PROPOSED CHLOR-ALKALI PLANT CSBP & FARMERS PTY. LTD.

Report and Recommendations by the Environmental Protection Authority

Department of Conservation and Environment,
Perth, Western Australia.

Bulletin 216 September 1985

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Department of Conservation and Environment
PERTH, WESTERN AUSTRALIA

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EXPLANATORY STATEMENT ON RISK ASSESSMENT

The formal analysis of risks and hazards of industrial development is new to the Environmental Protection Authority. Accordingly it has taken a cautious approach.

The EPA has taken note of how decisions on risks are taken in other parts of the world, and now proposes that decisions fall into three categories. These are as follows:

- A low level of risk which is acceptable. This level may be likened to the risk of being struck by lightning.

- A high level of risk which is unacceptable. This level may be likened to the risk of walking along the middle of a busy road.

- A middle level of risk, which is not unacceptable, but where a conscious decision should be made whether technical, social or economic actions should be taken to accommodate that risk. This level may be likened to the risk of walking along a footpath, where the decision had been made to build the footpath to keep pedestrians off the road.

For example, where a new industrial development has a risk level of 1 in a million in a residential zone, or 50 in a million in an industrial zone, the EPA has indicated that the extra risk is so small as to be acceptable. Where the risk is just above these levels, the EPA has recommended that technical and social actions be taken. The EPA has not yet any experience where risk has approached unacceptable limits. Therefore EPA has not proposed any values for the category of unacceptable risk.

Barry Carbon

B A CARBON
CHAIRMAN
16 October 1985

PREFACE

A major issue associated with the assessment of the proposed chlor-alkali plant is the risks and hazards that are associated with its operation. The release of liquefied chlorine is the principal determinant of the level of risk.

The EPA has adopted a set of standards of risk, below which the added risk from the proposal is acceptable. Different standards are proposed for various land use zones. The Authority does not indicate that risk levels above these levels are unsafe, but that above these levels, decision should be made on whether technical, social or economic action is necessary.

CHLOR-ALKALI PLANT

1. INTRODUCTION

CSBP & Farmers Ltd (CSBP) proposes to construct and operate a 10 000 tonne per annum chlor-alkali plant within the Kwinana industrial area. The plant, to be built in two stages, each of 5 000 tonnes per annum, would produce chlorine, caustic soda, hydrogen, hydrochloric acid, and sodium hypochlorite.

Chlorine, a gas at normal pressure and temperature, is used principally in Western Australia in the purification of water supplies and the treatment of sewage. Current State requirements, of approximately 4 500 tonnes per annum, are imported from the eastern states and overseas.

Chlor-alkali plants produce chemicals, such as chlorine, that are toxic and hazardous. As a consequence, the production of these chemicals has attendant risks which need to be understood and assessed. In addition, chlor-alkali plants generate discharges and wastes that have the potential to affect the environment, unless safeguards are integrated into plant design and operation.

A Notice of Intent was received from CSBP in March 1985. The Authority recommended that a Public Environmental Report (PER) should be prepared, and issued guidelines to the proponent (Appendix A). A four week public review period was proposed by the Authority.

A draft PER was submitted to the EPA on the 30th May. The Authority found the document to be deficient in content and form and informed the proponent that the document was unsuitable for public release. In general, the Authority was concerned that the document had not adequately described the process and had not discussed the nature and extent of issues and impacts involved in the project. Notwithstanding this advice, CSBP Ltd released the document for public comment. The public review period closed on 2 July 1985. Additional information was provided by the proponent. This has been incorporated in the assessment of this proposal. Several meetings have also been held between relevant Government departments and the proponent.

The EPA is of the view that it now has sufficient information to assess the implications of constructing the chlor-alkali plant at Kwinana. Some changes to the proposal outlined in the PER have been made by CSBP, and these have been incorporated in this Assessment Report. A list of these amendments is provided in Appendix B.

2. DESCRIPTION OF PROJECT

The proponent proposes to construct a chlor-alkali plant with a design capacity of 10 000 tonnes per annum (tpa) of chlorine and a quantity of sodium hydroxide (caustic soda). Also produced at the plant would be hydrochloric acid, hydrogen and sodium hypochlorite as by-product. It is the proponent's intention to initiate the first stage immediately following approval, while the second stage will depend on increased markets for the products.

