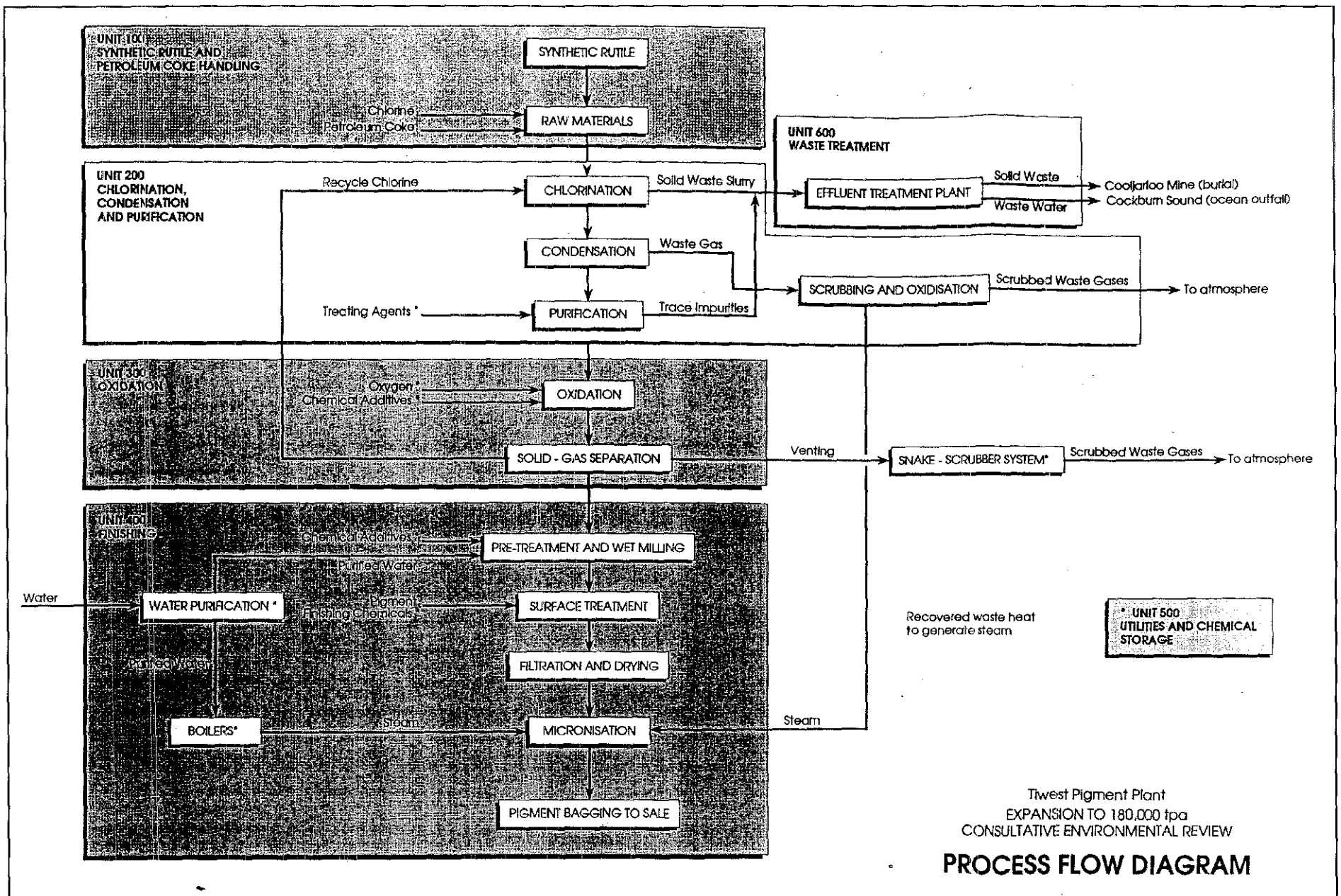

Figure 4. Process flow diagram (Source: CER, 1996).

