Chlor-alkali plant expansion to 42,000 tpa, Kwinana

Nufarm-Coogee Pty Ltd

Report and recommendations of the Environmental Protection Authority

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Summary

This report is to provide the Environmental Protection Authority (EPA) advice to the Minister for the Environment on the environmental factors relevant to the proposal to expand Nufarm-Coogee Pty Ltd's Chlor-alkali Plant at Kwinana.

The proponent proposes to increase chlorine gas production to 42,000 tonnes per annum (tpa) through the installation of a new electrolysis processing circuit. Storage of chlorine held on site will rise from a nominal 50 tonnes to 150 tonnes.

In the EPA's opinion, the following are the environmental factors relevant to the proposal:

(a) public safety (risk);

(b) groundwater quality; and

(c) chlorine gas.

The EPA notes that currently there are no adopted criteria for societal risk for general application in Western Australia. The EPA recognises that criteria for societal risk should be developed. Societal risk criteria for the Kwinana area were cited in AEA Technology (1995).

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 as set out in the CER and amendment of 31 December 1996, should be made enforceable conditions;

(b) the proponent should be required to review and update the quantitative risk assessment and the total hazards control plan at least every five years;

(c) the proponent should be required to develop joint emergency response plans with the Tiwest Joint Venture Pigment plant;

(d) the proponent should be required to implement an environmental management system;

(e) the proponent should be required to revise and implement an environmental management programme addressing risk management, air quality and groundwater quality monitoring; and

(f) 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 environs.

The EPA submits the following recommendations:

Recommendation 1

That the Minister for the Environment note the relevant environmental factors and the EPA's objective for each factor as set out in Section 3 of the report.

Recommendation 2

That subject to the satisfactory implementation of the EPA's recommended conditions and procedures as set out in Section 4 of the report, 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.

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Appendices

1. Introduction and background

This report is to provide Environmental Protection Authority (EPA) advice to the Minister for the Environment on the proposal by Nufarm-Coogee Pty Ltd to expand the operations of their chlor-alkali plant as set out in their Consultative Environmental Review, October 1996.

The proposal to expand the chlor-alkali plant was referred to the EPA in August 1996, and the level of assessment was set at Consultative Environmental Review (CER). The CER report (Chlor-alkali Plant, Kwinana Expansion to 42,000 tpa, October 1996) hereafter called the CER, was made available for public release between 21 October 1996 and 4 November 1996.

The proposal is to expand production of chlorine to 42,000 tpa in order to supply chlorine to Tiwest's Titanium Dioxide Plant, which is also proposing to expand its operations. Further details 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.

Appendix 1 provides maps and diagrams relating to the proposal. A list of organisations that made submissions is included in Appendix 2 and references are listed in Appendix 3.

2. The proposal

The Nufarm-Coogee Chlor-alkali plant is situated within the Tiwest Titanium Dioxide Pigment plant site in the Kwinana Industrial Area. The location of the proposal site is shown in Appendix 1: Figure 1. The features of the existing and proposed operation are presented in Table 1 over.

It is proposed to increase chlorine production to 42 000 tpa to supply the planned expansion of the titanium dioxide plant. This will be done by setting up a new electrolysis circuit independent of the existing circuit. The new production train will contain three 50 tonnes storage tanks for chlorine, with a maximum inventory of 100 tonnes. When added to existing storage, this will give a maximum total storage of 150 tonnes of chlorine on site. All chlorine is exported by dedicated pipeline to Tiwest. There is no filling of containers with chlorine on site.

Production of caustic soda will increase proportionally. Excess caustic soda will be exported to Coogee Chemicals tank terminal by underground pipeline and sold locally.

Production of byproduct hydrogen and sodium hypochlorite will increase proportionally. Hydrogen will be burnt to produce steam. Sodium hypochlorite is sold locally, with excess hypochlorite destroyed in the brine dechlorination system and chlorine recycled to the process.

Water and electricity consumption will increase at a rate slightly less than in direct proportion, due to increased efficiencies in the process.

A new independent waste gas scrubber system will be built with the new electrolysis circuit to ensure that chlorine is not discharged to atmosphere.

All liquid wastes will be pumped to the Tiwest effluent disposal plant with disposal becoming the responsibility of Tiwest under DEP licence.

In assessing the proposal, consideration has been given to the combined impact of the existing plant and the proposed additional plant.

Table 1. Process inputs and products for existing and proposed operation

Process Input

	Existing 17,000 Tpa	Proposed 42,000 Tpa	% Increase 147
Raw Materials **Salt:** Naturally evaporated solar salt from Lake Deborah, trans-shipped from Koolyanobbing by rail to the new Westrail depot at Kwinana, then by road into the plant.	39,000 Tpa	88,000 Tpa	126
Water: Potable scheme water, supplied by the Water Corporation, via the TIWEST reticulation network.	180,000 Tpa	400,000 Tpa	122
Energy **Electricity:** Currently sourced from Western Power grid. Power to the grid is expected to be supplemented by co-generation facility planned by TIWEST. In event of emergency, power will be drawn direct from the co-gen facility.	54,000,000 (kW.h pa)	129,000,000 (kW.h pa)	139
Steam: A new package boiler will be installed to burn by-product hydrogen. This, in conjunction with a new energy efficient caustic evaporator, will make the plant almost self sufficient in steam. Any shortfall will be purchased from TIWEST via the existing pipeline	16,000 Tpa	6,000 Tpa	-63
Ancillary Materials **Nitrogen:** Compressed dry nitrogen is used for process purging, brine dechlorination, and as an inert padding gas for chlorine export. Supply is via the TIWEST supply pipeline from the Air Liquide air separation plant.	3,000 Tpa	6,000 Tpa	100
Sulphuric Acid: 98% sulphuric acid for chlorine drying is supplied by Coogee Chemicals. It is all re-exported, in diluted form, for use in copper sulphate manufacturing process	400 Tpa	900 Tpa	125