The plant would be established at CSBP & Farmers Ltd's existing site at Kwinana (Figure 1).

2.1 The Proposal

The main raw material requirements of a chlor-alkali plant are salt (sodium chloride) and electricity. Major process inputs are shown in Table 1.

TABLE 1

Process Inputs (10 000 tpa chlorine)

DESCRIPTION	QUANTITY	SOURCE	TRANSPORT MODE
Salt (sodium chloride)	17 500 t	WA solar supplies	Road and/or rail
Hydrochloric acid	250 t	Adjacent plant	Private road
Sulphuric acid	520 t	Adjacent plant	Private road
Soda Ash (Na_2CO_3)	270 t	Local supplier	Road
Electricity	25 x 10^6 kWh	State grid	
Water	80 000 m^3	Local ground-water or scheme water	Pipeline

SOURCE: PER

Chlorine is produced by electrolysis [ie by the passage of electric current through salt water (brine)]. The gaseous products of electrolysis include chlorine and hydrogen. Three major methods exist to separate these products:

(i) mercury cells
(ii) diaphragm cells
(iii) membrane cells.

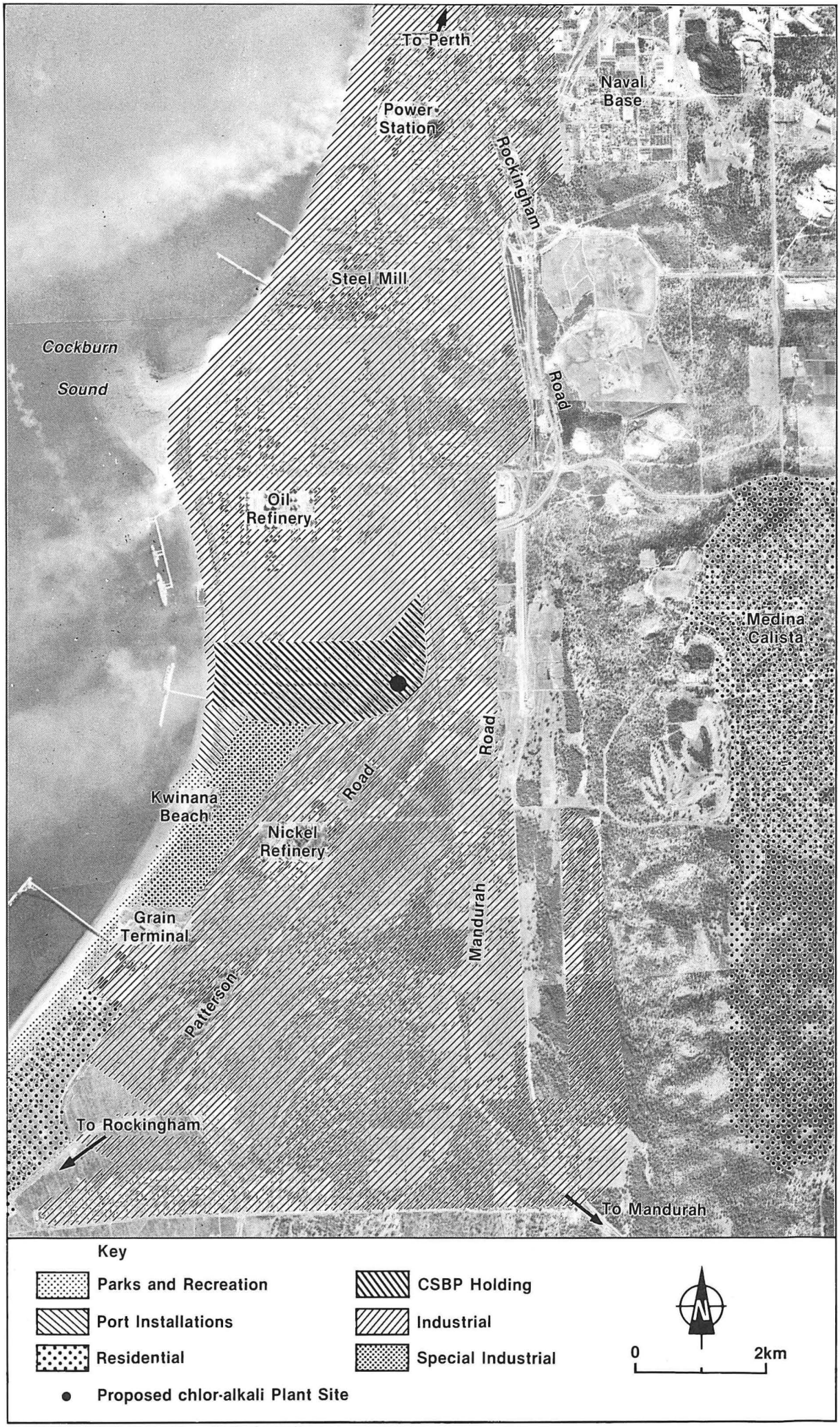


Figure 1 — Proposed chlor-alkali plant site

Mercury cells tend to produce mercury contamination in their product and waste discharges which can generate environmental problems. Diaphragm cells employ asbestos and produce poor quality product. Membrane cells are a recent development, are energy efficient and produce minimum cell waste. The proponent has chosen membrane cell technology for this proposal.

The major component of the plant is the series of membrane cells, within which electrolysis takes place. The membrane separates the anolyte (chlorine and sodium chloride solution) from the catholyte (hydrogen and sodium hydroxide solution).

Chlorine gas produced by the process would be cooled to reduce the water vapour in the gas and then dried with sulphuric acid. The dry chlorine would then be compressed and condensed in a liquefaction unit. Finally, the chlorine would be refrigerated to $-34^{o}C$ and stored in bulk tanks. These will normally operate at atmospheric pressure, 101.3 kilopascals (kPa) but during filling of drums and cylinders, their pressure will be raised to approximately 8 atmospheres (800 kPa).

CSBP proposes that on-site bulk storage would be 50 tonnes of chlorine in three 25 tonne storage vessels, one of which would be used for emergency standby. Chlorine would also be stored in 1 tonne transportable pressure drums and 70 kg and 33 kg cylinders. The maximum on-site inventory of liquid chlorine is proposed by CSBP to be in the order of 160 tonnes. Storage vessels would be located within a concrete bund.

In view of the potential hazards associated with the establishment and operation of a chlor-alkali plant, CSBP commissioned a risk assessment of the proposal. This was incorporated within the PER as Appendix 1. Further discussion on the risk assessment of the chlor-alkali plant is given in Section 5.1.