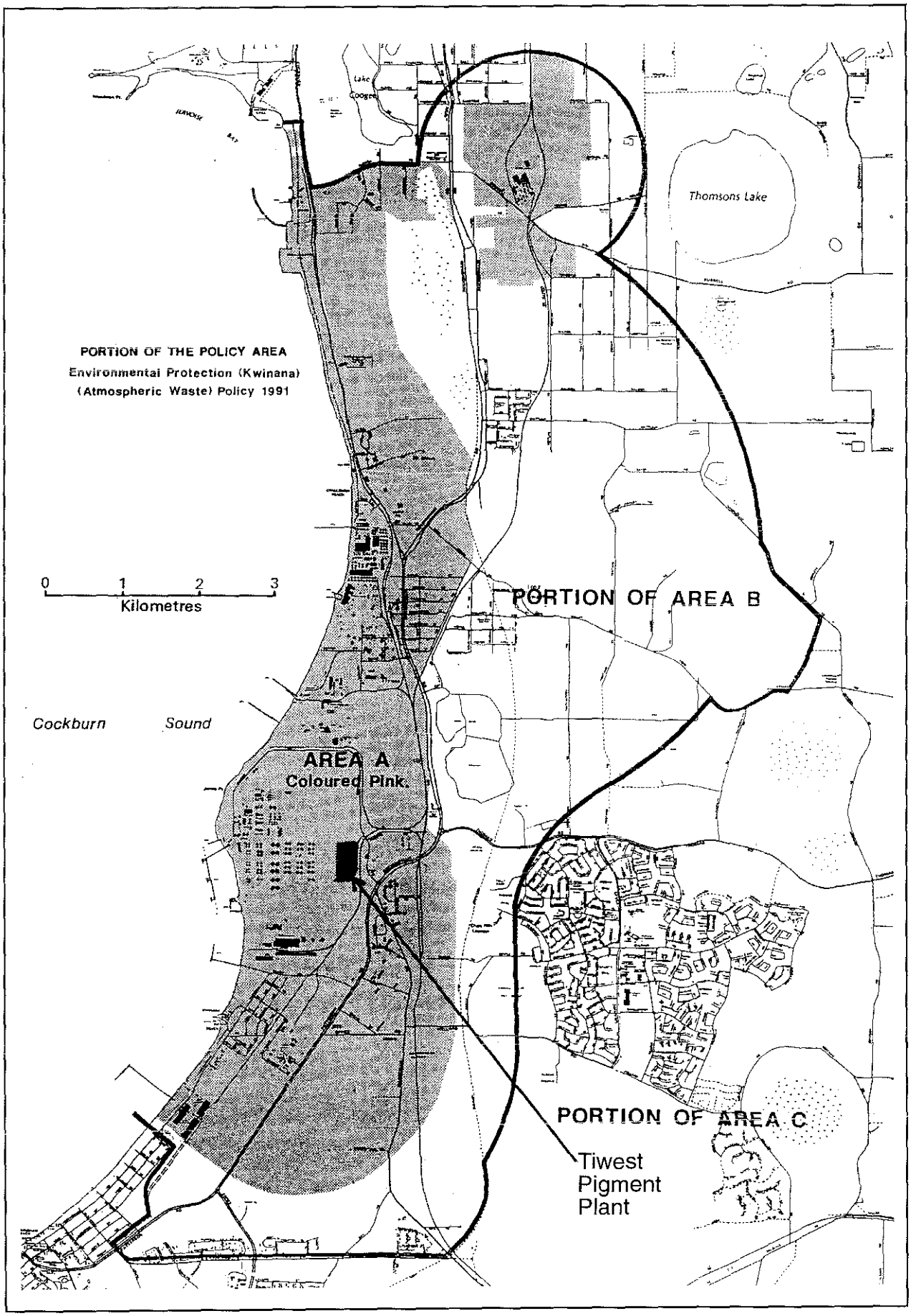

Figure 6. Kwinana EPP area

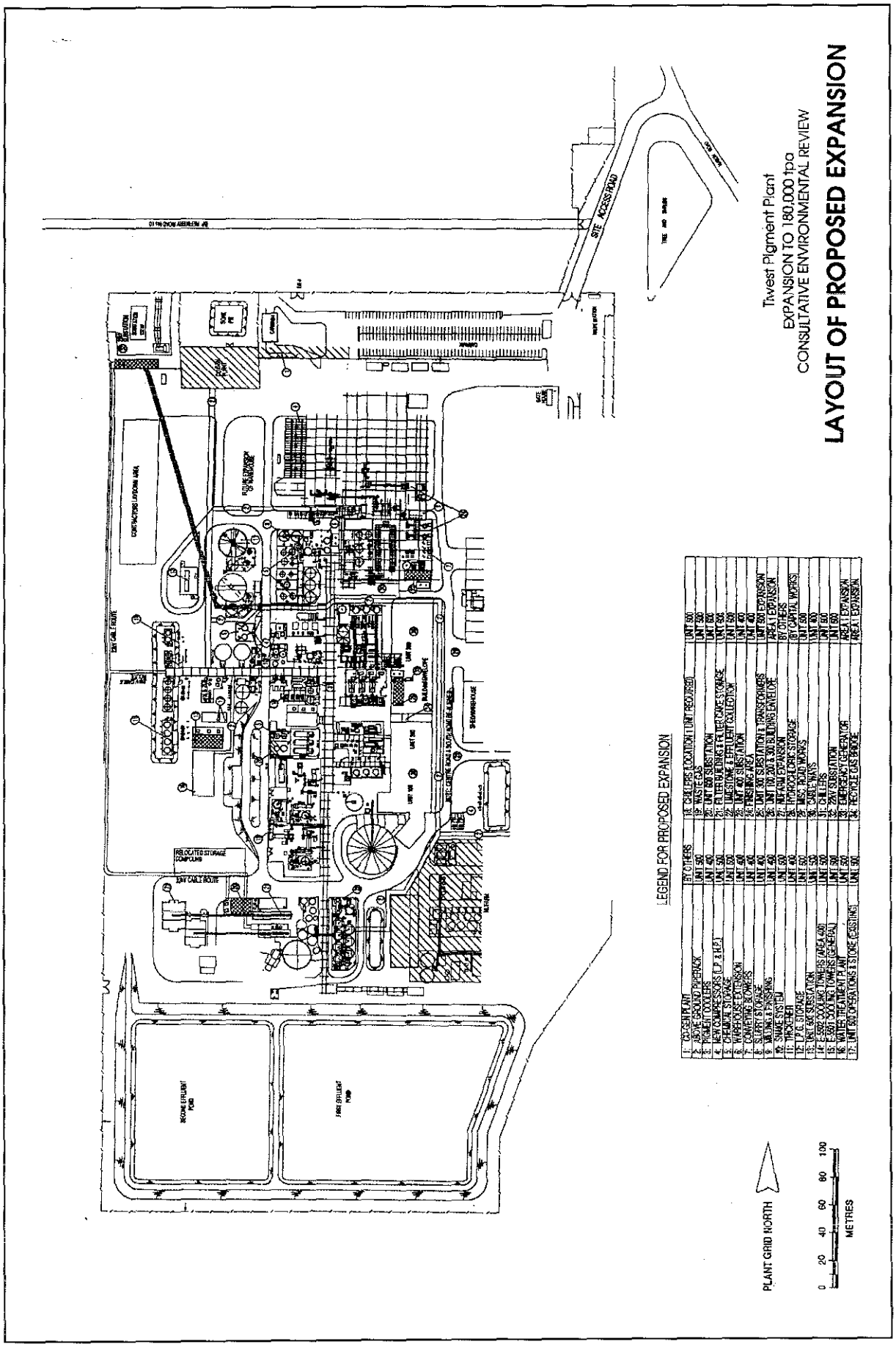

Figure 5. Layout of proposed expansion (Source: CER, 1996).