Process Output

	Existing 17,000 Tpa	Proposed 42,000 Tpa	% Increase
Products **Chlorine:** All chlorine gas from the project will be supplied by dedicated pipeline to TIWEST for titanium dioxide pigment production. **Chlorine storage:** amount of storage on site at any time	17,000 Tpa 50 tonnes	42,000 Tpa 150 tonnes	147 200
Caustic soda (100% basis): Co-produced caustic soda will be sold locally for chemical manufacturing and mineral processing, taking the place of currently imported material. Caustic soda will be exported to Coogee Chemicals tank terminal by an underground pipeline.	19,150 Tpa	47,320 Tpa	147
Hydrogen: Will be used internally as boiler fuel. A small bleed of hydrogen vented to atmosphere as part of the process safety pressure control system	480 Tpa	1,190 Tpa	148
By-products **Sodium hypochlorite solution 12.5%:** produced when chlorine in waste gas streams is absorbed in caustic soda in the plant scrubbing system. This is sold for water and swimming pool chlorination. Surplus hypochlorite can be destroyed in the brine dechlorination system, with chlorine being liberated and re-cycled to the process.	2,500 Tpa	6,000 Tpa	140
Wastes **Water vapour**: evaporation from cooling tower	52,500 Tpa	122,000 Tpa	132
Liquid effluent: pumped to Tiwest	123,490 Tpa	226,220 Tpa	83

Source: Nufarm-Coogee Pty Ltd 1996: Consultative Environmental Review

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 4, that the following are the environmental factors relevant to the proposal:

(1) public safety (risk);

(2) groundwater quality; and

(3) chlorine gas.

These relevant factors are discussed in the following Sections 3.2 to 3.4 inclusive.

3.2 Public safety (risk)

Aspects of public safety (risk)

Due to the establishment of a new chlorine production circuit, there is the potential for an increase in the risk of toxic chlorine gas release from the additional process equipment.

For the current operation, hazards and risks at the plant were reviewed by VRJ Risk Engineers Pty Ltd (Nufarm-Coogee 1996a). All dangerous goods present on site were considered and chlorine was considered to be the only material present in sufficient quantities that might pose an off-site risk, to warrant inclusion in individual risk calculations.

The existing plant, with the current 25 tonnes storage tanks and a nominal maximum chlorine inventory of 50 tonnes, easily meets the criteria for the assessment of risk from industry as set out in Bulletins 611 and 627 (EPA 1992a and 1992b). Ongoing safety is maintained through management of operations in accordance with an approved Total Hazards Control Plan (THCP) administered by the Department of Minerals and Energy (DME). The existing chlor-alkali plant at Kwinana has been in operation for over five years and no adverse environmental impacts have been identified. There have been no major incidents of chlorine gas release reported.

Preliminary quantitative risk assessment (QRA) of the proposed expansion, including both existing and proposed production plant, has been carried out by VRJ Risk Engineers Pty Ltd (Nufarm-Coogee 1996c). Again, chlorine was considered to be the only material which contributed to individual risk calculations. Risk contours for the expanded operation, including existing and proposed plant, are shown in Appendix 1: Figure 2 for three additional 25 tonne storage tanks and in Appendix 1: Figure 3 for three additional 50 tonne storage tanks.

Currently there are no adopted criteria for societal risk. The EPA recognises that there is a need to develop societal risk criteria for general application in Western Australia. AEA Technology (1995) considered various risk criteria in the cumulative risk study for the Kwinana Industrial Area.

Societal risk evaluation for the expanded plant has been undertaken by VRJ Risk Engineers Pty Ltd (Nufarm-Coogee 1996c) along the guidelines described in the report "Public Risk Criteria for the Kwinana Industrial Area" which was prepared by Technica Pty Ltd in 1990 for the EPA. These criteria have been reviewed by the EPA and found acceptable but have not been formally adopted. These criteria were also considered in AEA Technology (1995).

In addition the consequence distances of the "worst case scenario" event were requested by DEP to ensure that there would not be unacceptable levels of risk at nearby residential areas in case of such an event.

Assessment

The area considered for assessment of this relevant environmental factor, public safety (risk), is within the Nufarm and Tiwest plant area and the surrounding premises and properties.

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 societal risk is kept to an acceptable level. The EPA considers that the societal risk criteria cited in the Kwinana Cumulative Risk Study (AEA Technology 1995) and developed by Technica 1990 are suitable standards to apply to this proposal. Management of risks and hazards must also comply with the requirements of DME.