The plant would generate a number of effluent streams. Gaseous emissions, these would be controlled to ensure that the discharge of chlorine to the atmosphere would not exceed 1 part per million (ppm) and that of gaseous hydrochloric acid, 0.205 gram per cubic metre (g/m^3). Chlorine emissions would be minimised by the installation of a chlorine scrubbing system consisting of two identical absorption towers connected in series, such that the second tower acted as a back-up for the first.

Limited quantities of liquid and solid wastes would require disposal. The PER indicates that a small volume of brine would need to be bled from the brine purification circuit. CSBP proposes to discharge this

brine bleed (10 cubic metres per day) into Cockburn Sound. Solid wastes resulting from the process would be removed to an approved landfill site.

2.2 Proposed Site

The proposed site is located at Kwinana, on land currently owned by CSBP & Farmers Ltd. As indicated in Figure 1, the site is within an existing industrial zoned area and is surrounded by established industry on three sides. To the south west is Kwinana Beach, an area that is zoned for industry but contains residential dwellings.

As proposed in the PER, the chlor-alkali plant would become integrated into the present operations of the fertilizer plant. It would receive inputs from various parts of existing plant and would contribute chemicals such as hydrochloric acid back to the present plant.

The Kwinana site was preferred to other locations at Geraldton, Bunbury and Bayswater. Proximity to the product market, availability of logistic support and company planning regarding chemicals manufacture were indicated in the PER as reasons for the strong preference for Kwinana.

3. REVIEW OF SUBMISSIONS

The PER was released to the public and government departments for comment on 4 June for a four week review period, which ended on 2nd July 1985.

A total of 19 submissions was received - 15 from government agencies and 4 public submissions. All the submissions have been analysed and the main issues summarised in Table 2. A detailed list of comments can be found in Appendix C, which also includes the list of people and government departments making submissions.

The issues that received most frequent comment related to:

- land use planning and residential amenity;
- site selection;
- operational safety and risk analysis;
- air pollution; and
- rail/road transport.

Information and comments provided in submissions have been used to assist in the evaluation of the chlor-alkali plant proposal.