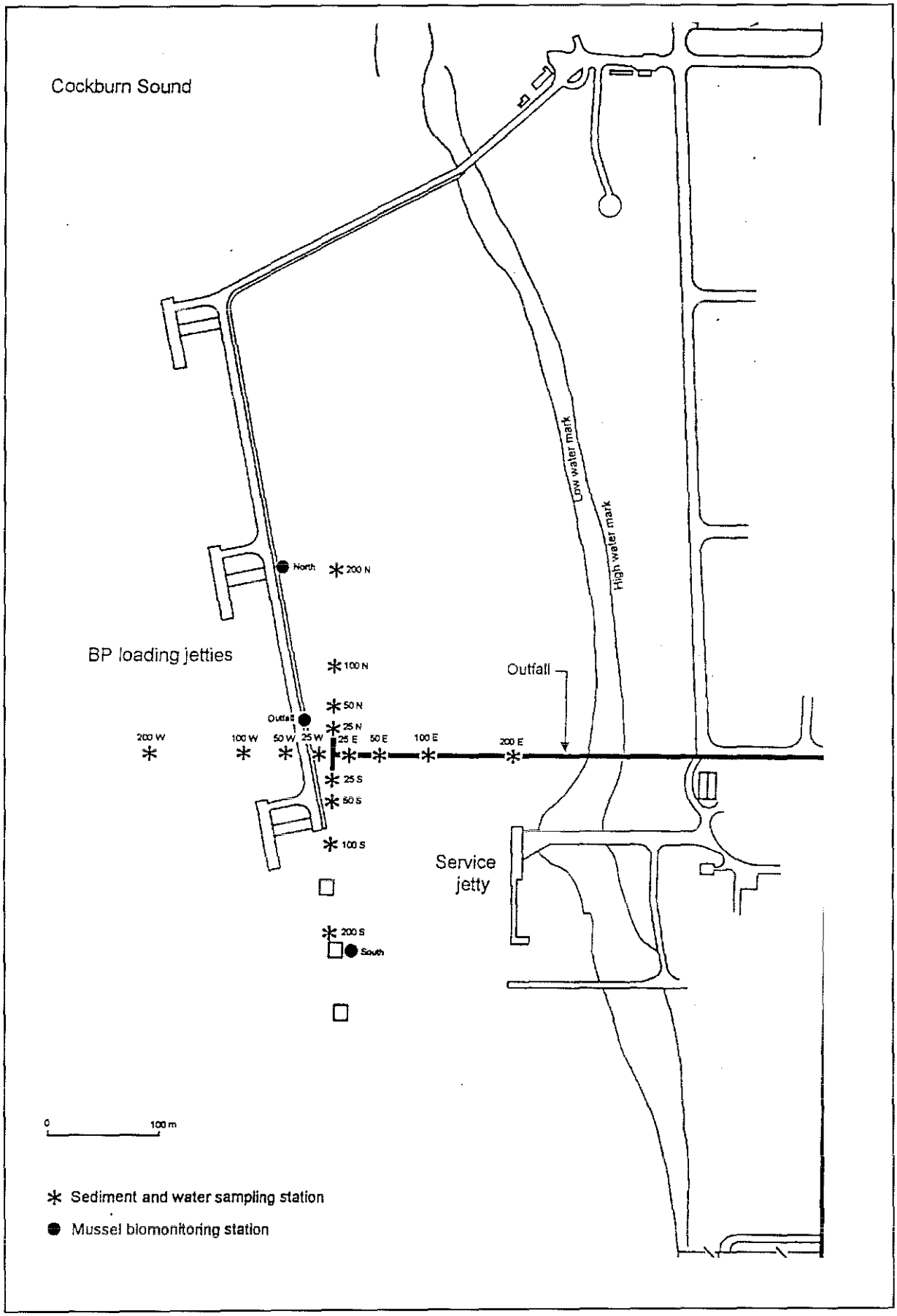

Figure 8. Wastewater disposal pipeline and diffuser.