Risk has been shown by VRJ Risk Engineers Pty Ltd (Nufarm-Coogee 1996c) to meet the off-site individual fatality risk criteria (EPA 1992a and 1992b), see Table 2 below.

Table 2. Individual Risk

Place	EPA criteria, maximum risk level	Estimated maximum risk level
at plant boundary	50 x 10^6/year	32 x 10^6/year
in buffer zone, at nearest public access area	10 x 10^6/year	1 x 10^6/year
in residential area	1 x 10^6/year	less than 1 x 10^7/year

Comments received from DME indicated that this assessment was of a high standard.

Risks associated with the transport of chlorine by pipeline to Tiwest have been taken into account in the preliminary QRA. Cumulative risk levels from both Tiwest and Nufarm expansion were also determined and reported in Tiwest Joint Venture 1996, and meet the EPA criteria for individual and societal risk.

DME has recommended that a construction safety management plan and procedure manual for work around operating plant be prepared and implemented and that the revised Total Hazards Control Plan for the expanded plant be reviewed by an independent third party. These recommendations have been accepted by the proponent and included in their revised commitments.

The EPA notes that the QRA has shown that individual risk can be held to an acceptable level when the capacity of the three new chlorine storage tanks is 50 tonnes each and the maximum on site storage of chlorine is 150 tonnes (Appendix 1: Figure 3). This result is due to the adoption of best practice storage designs and the additional safeguard of installing liquefaction and vaporisation equipment within a secondary containment building. This result agrees with a study undertaken by J A Goldsmith, (Quantarisk 1991), for the EPA, which concluded that the design of the chlorine storage facility could be a more important factor in determining overall risk than the size of the storage vessel.

The EPA notes that previously bulk chlorine storage has been limited to a 50 tonnes maximum. This conservative limit was placed on storage due to limited knowledge about chlorine storage and clear public concern, and the fact that risk assessment was still in its formative stage. As a consequence of improved engineering and safety design for chlorine storage in Western Australia, the development of risk assessment capability and the satisfactory safety performance of chlorine producers in Western Australia, the EPA considers that should a proponent wish to increase on-site chlorine inventory, the proposal should be referred to the EPA for assessment. Any such proposal should undergo a quantified risk assessment to demonstrate compliance with EPA individual risk criteria and societal risk criteria, when the latter have been set. It has been show that the EPA's objective with regards to individual risk can be met by this proposal.

With regard to societal risk, comments from DME indicate that the societal risk fall within limits acceptable to them. Commitments made by the proponent to reduce individual risk are also relevant to the reduction of societal risk.

The EPA notes that using the guidelines from the Technica 1990 study, VRJ Risk Engineers Pty Ltd (Nufarm 1996c) have found that the societal risk for the expanded plant falls within the "negligible " area of the graph (Appendix 1: Figure 4).

The EPA notes that in consideration of the consequence distance of the "worst case scenario" event, it was found that under adverse weather conditions the maximum impact distance where 10% fatalities would be expected to result, is 405m. The EPA notes that the nearest residential area occurs some 2.2 km distant and the nearest residence approximately 1.5 km distant.

The EPA further notes the storage and processing safeguards installed for the prevention of and reduction in rate of emission of toxic chlorine gas.

Within the CER document and in response to submissions on this factor, the proponent has made the following commitments:

- to adopt best practice for design of bulk liquid chlorine installation for expanded plant;
- to operate the storage in such a manner that sufficient empty capacity is maintained in the tanks to receive the contents of any tank which may leak;
- to review hazards of proposed expansion by formal HAZOP study of expanded plant;
- to undertake quantitative risk assessment of completed design for expanded plant;
- to prepare a plan and management procedures to address specific risks and hazards associated with construction activities around a working plant;
- to manage construction activities in accordance with approved plan;
- to review and update Total Hazards Control Plan to cover the operation of the expanded plant;
- to commission an independent third party audit of the revised Total Hazards Control Plan;
- to manage the operation of the plant in accordance with the requirements of the revised Total Hazards Control Plan; and
- to review and update QRA in light of operational experience and new assessment techniques at 5 yearly intervals.

Having particular regard to:

(a) the improved design and operational management methods currently applied to the production and storage of chlorine;

(b) the good safety record of the proponent's chlorine plant operations;

(c) the advancements in risk analysis techniques; and

(d) the outcomes of risk assessment undertaken on the upgraded project and technical advice from DME,

it is the EPA's opinion that its objective for public safety (risk) can be met by the proposal, provided that the proponent fulfils the design and operational commitments made in the CER and develops joint emergency response plans with Tiwest Joint Venture Pigment plant as both plants are situated on the same site.

3.3 Groundwater quality

Aspects of groundwater quality

There is the potential for leaks to occur from the salt storage, brine preparation and contaminated waste drainage systems and cause further contamination of the superficial groundwater aquifer beneath the site. The groundwater beneath the site is known to be already contaminated with nitrogen compounds, sulphate, sodium, herbicides and phenols, by the former Chemical Industries Kwinana (CIK) plant operations.