TABLE 2

SUMMARY OF ISSUES RAISED IN SUBMISSIONS

MAIN ISSUES	PUBLIC SUBMISSION NO. 1	2	3	4	GOVERNMENT DEPARTMENT SUBMISSION NO. 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	TOTAL
Document inadequate		.		.														.		3
EIA process		.		.																2
Land use planning/ residential amenity	.	.	.	.		.						.								6
Site Selection	.	.	.	.		.	.					.								7
Costs/benefits to community			.	.								.								3
Plant design/process/ technology				.							.				.					3
Buffer zone				.																1
Handling and storage of hazardous chemicals			.	.		.									.			.		5
Operational safety/risk analysis		.	.	.		.					.			.	.			.		8
Emergency procedures/ contingency plans			.	.		.										.		.		5
Plant failure				.							.									2
Noise									.	.									.	3
Water demand				.														.		2
Air pollution (all emissions inc. chlorine)		.	.	.							.				.					6
Odour control		.		.																2
Meteorology		.		.																2
Liquid waste		.		.							.							.		4
Solid waste		.		.							.	.						.		5
Soils and groundwater contamination				.														.		2
Road/rail transport	.		.			.					.				.	.	.			7
Cumulative impacts of plant and other industries	.		.	.		.						.								5
No impact foreseen/No comment							.	.		.			.	.						5

4. ASSESSMENT OF THE PROPOSED SITE

The review of any site proposed for development requires two broad issues to be examined:

- whether the site is suitable/appropriate for the development; and
- identification of any impacts that the development might have on adjacent or surrounding land and land uses.

The nature of the development determines the type and extent of impacts both on and off the site. This proposal is for a relatively small chemical plant.

A number of submissions included expressions of concern about the proposed site, although most of these were more concerned about the compatibility of a chlor-alkali plant with other land uses in the vicinity of the site rather than any particular characteristics of the site.

CSBP identified in the PER four potential sites on which the proposed plant could be located. These were Geraldton, Bayswater, Kwinana and Bunbury. All sites are on land currently owned by the proponent. An assessment of the suitability of each site, presented in summary in Table 2 in the PER, was undertaken by CSBP. The selection criteria included:

- proximity to the market;
- availability of adequate land (0.5 ha);
- availability of appropriately skilled plant operators and engineering maintenance;
- availability of electricity and transport links; and
- hazardous nature of products.

The preferred site is located on land adjacent to the CSBP & Farmers Ltd fertilizer plant at Kwinana. It is within the Kwinana Industrial Area and is zoned Industrial under the Metropolitan Region Scheme.

The site has been partly cleared and is covered by Acacia rostellifera and grasses. An unconfined aquifer, reflecting the surficial groundwater level, lies within two metres of the surface. The soils, consisting of unconsolidated calcareous sands, are part of the Becher-Rockingham beach ridge plain (Woods & Searle, 1983).

Adjacent land uses to the north, east and west are industrial, but the settlement of Kwinana Beach lies to the south-west (Figure 1). This area is included within the Industrial zoning for Kwinana, but residential dwellings remain. The 1981 Census indicated that Kwinana Beach had a population of 301, a decline from 402 in 1976. The long term planning aim is to continue to reduce the number of dwellings within the Kwinana Industrial Area, through acquisition by the Government and also through the prohibition of new, residential uses under the Town of Kwinana Town Planning Scheme.

Also located in this settlement is Kwinana Beach, a frequently used recreation area. In 1978, a recreational survey indicated that the beach was visited by more than 600 people on one day, mainly as family groups (Feilman Planning Consultants, 1978).

Section 5.1 of this Report discusses the assessment of risks and hazards which may be appropriate within particular land use zones. The administration of the zoning concept is central to the Authority's subsequent recommendations on risks and hazards, and therefore to specific recommendations on the Chlor-Alkali proposal.

The residential area at Kwinana Beach is within the industrial zone, and therefore represents a conflict of purpose, and is incompatible with the Metropolitan Region Scheme.

Recommendation 1

The EPA recognizes that there are residents living in industrial zoning at Kwinana Beach. In order to minimise the conflict, the Government should provide opportunities for these residents to relocate to other areas.

The EPA is cognizant that the residents of Kwinana Beach are entitled to adequate consideration of social needs. Therefore the EPA is not recommending immediate relocation of residents, but is indicating the need for a sensitive acceleration of the relocation programme.