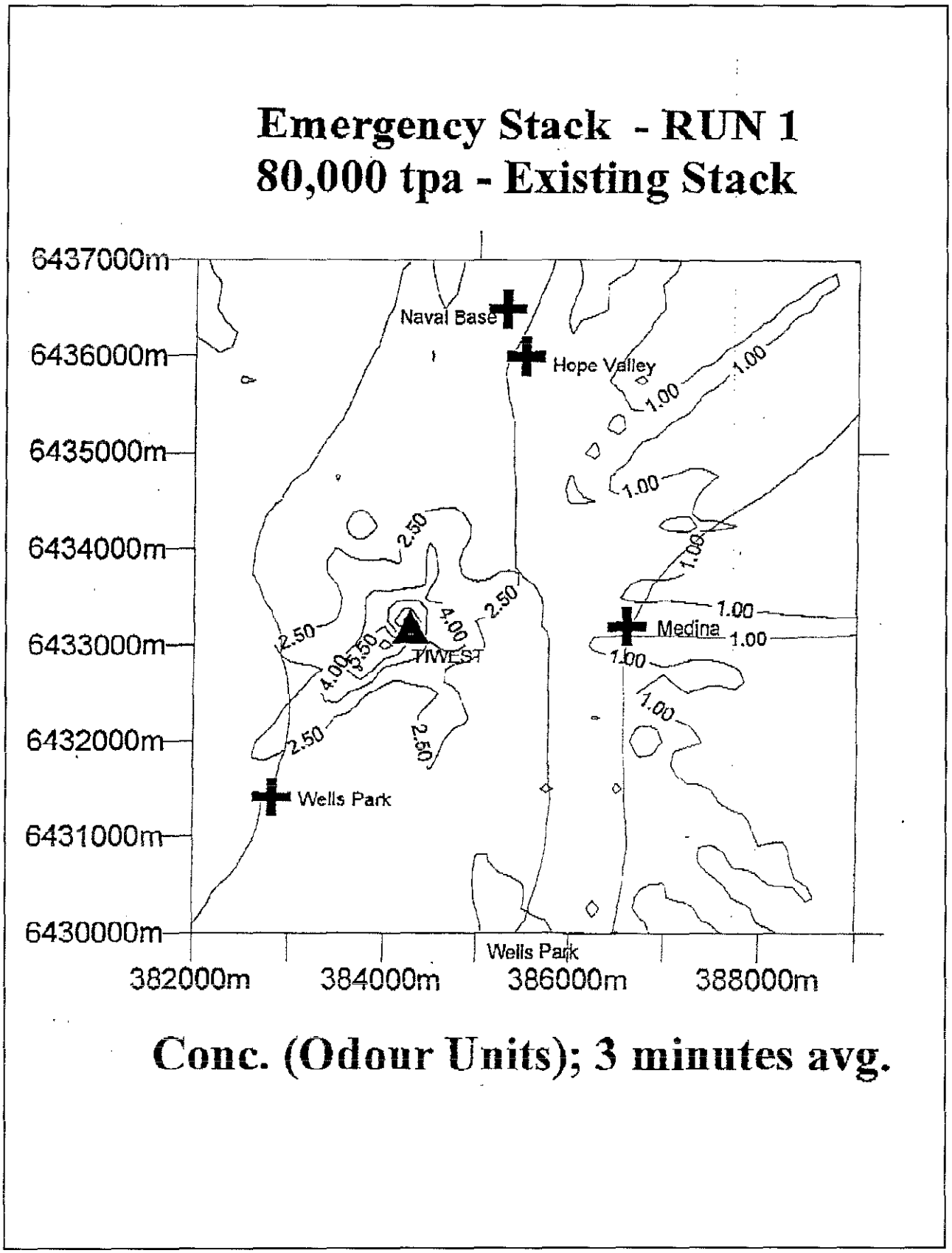

Figure 7. Predicted odour concentrations in OUs for 80,000tp production

Table 1. Summary of plant and equipment (CER, Table ES-1).

	80,000 tpa	120,000 tpa	165,000 tpa *
Unit 400 Finishing	– micronisers and tunnel dryers.	Install additional: – two slurry storage tanks; – three micronisers; – three sand mills; – four filters; – one treatment tank; – first spin flash dryer ; – bagging capacity (two packers); – pigment coolers; – conveying blowers; – slurry storage; – warehouse extension; – thickener.	Install additional: – storage tank; – microniser; – three sand mills; – three filters; – second treatment tank; – second spin flash dryer; – bagging capacity (two packers).
Unit 500 Utilities and Chemical Storage	– chemical storage and utilities including on-site boilers.	Install additional: – cooling towers (two cells); – three air compressors; – water treatment facilities; – water chiller; – transformers and emergency generators; – chemical storage facilities for sodium aluminate, sulphuric acid, treating oil and sodium silicate. Replace: – six LPG storage cells with single LPG storage tank; – on-site boilers with steam generation from Co-generation facility.	Install additional: – cooling towers (two cells).
Unit 600 Waste Treatment	– Effluent Treatment Plant and solids storage building.	Install additional: – Effluent Treatment Plant; – filtration units; – filter cake storage building; – limestone silo; – effluent collection facility.	

* To expand from 165,000 tpa to 180,000 tpa the Plant will be debottlenecked as appropriate.

	80,000 tpa	120,000 tpa	165,000 tpa *
Unit 100 Synthetic Rutile and Coke Handling	– combined petroleum coke and synthetic rutile materials handling.	Install additional: – separate petroleum coke and synthetic material handling facilities. New SR hopper and coke day bins and pneumatic blow pots.	Install additional: – SR and coke pneumatic blow pots.