Groundwater quality is currently monitored for any impact from the plant operation. Although there is no known impact on groundwater quality from the existing plant operation (CER Table 5.3.1.1), groundwater contamination has occurred at the company's sister plant due to a pipe failure. Accordingly this factor was considered relevant .

Assessment

The area considered for assessment of this relevant factor, groundwater, is within the Nufarm plant area.

The EPA's objective in regard to this environmental factor is to ensure that Nufarm-Coogee implements sound design and management practices 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 assessment if applicable.

The EPA notes that in response to the potential for impact from this factor, the following commitments have been made by the proponent:

- an environmental design review will be undertaken of the design of the salt storage, brine preparation and waste drainage areas;
- underground pipes will be replaced with surface collection drains for ease of inspection and maintenance;
- the new salt storage pad will be furnished with a leak detection and recovery system, with a secondary containment membrane underneath;
- groundwater quality will be monitored in the vicinity of potential leak sources for early detection; and
- plant operational standards and monitoring programmes will be assessed by routine corporate environmental audit.

Having particular regard to the proponent's commitments, the EPA considers that the proposal can be managed to meet its objective of maintaining groundwater quality. This factor can be monitored under Part V licensing of the Environmental Protection Act (1986) WA.

3.4 Chlorine gas

Aspects of chlorine gas

This factor relates to normal operational emission and emergency emissions through the chlorine gas scrubber, rather than accidental or catastrophic emissions from other sections of the plant. Under normal operations the scrubber receives chlorine gas from liquefaction, tank venting after export and brine dechlorination. The scrubber can also be used to draw off and remove any accidental chlorine emissions within the storage secondary containment building.

The existing plant has an efficient absorption and scrubbing system for the complete removal of chlorine from waste gas streams. The scrubbing system is designed to absorb worst case, plant upset, chlorine loads with no detectable release of chlorine to atmosphere. Normal process load during routine operation is approximately 1 tonne/day of chlorine, but it has a demonstrated

absorption capacity of 2.3 tonne-hour with no detectable chlorine in vent gas. The scrubber vent stack is continuously monitored for chlorine. Should a chlorine concentration above 10 ppm be detected in the vent gas, an alarm sounds. The integrity of the scrubbing and associated monitoring system is assured by quality control procedures defined in the plant's Total Hazards Control Plan. The scrubbing system has performed reliably for some years. It is planned to install a similar independent scrubber system for the expanded plant.

The following interim guideline for chlorine emissions, taken from the DEP draft policy for air discharges from stationary sources (DEP 1996), has been applied to the expansion:

- design ground level concentration (3 minute average) for continuous chlorine emissions should not exceed 0.012 ppm at nearest residence.

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 guideline recommended by the DEP for chlorine emissions is an acceptable standard for this assessment.

The proposal, under normal operations, will have no measurable effect on air quality within the Kwinana EPP buffer area. Two questions were posed by the DEP regarding the conditions under which the ground level chlorine concentration criteria could be exceeded and backup for the scrubber. In reply the proponent described management procedures and backup measures which were considered to adequately address concerns in these areas. The absorption/scrubber circuit is a semi-redundant system which also incorporates diversity to ensure adequate scrubbing capability under foreseeable emergency conditions. Suction is normally maintained with an electrically driven exhaust fan, but this is backed up by nitrogen ejector. The system has two continuously operating circulation pumps, which are cross connected, and only one of which is required for emergency operation.

There is no additional "stand-by system" to cater for *total system failure* of the main circuit. However, should all scrubbing capability be lost, the plant can be shut down instantly from the Distributed Control System (DCS), from any of four emergency stop buttons in the process area, from the rectifier control panel, or from the high tension switch room. This de-energises the cell line and stops any further production of chlorine.

Following an emergency shut-down, the in-process inventory of chlorine between the electrolysers and the chlorine safety seal will be automatically purged through to the Absorption/Scrubbing system by nitrogen pressure. If the absorption system is not operational, then this quantity (about 2 kg) of chlorine will be discharged to atmosphere, diluted with purge nitrogen, as a turbulent plume from the scrubber vent.

The EPA notes a gas dispersion modelling study for the expanded plant has been undertaken by VRJ Risk Engineers (Nufarm-Coogee Pty Ltd 1996d) which shows that the limiting residential ground level chlorine concentration would not be reached at any location even in the unlikely event of both vents discharging simultaneously at 100 ppm of chlorine gas With both vents discharging at 235 ppm, a ground level chlorine concentration of 0.012 ppm would occur approximately 70m from the plant; the nearest residential area is approximately 2.2 km from the plant and the nearest residence approximately 1.5km from the plant.

The EPA notes the proponent's commitments that:

- the new chlorine scrubber system will be designed to a performance and reliability standard at least equal to the existing proven system;
- existing procedures for monitoring, operation, maintenance, reporting and auditing will apply to both systems; and
- ongoing maintenance of the chlorine scrubbing and monitoring system will be ensured by review and update of the quality assurance procedures contained in the THCP to cover the requirements of the expanded plant.

Having particular regard to:

(a) the proponent's commitments;
(b) the proven reliable performance of the existing scrubbing system; and
(c) the predicted compliance with DEP's interim guideline on ground level concentrations for chlorine emissions,

it is the EPA's opinion that chlorine emissions associated with the proposal can be managed to meet the above stated objective. This factor can be monitored under Part V licensing of the Environmental Protection Act (1986) WA.