5. ENVIRONMENTAL IMPACTS

A chlor-alkali plant raises significant hazard issues as a consequence of its products and the production process. Chlorine, caustic soda, hydrogen, hydrogen chloride and sodium hypochlorite are all hazardous chemicals. Two of these, chlorine and hydrogen chloride, constitute off-site hazards as they are toxic irritant gases. A detailed discussion of

these hazardous materials is presented in Section 4.1 of the analysis prepared by Cremer and Warner Ltd (CWL) in Appendix 1 of the PER.

A number of emissions from the chlor-alkali plant would require management in order that their impacts are reduced and minimised.

5.1 Risk Assessment

The Authority recognises that the assessment of risks to the community of a chlor-alkali plant is an important component of evaluation of the environmental impact of the proposal.

Risk is defined as the "probability that a hazard, in terms of a specified level of loss or injury to people or property will occur in a specific period of time" (Pomeroy, 1982). Cremer and Warner Ltd (1985) have used 'hazard' to describe a set of conditions which could lead to an accident with harmful consequences.

Risk assessment methodology consists of the following elements:

(i) HAZARD IDENTIFICATION OR DEFINITION: i.e. identification of potential hazards or hazard events.

(ii) RISK ESTIMATION: i.e. determination of the likely severity of consequences of the event and its product with the likely frequency of the event.

(iii) SOCIAL EVALUATION: i.e. standards of assessment and an evaluation of the social risk.

There is an extensive assessment of risks of this project carried out by Cremer and Warner Ltd, even though the proposal details have not been finalised. Much of the discussion in this section of the Assessment Report is based on that analysis, which the Authority believes is an acceptable assessment of the proposal.

5.1.1 Hazard Identification

The Cremer and Warner Report (Appendix 1 of the PER) indicates that the "major hazards associated with chlor-alkali plants are those that arise from loss of containment of chlorine" (CWL, p 5-1).

That report points out that the

> "dominant risks ..... come from possible failures of equipment handling liquid chlorine in liquefac-

tion, storage, loading and transportation systems or, to a lesser extent, from overloading or failure of the gaseous chlorine absorption system" (CWL, p 4-19).

While chlorine represents the major hazard, due to its toxicity and intensely irritating properties, other hazards were identified by CWL. These are discussed in Section 4 of Appendix 1 of the PER, and are summarised in Table 3.

A significant aspect of the hazards of the chlor-alkali plant is the storage of chlorine. As mentioned in Section 2.1, CSBP propose to store liquefied chlorine in two 25 tonne bulk storage vessels and smaller 1 tonne and 70 kg and 33 kg cylinders. The proponent expects the maximum on-site quantity of stored chlorine to be 160 tonnes.

Following advice received from Cremer and Warner Ltd, CSBP altered its original intention to hold 200 tonnes of chlorine in on-site bulk storage.

The matter of the quantity of on-site bulk storage of chlorine is critical to the consideration of risk. There needs to be adequate on-site inventory for commercial purposes but this quantity should be kept to a practical minimum to reduce risks. In addition, because chlor-alkali plants operate continuously, appropriate on-site storage is required for chlorine produced over a weekend or for longer occasions like long weekends, Christmas or Easter.

5.1.2 Risk Estimation

Risk estimation attempts to characterise and quantify releases (in the case of a chlor-alkali plant) due to each identified event and indicate the consequences of the event.

A release of chlorine from the plant was identified by CWL as the most significant likely event. Their assessment concentrated on various chlorine-related events as they were perceived to constitute the highest level of risk.

In Appendix 1 of the PER, Cremer and Warner Ltd estimated the frequency of various failure events. These are presented in Table 4. In relation to a failure of a bulk storage vessel, CWL estimate the frequency of a catastrophic failure and instantaneous loss of contents of a bulk storage vessel at between 1 and 3 per million per annum, and partial failures of bulk storage vessels at up to 30 per million per year.