Unit 200 Chlorination, Condensation and Purification	– three chlorinators and waste gas treatment facilities including two WGIs, STO and emergency stack.	Install additional: – two chlorinators; – emergency stack or upgrade existing emergency stack; – condensing equipment, condensing column, recirculating pumps, heat exchangers etc.; – two $TiCl_4$ surge tanks; – purification equipment (reboilers, reactor column, condensers and pumps etc.).	Install additional: – chlorinator; – STO or WGI.
Unit 300 Oxidation	– three 3.3t/l/h oxidation lines.	Install additional: – 5 t/l/h oxidation line; – insitu $AlCl_3$ manufacturing unit; – Garo compressors; – sand recovery building.	Install additional: – oxidation line or upgrade existing lines using enhanced oxidation technology.

* To expand from 165,000 tpa to 180,000 tpa the Plant will be debottlenecked as appropriate.

Table 2. Summary of proposal characteristics (CER, Table ES-2).

		Units	Existing Production 80,000 tpa	Expanded Production				
				120,000 tpa	165,000 tpa	180,000 tpa	Predicted Change 80,000 to 180,000 tpa absolute	%
INPUTS	**Raw Materials**							
	- Synthetic Rutile	tpa	93,600	140,400	193,050	210,600	117,000	125
	- Petroleum Coke	tpa	29,600	44,400	61,050	66,600	37,000	125
	- Chlorine	tpa	16,000	24,000	33,000	36,000	20,000	125
	Utilities							
	- Natural gas	GJpa	1,768,000	516,033	709,533	774,033	(993,967)	(56)
	- LPG	kLpa	2,400	3,600	4,950	5,400	3,000	125
	- electricity	MWh	76,000	114,000	156,750	171,000	95,000	125
	- 200 and 600 TDS scheme water	MLpa	2,200	3,400	4,600	5,000	2,800	127
OUTPUTS	**Liquid Waste**							
	- effluent to Cockburn Sound	MLpa	1,600	2,400	3,300	3,600	2,000	125
	Solid Waste							
	- moist solid waste disposed to Cooljarloo mine	tpa	62,800	94,000	129,000	141,000	78,200	125
	Gaseous Waste							
	- CO_2 atmospheric emissions	tpa	222,200	228,000	313,500	342,000	119,800	54
	- NO_x atmospheric emissions	tpa	93.5	77.	107	116	22.5	24
	- SO_2 atmospheric emissions	tpa	56	239	518	865*	809	1440