4. 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 as amended on 31 December 1996, should be made enforceable conditions. A summary of commitments is given in Table 3;

(b) the proponent should be required to review and update the quantitative risk assessment and total hazards control plan at least every five years to the requirements of the EPA on advice of the Department of Environmental Protection and the Department of Minerals and Energy;

(c) the proponent should be required to develop joint emergency response plans with the Tiwest Joint Venture Pigment plant prior to commissioning of the new chlorine processing systems to the requirements of the EPA on advice of the Department of Environmental Protection and the Department of Minerals and Energy;

(d) the proponent should be required to revise and implement an environmental management plan, and environmental management procedures in order to implement the proposal and to manage the relevant environmental factors to ensure that the environmental 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, auditing and reporting to ensure compliance with this condition;

(e) the proponent should be required to revise and implement an environmental management programme addressing risk management, air quality and groundwater quality monitoring; and

(f) 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 plan should be submitted at least six months prior to decommissioning.

The implementation of these conditions should be audited by the Department of Environmental Protection.

5. Recommendations

The EPA submits the following recommendations:

Recommendation 1

> That the Minister for the Environment note the relevant environmental factors and the EPA's objective for each factor as set out in Section 3 of the report.

Recommendation 2

> That subject to the satisfactory implementation of the EPA's recommended conditions and procedures as set out in Section 4 of the report, 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.

Table 3. Relevant environmental factors, objectives, proponent's commitments and EPA's opinion

Relevant factor	Objective	Proponent's commitments	EPA's opinion
Public Safety (risk)			
Individual and Societal Risk	Ensure that individual risk is managed to meet the EPA criteria as set out in EPA Bulletins 611 and 627 and that societal risk is managed to be kept at an acceptable level as determined by criteria developed in Technica 1990 and cited in AEA Technology (1995).	• To adopt best practice for design of bulk liquid chlorine installation for expanded plant; • to operate the storage in such a manner that sufficient empty capacity is maintained in the tanks to receive the contents of any tank which may leak; • to review hazards of proposed expansion by formal HAZOP study of expanded plant; • to undertake quantitative risk assessment of completed design for expanded plant; • to prepare a plan and management procedures to address specific risks and hazards associated with construction activities around a working plant; • to manage construction activities in accordance with approved plan; • to review and update Total Hazards Control Plan to cover the operation of the expanded plant; • to commission an independent third party audit of the revised Total Hazards Control Plan; • to manage the operation of the plant in accordance with the requirements of the revised Total Hazards Control Plan; and • to review and update QRA in light of operational experience and new assessment techniques at 5 yearly intervals.	Objective met through proponent's revised commitments which include recommendations of DME. Joint emergency response plans to be developed by Nufarm-Coogee Pty Ltd and Tiwest Joint Venture.
Groundwater quality	Implement sound design and management practices to avoid contamination of groundwater . Refer draft WA Guidelines for Fresh and Marine Waters (EPA Bulletin 711, 1993) and Dutch and Victorian EPA criteria where applicable.	• To undertake an environmental design review of the design of the salt storage, brine preparation and waste drainage areas; • to replace underground pipes with surface collection drains for ease of inspection and maintenance; • to furnish the new salt storage pad with a leak detection and recovery system, and a secondary containment membrane; • to monitor groundwater quality in the vicinity of potential leak sources for early detection; and • to assess plant operational standards and monitoring programmes by routine corporate environmental audit.	Objective can be met through proponent's commitments and monitored through the licensing provisions of the Environmental Protection Act (1986) WA.
Chlorine Gas	Ensure chlorine emissions meet acceptable standards so that they do not adversely affect the health, welfare and amenity of nearby land users.	• To design new chlorine scrubber system to a performance and reliability standard at least equal to existing system; • to apply existing procedures for monitoring, operation, maintenance, reporting and auditing to both systems; and • to ensure on-going maintenance of chlorine scrubbing and monitoring system by review and update of THCP.	Objective can be met through proponent's commitments and monitored through the licensing provisions of the Environmental Protection Act (1986) WA.