TABLE 3

CHECK LIST FOR HAZARDS

Area	HAZARD OR NUISANCE														Comments
	Within the Works								Outside the Works						
	FIRE	EXPLOSION	CORROSION	SMELL	TOXICITY	NOISE	HEALTH	DUST	VENTS/ RELIEF	RADIATION	NOISE	SMELL	TOXICITY	HEALTH	
Cell Room	X	X	X	X	X							X	X		H_2/O_2 or H_2/Cl_2 explosions
Brine Dechlorination			X	X	X				X			X	X		In upset condition, partial pressure of chlorine over brine
Brine Treatment			X	X	X	X		X	X			X			Concentrated HCl addition, + soda ash, caustic, barium carbonate
Hydrogen Treatment	X	X			(1)	X	X		X		X				(1) Nitrogen purging during maintenance could be a problem
Caustic Evaporation	X		X			X			X		X				5 ppm of hydrogen in caustic
Chlorine Treatment	X	X	X	X	X							X			H_2/Cl_2, Fe/Cl_2 Ti/Cl_2 fires
Chlorine Comp.	X	X	X	X	X	X					X				H_2/Cl_2, Fe/Cl_2 Ti/Cl_2 fires
Chlorine Liqu.	X	X	X		X		X						X	X	Arcton 22 used in liquefaction
Chlorine Storage and Export	(2)	X	X	X	X				X			X	X		(2) No flammable materials should be allowed in area
Chlorine Absorption and Hypo	X	X	X	X	X	X			X		X	X	X		
Hydrochloric Acid	X	X	X	X	X				X			X	X		

SOURCE: CWL, 1985

TABLE 4

ESTIMATED FAILURE FREQUENCIES

FAILURE EVENT		ESTIMATED FREQUENCY
(a)	Pressure Vessel (Storage)	
	Catastrophic failure and inst. loss of contents	1 to 3 x 10^{-6}/yr
	Disruptive (partial) failure (=1 1/2" dia.)	10 x 10^{-6}/yr
	Disruptive (partial) failure (=1 1/2" dia.)	30 x 10^{-6}/yr
	Assumed that 30% of the disruptive failures will be below the liquid level and 70%, ie as the manway/-connections are an integral unit on top of the vessel.	
(b)	Pipework and Valves	
	Catastrophic failures (1 to 3") (depends on degree of support/protection)	0.3 to 1.0 x 10^{-6} per metre per year
	Partial failures	1 to 10 times catastrophic failure rate depending on circumstances
(c)	Gaskets	
	Typically	3 x 10^{-6} per gasket per year
(d)	Catastrophic rupture of tanker hose/connection	1 x 10^{-6} per operation
(e)	Failure of excess flow check valve (depending on nature of flow)	0.1 to 0.01/demand
(f)	Failure of remote operated valve to close on demand	0.05/demand
(g)	Failure of general instrument trip system	0.02/demand

SOURCE: CWL (1985)

Once these failure frequencies have been estimated, it is possible to estimate the consequences of a failure or event. Examples presented in Table 5, which is taken from the CWL Report, are based on bulk on-site storage of 2 x 25 tonne vessels and no bulk road transport of chlorine.

TABLE 5

DISPERSION CONSEQUENCES OF SELECTED FAILURE CASES

DESCRIPTION OF UNWANTED EVENT	RELEASE RATE	WIND SPEED /STABILITY	CHLORINE CONCENTRATION DOWNWIND (ppm) 250 m	500 m	1 000 m	1 500 m	2 000 m
Catastrophic failure of full storage tank	25 te Inst.	2F	6 680	3 770	2 030	1 120	650
		4D	8 700	4 360	1 030	410	220
		7D	11 000	4 700	1 260	570	320
Guillotine failure of liquid pipeline (single phase flow)	22 kg/s	2F	8 900	4 650	1 540	670	350
		4D	1 870	590	160	68	35
		7D	1 080	200	52	-	-
Disruptive failure of storage tank or liquid pipeline/transfer hose (2 phase flow)	7 kg/s	2F	8 000	2 500	500	180	100
		4D	1 000	200	35	-	-
		7D	230	60	-	-	-
Partial failure of liquid pipeline	1.4 kg/s	2F	2 420	530	130	78	61
		4D	215	57	-	-	-
		7D	102	-	-	-	-
Cell room output - pipe failure	0.35 kg/s	2F	600	179	60	31	19.8
		4D	52	-	-	-	-
		7D	41	-	-	-	-

SOURCE: CWL (1985)

2 : 1.5 metres/second
4 : 4 metres/second
7 : 7 metres/second
F : stable
D : neutral

It is clear from this table that in terms of exposure to gaseous chlorine, the worst case would be an instantaneous release from a bulk storage vessel.