* Sulphur dioxide emissions from Tiwest are only a small component (2.2%) of the total licenced sulphur dioxide emissions from Kwinana industries (1,350 g/s or 42,600 tpa).

Table 3a. Predicted sulphur dioxide emissions (CER, Appendix C).

PREDICTED SULPHUR DIOXIDE EMISSIONS

PROPOSED EXPANSION TO 120,000 TPA

Operation	Frequency (%)	Emission (g/s)
SWGI and FWGI	81	0.12
SWGI and STO	8.3	32
	0.7	39
FWGI and STO	8.3	45
	0.7	51
STO	0.92	95
	0.08	102

PROPOSED EXPANSION TO 165,000 TPA

Operation	Frequency (%)	Emission (g/s)
SWGI and FWGI and STO	74.5	2.5
	6.5	13
SWGI and STO	8.3	68
	0.7	77
FWGI and STO	8.3	80
	0.7	90
STO	0.92	131
	0.08	140

PROPOSED EXPANSION TO 180,000 TPA

Operation	Frequency (%)	Emission (g/s)
SWGI and FWGI and STO	74.5	14
	6.5	26
SWGI and STO	8.3	80
	0.7	90
FWGI and STO and STO (2)	8.3	92
	0.7	102
STO and STO (2)	0.92	143
	0.08	153

key: FWGI First Waste Gas Incinerator
SWGI Second Waste Gas Incinerator
STO Standby Thermal Oxidiser

Table 3b. Predicted sulphur dioxide emissions (Revised on 27-Nov-96.

PROPOSED EXPANSION TO 120,000 TPA

Operation		Frequency (%)	Emission (g/s)
SWGI and FWGI	Av.	74.50	0.48
	Peak.	6.50	0.51
SWGI and STO	Av.	8.28	24.21
	Peak	0.70	25.90
FWGI and STO	Av.	8.28	36.07
	Peak	0.70	38.60
STO	Av.	0.92	95.40
	Peak	0.08	102.08

PROPOSED EXPANSION TO 165,000 TPA

Operation		Frequency (%)	Emission (g/s)
SWGI and FWGI	Av.	74.50	0.66
	Peak.	6.50	0.70
SWGI and STO	Av.	8.28	59.98
	Peak	0.70	64.18
FWGI and STO	Av.	8.28	71.85
	Peak	0.70	76.88
STO	Av.	0.92	131.18
	Peak	0.08	140.36

PROPOSED EXPANSION TO 180,000 TPA

Operation		Frequency (%)	Emission (g/s)
STO	Av.	0.92	143.10
	Peak	0.08	153.12

Note: SWGI & FWGI frequency and emissions not calculated for 180,000 tpa case.
Tabulated mass emission rates are calculated estimates and do not include any contingency allowance. The uncertainties associated with these calculations is in the order of ±10%. Any regulated or licensed emission limit must therefore accommodate such uncertainties to be meaningful and to provide compliance confidence.

key: FWGI First Waste Gas Incinerator
SWGI Second Waste Gas Incinerator
STO Standby Thermal Oxidiser