Appendix 1

Figures

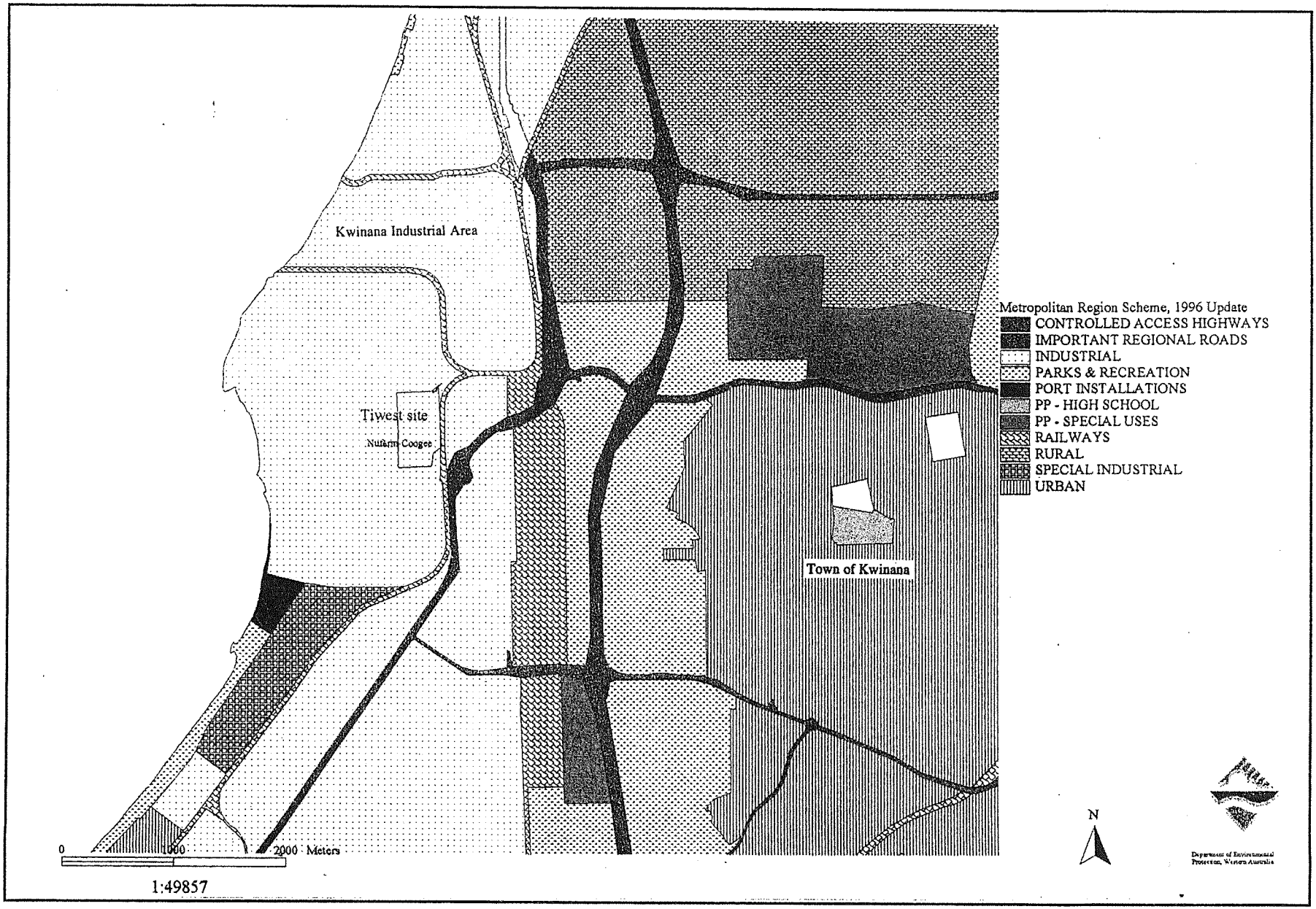

Figure 1. Location of Nufarm-Coogee site

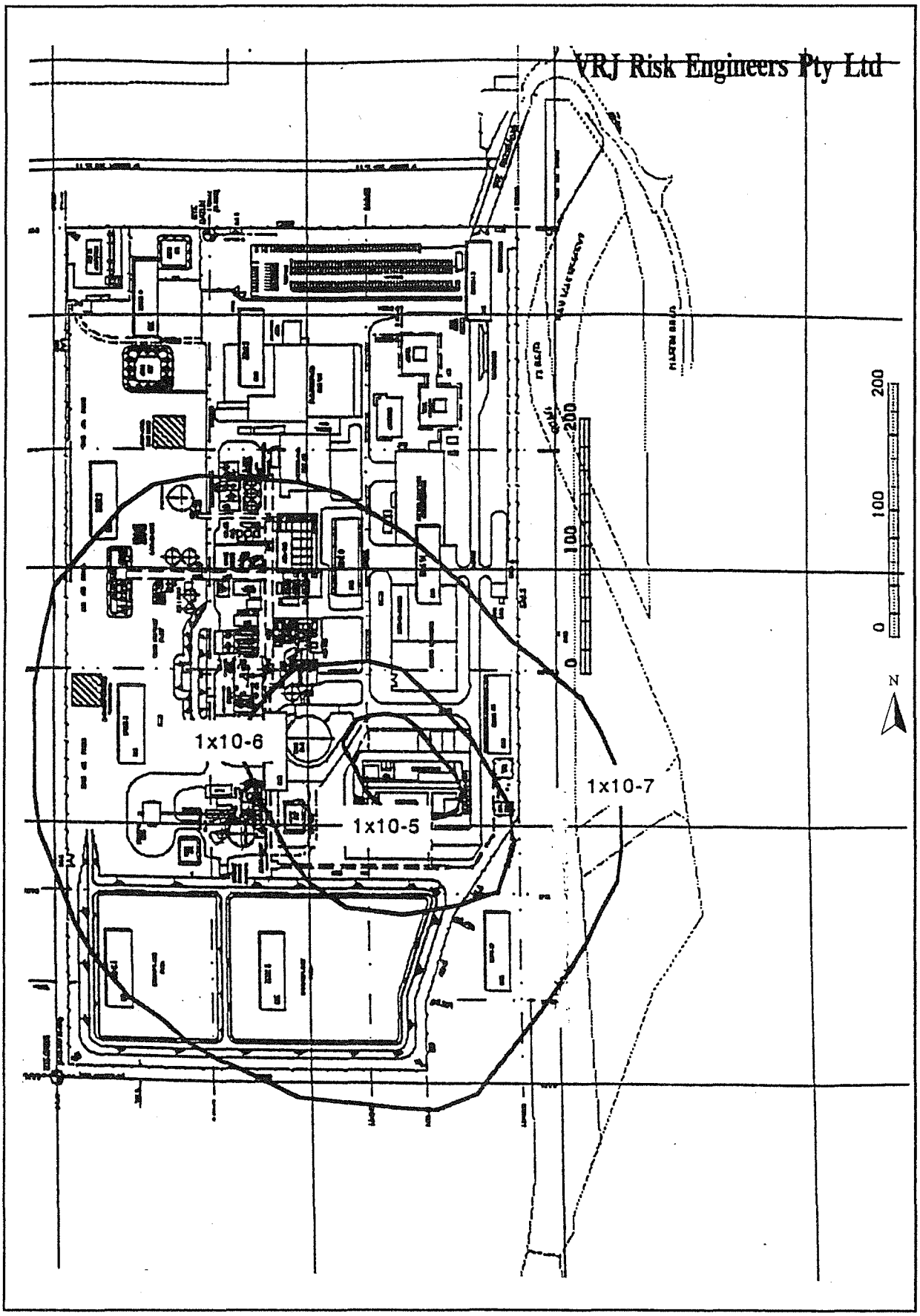

Figure 2. Individual risk contours for Nufarm-Coogee Kwinana Chlor-Alkali Plant expansion (25 tonne storage tanks). (Source: VRJ Risk Engineers Pty Ltd, 1996)