By estimating chlorine concentrations over various distances, it is possible to quantify the level of risk that individuals would be exposed to following an event. An issue of prime relevance here, is the toxicity of chlorine. CWL point out in their Report that there "is a wide variation in the toxic and human response data and this is discussed further in Appendix IV (of their Report)" (CWL, p 5-3).

In order to carry out their risk assessment, CWL adopted chlorine toxicity doses that are illustrated in Figure 2.

A comparison of Table 5 and Figure 2 indicates that potentially lethal levels of gaseous chlorine would be experienced at some distance from the plant, in the case of a major event or failure.

5.1.3 Social Evaluation

The information obtained during the risk estimation can be used to define individual risk levels.

There is some level of risk associated with almost all human activities. Many are accepted because the activity is undertaken voluntarily, while others are imposed because they are involuntary. Risks associated with the operation of a chemical plant in close proximity to a residential area may be of concern to residents, but not necessarily to employees working in the plant. This suggests that there is some level of risk that people are prepared to accept.

The identification of standards of risk is a difficult task in itself and is subject to many issues. One of these issues that is relevant to the chlor-alkali porposal is the quantity of liquefied chlorine stored in bulk inventory on the plant site. Cremer and Warner Ltd have reviewed the difference in individual risks associated with the bulk storage of 200 tonnes of chlorine (as originally proposed) versus 50 tonnes. They have concluded that

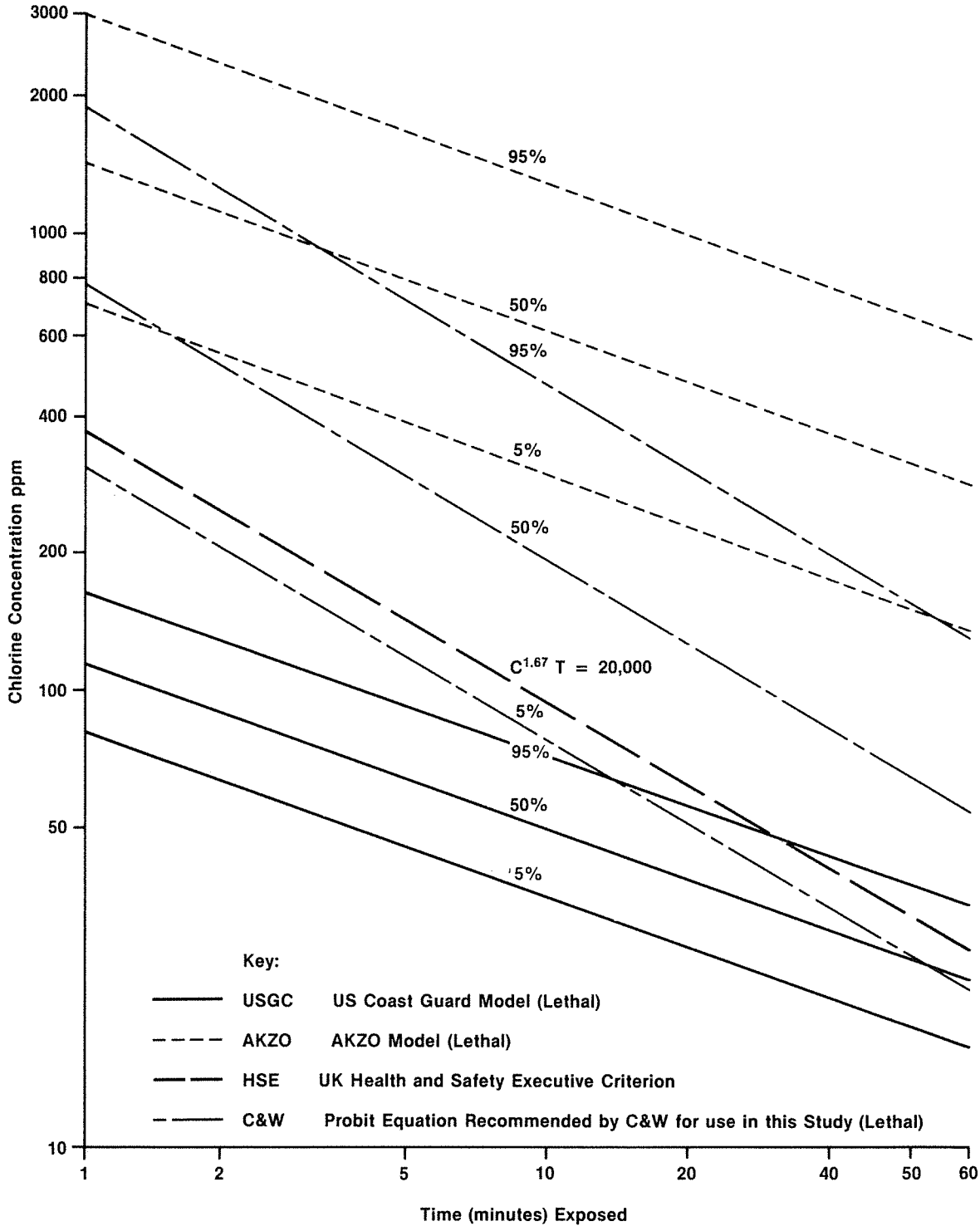
> "risk levels could be reduced by some 50% by having 2 x 25 tonne bulk storage tanks, no bulk transport and the remaining inventory requirement held in 1 tonne drums and smaller cylinders" (CWL, p 1-2).