TIWEST JOINT VENTURE PIGMENT PLANT
MARINE SEDIMENT ANALYSIS
RANGE OF VALUES

PARAMETERS	YEAR						GUIDELINES	
	BASELINE 30/3/90	YEAR 1 12/9/92	YEAR 2 9/12/93	YEAR 3 26/8/94	YEAR 4 25/9/95	YEAR 5 24/5/96	ERL	ERM
Al ($mgkg^{-1}$)	6300 - 11964	7200 - 11329	6512 - 11329	4765 - 17629	6512-16094	ND	7140[1]	17850[1]
Cr ($mgkg^{-1}$)	12 - 27	5 - 27	10 - 20	9 - 32	8 - 43	12.5 - 59	81[1,2]	370[1,2]
Fe_2O_3 (%)	0.15 - 0.99	0.7 - 1.5	0.25 - 1.01	0.12 - 1.88	0.17 - 3.44	ND		
Mg O (%)	1.22 - 2.60	1.20 - 2.30	1.05 - 2.24	0.94 - 2.34	1.13 - 2.34	ND		
Mn ($mgkg^{-1}$)	1.00 - 18.25	21.0 - 58.0	20.0 - 50.0	20.0 - 150	23 - 435	20 - 605		
Ti ($mgkg^{-1}$)	225 - 1091	ND	400 - 800	240 - 1260	350 - 1200	350 - 1650		
V ($mgkg^{-1}$)	3 - 8	5 - 44	<5 - 10	5 - 14	5 - 21	5.50 - 31.00		
^{224}Ra ($Bqkg^{-1}$)	ND	ND	ND	ND	7 - 46	2 - 22		
^{226}Ra ($Bqkg^{-1}$)	13 - 24	7.4 - 15.6	6.8 - 20.0	5 - 37	6 - 23	9 - 27		
^{228}Ra ($Bqkg^{-1}$)	37 - 51	15	15 - 138	50 - 533	2 - 23	13 - 23		
^{228}Th ($Bqkg^{-1}$)	7 - 21	3.6 - 16.8	7.1 - 19.0	5 - 42	4 - 28	5 - 37		
^{230}Th ($Bqkg^{-1}$)	ND	12 - 127	35 - 201	17 - 150	18 - 132	21 - 95		
^{232}Th ($Bqkg^{-1}$)	ND	5.6-17.0	9.3 - 24.2	4 - 37	5 - 15	5 - 40		

ND = Not Determined. Aluminium oxide, iron oxide and magnesium oxide deleted from monitoring programme following changes to Licence No. 5320
SOURCE: Kinhill (1996). Ocean Outfall - Five Years of Post-commissioning Monitoring. Refer to Kinhill report for spatial distribution of sample sites and discussion of relationships between values and Tiwest outfall. [Al ($mgkg^{-1}$) calculated from reported Al_2O_3 (%) x 5,294].

(1) Southern Metropolitan Coastal Waters Study (1991 - 1994)
(2) Long et al (1995)

Table 4. Results of marine sediment quality analysis

Appendix 2

List of submitters

State and local government agencies:

- Health Department of Western Australia
- Department of Minerals and Energy
- Water Corporation
- City of Cockburn
- Town of Kwinana

Members of the public:

- Conservation Council of Western Australia Inc
- Anonymous

Appendix 3

Consolidated List of Proponent's Environmental Management Commitments

CONSOLIDATED LIST OF MANAGEMENT COMMITMENTS

The Tiwest Joint Venture (Tiwest) proposes to modify its existing Titanium Dioxide Pigment Plant at Kwinana to permit a staged increase in production to nominally 180,000 tonne per annum. A Definition Study Document and a Consultative environmental Review (CER) have been prepared by Tiwest to meet the requirements of the Western Australian Government. The CER was available for public comments for four weeks, commencing 7 October 1996 and closing 4 November 1996. Following public review Tiwest on 4 December 1996 submitted the final version of a document responding to questions raised by the public and decision-making authorities. Following further discussions with the DEP and EPA, Tiwest now provides, as a consolidated list, the following environmental commitments in support of the proposal.

Implementation

- Tiwest commits to implement the environmental protection measures described in the Consultative environmental Review titled Tiwest Pigment Plant Expansion to 180,000 tpa (October 1996) and in response to public submissions.

Environmental Management

- Tiwest will continue to revise and implement its EMP, specifically for each stage of the Pigment Plant expansion. The revised EMP will be submitted to the DEP prior to commissioning each stage of the expansion. The EMP will address, but not be limited to :

  1. monitoring of atmospheric emissions;
  2. monitoring and management of effluent discharge to Cockburn Sound;
  3. detection and management of leaks from wastewater ponds;
  4. noise monitoring;
  5. radiation monitoring and management;
  6. quality assurance procedures; and
  7. water use efficiency programme.

Sulphur Dioxide

- Tiwest will ensure that when all incineration, heat removal and scrubbing equipment is on-line, the total installed capacity of this equipment will be sufficient to treat all chlorinator waste gases on an ongoing basis. The installed heat removal equipment, associated with chlorinator waste gas incineration, will be of sufficient capacity to handle the variations in chlorinator waste gas composition that may result during a chlorinator start-up or routine process variation.

- Tiwest will demonstrate as part of the works approval for the stage three expansion, to the satisfaction of the DEP, that when all incineration, heat removal and scrubbing equipment is on-line, the total installed capacity of this equipment will be sufficient to treat all chlorinator waste gases at the nominated production rate.