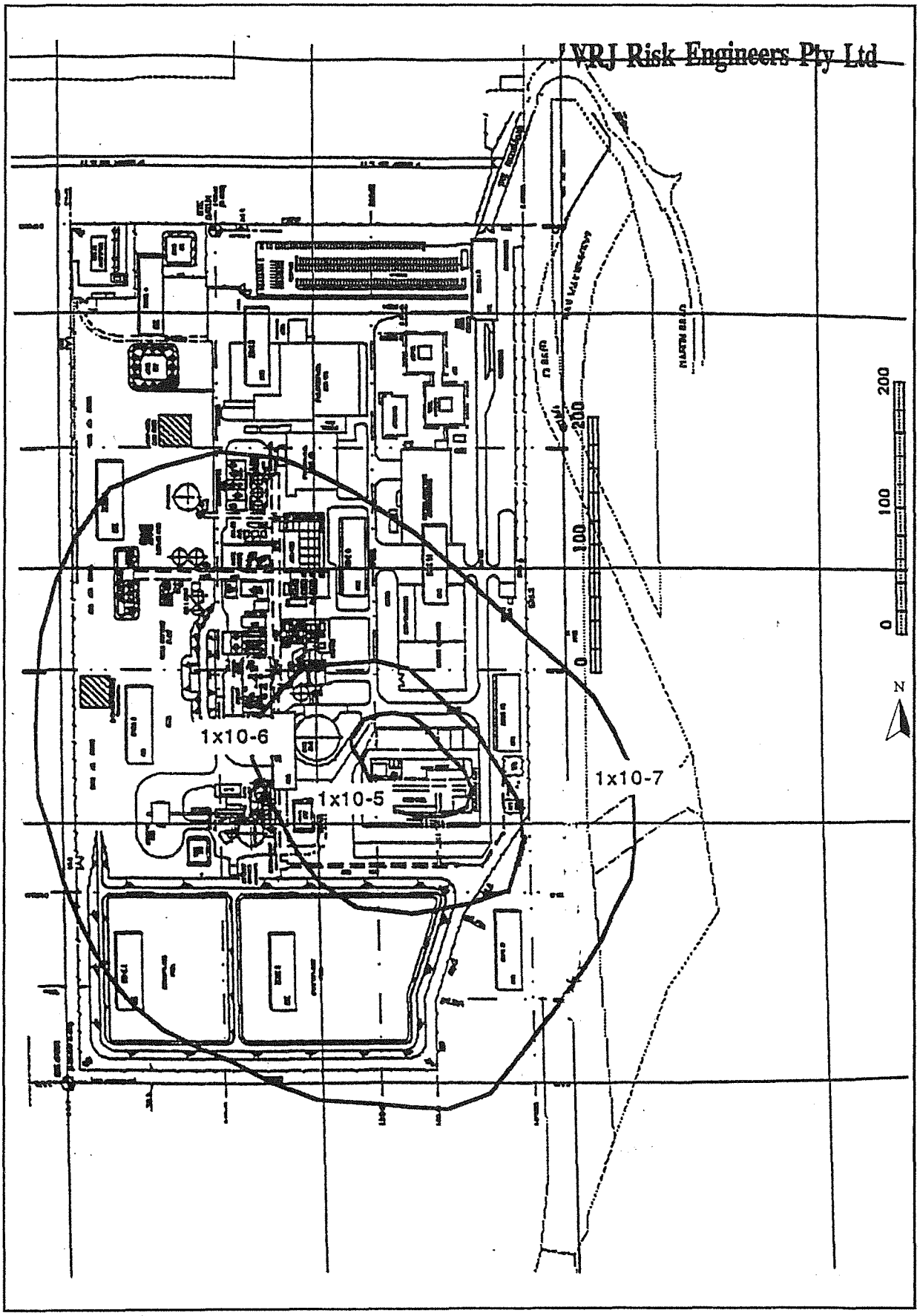

Figure 3. Individual risk contours for Nufarm-Coogee Kwinana Chlor-Alkali Plant expansion (50 tonne storage tanks). (Source: VRJ Risk Engineers Pty Ltd, 1996)

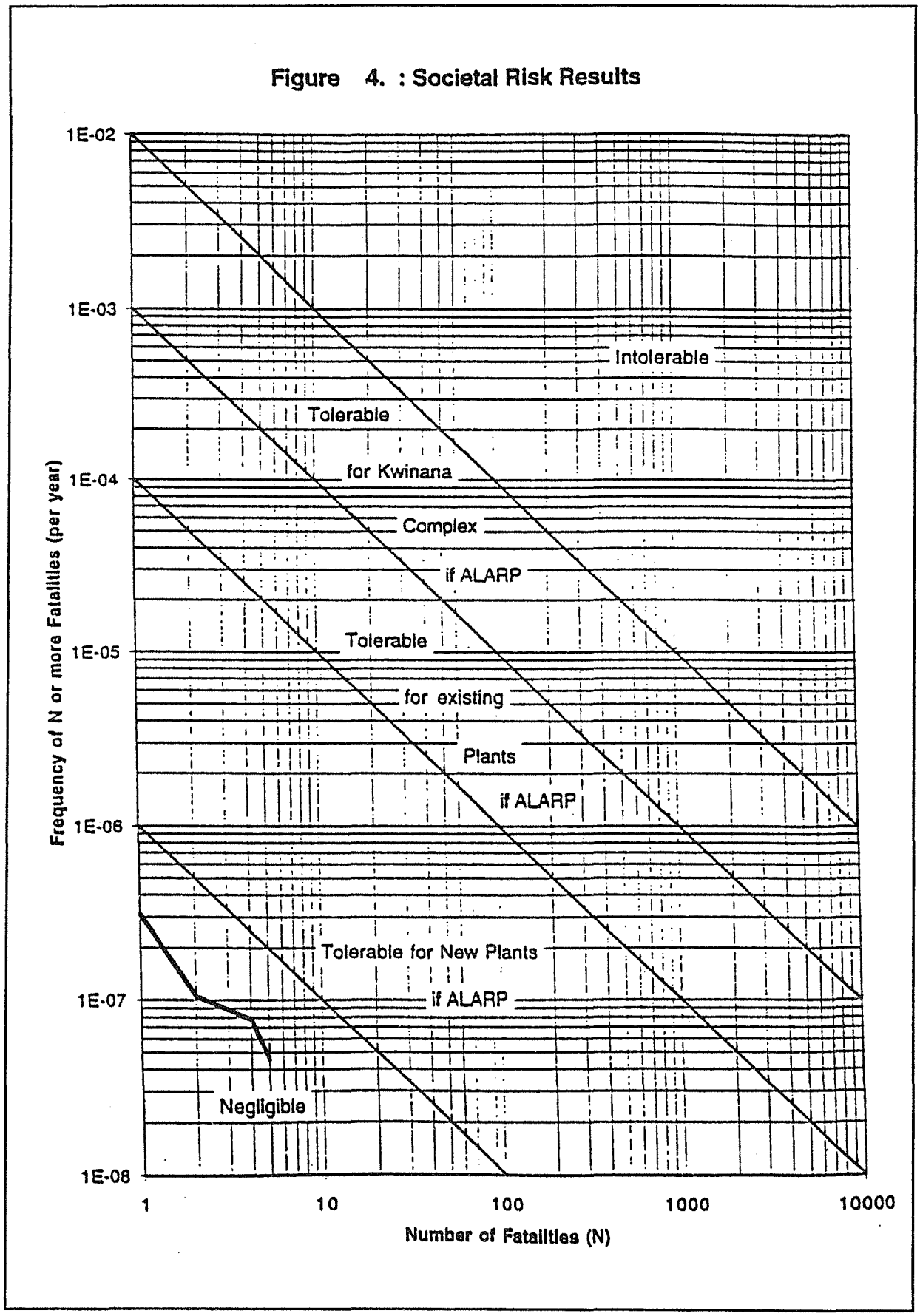

Figure 4. Societal risk results.

Appendix 2

List of organisations that made submissions

Town of Kwinana
City of Cockburn
Department of Environmental Protection
Health Department of WA
Department of Minerals and Energy

Appendix 3

References

Nufarm-Coogee Pty Ltd 1996 (a), *Hazards and Risk Analysis for Kwinana Site,* VRJ Risk Engineers Pty Ltd

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