	• Tiwest will investigate practicable means of achieving reductions in the value and frequency of peak emissions of sulphur dioxide and the mass emissions of sulphur dioxide per tonne of pigment produced.
"Snake" Scrubbing System	• Tiwest commits to demonstrate performance of the Snake Scrubbing System to the satisfaction of the DEP, as part of the Works Approval process for each stage of expansion.
Odours & CO	• Tiwest will design and install emergency stack facilities to ensure that odours and CO emanating from the Plant do not unreasonably interfere with the health, welfare, convenience or amenity of the nearest affected residence.
Greenhouse Gases	• Tiwest will investigate the environmental benefits of entering the C21 "Greenhouse Challenge" voluntary agreement programme for the estimation, reporting and auditing of greenhouse gas emissions.
Noise	• Tiwest will ensure that the purchase specification for all new equipment associated with the expansion will include the following requirement: equipment suppliers must warrant that the "A" weighted sound pressure level is not greater than 85dB at a distance of 1 metre from any part of the equipment as determined in accordance with AS 1217.5-1985.
	• Tiwest will ensure that the design composite noise level of the expanded Plant meet the requirements (including the provision to vary or exceed the assigned noise levels) of the relevant noise control regulations in the Environmental Protection Act. Model outputs demonstrating this compliance will be provided to the satisfaction of the DEP as part of Works Approval for each expansion phase.
	• Within 6 months following the commissioning of each expansion stage, Tiwest will conduct noise surveys (including baseline measurements) and assessments (including the impact of tonal noise) and provide a report to the DEP detailing how noise compliance has been or will be achieved.
	• Tiwest will design the facility so as to, as far as reasonable and practicable, meet the assigned noise levels of the proposed Noise Regulations.
Water Use Efficiency	• Tiwest commits to continuing to adopt reasonably practicable means of reducing fresh water use. In the event of a major water recycling project commencing in the Kwinana area, Tiwest will investigate the feasibility of utilising the water produced.
Wastewater Discharge	• Tiwest commits to only discharge to Cockburn Sound wastewaters which permit the maintenance of the environmental quality objectives of the receiving waters, outside the mixing zone.

- Tiwest commits to conduct further investigations to better define the extent of enrichment of metals in marine sediments adjacent to the Tiwest outfall and to address the likely consequences of increased discharge resulting from the proposed expansion. A report of the findings of this investigation will be submitted to the DEP by 1 February 1998.

- Tiwest commits that, in the event that monitoring results demonstrate an increasing trend with potential to cause an unacceptable impact to the marine environment, appropriate investigations and, if necessary, corrective measures will be taken.

Groundwater

- If disturbance of groundwater is necessary during construction, Tiwest will develop and implement procedures for the handling and disposal of potentially contaminated groundwater to the satisfaction of the DEP on advice from the Water and Rivers Commission.

Radiation

- Tiwest commits to continuing current investigations and to implementing measures to manage build-up of radioactive scale in Pigment Plant pipework, to the satisfaction of the Radiological Council.

- Tiwest commits to managing radiation within the Plant site and its environs in accordance with its Radiation Management Plan, as approved by the Radiological Council.

- Tiwest will ensure that no radioactively contaminated equipment is removed from site without an approved disposal method, to the satisfaction of the Radiological Council and/or the Department of Minerals and Energy.

Hazard & Risk

- Tiwest commits to implement the proposal so as to incorporate the risk reduction measures cited in the AEA Technology Quantitative Risk Assessment report (AEA/CS16129000/Z/2 Issue 1, October 1996).

- Tiwest will achieve all appropriate risk criteria for the Pigment Plant as required by the EPA, and to reduce risks as low as reasonably practicable through implementation of risk mitigation measures where appropriate.

- Prior to the commencement of each construction phase, Tiwest will prepare and implement a construction safety management plan and procedure manual for work around the operating Plant.

- Prior to the commissioning of each of the Plant expansions, Tiwest will revise as necessary the Total Hazard Control Plan (THCP) to align with the risks and hazard of the expanded Plant, to the satisfaction of The Chief Inspector, Explosives and Dangerous Goods Division of the Department of Minerals and Energy. The THCP will take into account all relevant emergency events, including Plant upset conditions, and co-ordination with operators of other facilities located within the Tiwest property.

Process Integrity

- Tiwest commits to maintaining the process equipment, instrumentation and alarm systems consistent with the safety and reliability assessment of the Plant, to the satisfaction of the Chief Inspector, Explosives and Dangerous Goods Division of the Department of Minerals and Energy or such other person as may subsequently have responsibility for that function.

Fugitive $TiCl_4$ Emissions

- Tiwest commits to continue to implement improvements in existing and planned Pigment Plant design and operational procedures so as to continue to reduce the frequency and severity of $TiCl_4$ emissions.

Appendix 4

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