The Authority's assessment has been based on this storage configuration and the PER indicates that CSBP have accepted the proposition that they should not hold more than 50 tonnes of chlorine in bulk inventory, in 25 tonne vessels.

Recommendation 2

The EPA recommends that the quantity of chlorine on-site (inventory) does not exceed that stated in this Assessment Report. Any increase in on-site chlorine inventory would require a further risk analysis.

The Authority is not aware of the existence of any individual risk standards or criteria in Western Australia. It is, however, aware that the



Source: Cremer & Warner (1985)

Figure 2 — Comparison of Chlorine Toxic Dose Data

identification of such risks has been undertaken elsewhere. For example, the NSW Department of Environment and Planning has reviewed overseas studies and local data and formulated fatality risk criteria (DEP, 1985). Similar investigations in the United Kingdom have led to the definition of acceptable levels of risk. For example, the 6th Report of the Royal Commission on Environmental Pollution provided the following comments on individual risks associated with various activities:

> "Some of these risks, such as those arising from smoking or from rock climbing, are accepted voluntarily by individuals. Others are concomitants of our everyday lives, such as risks at work or from aircraft or car accidents. Another category of risks we attribute to acts of God. Generally, risks greater than about 1 in 1 000 per year are considered unacceptable. With risks of the order of 1 in 10 000 per year public money will be spent to try to eliminate the causes and to mitigate their effects. Risks below 1 in 100 000 are considered as individual risks and warnings may be given. Risks below 1 in 1 million per year are generally accepted without concern." (Royal Commission, p 77).

In view of the lack of existing risk standards in Western Australia and the nature of the potential impacts of the chlor-alkali proposal, the Authority has adopted some levels of risk as a guide for assessment. They coincide with those proposed by the NSW Department of Environment and Planning.

The EPA is now prepared to recommend a set of standards for risk, below which the extra risk is acceptable. Different standards are proposed for different land use zones. The EPA does not indicate that risk levels above these are unsafe, but that at these levels the issue of risk should be considered further. Above the proposed levels decisions should be made on whether technical, social or economic action is necessary.

The EPA has not recommended any standards beyond which a proposal would be considered unsafe. There are indications that ongoing studies in Australia may subsequently elucidate any need for such standards. For this particular proposal, the EPA has sought to indicate those levels below which the extra risk is acceptable.

Recommendation 3

The EPA recommends that for impact assessment in Western Australia, an individual risk standard in residential zones should be up to 1 in a million per year (1×10^{-6} per year).

In addition, the Authority adopts the following standard of assessment for fatality risk for other land uses.

Land use	*Fatality Risk Standard per million per person per year*
Recreation	
Passive	*Up to 10*
Active	*Up to 5*
Commercial	*Up to 5*
Public Roads	*Up to 20*
Industrial	*Up to 50*

5.1.4 Risk Assessment

Cremer and Warner Ltd have estimated that the following individual risk levels would be experienced by the Kwinana Beach residents if the proposed chlor-alkali plant was operational.

Locality	Distance from chlor-alkali plant	Risk
Nearest residential part of Kwinana Beach	600 m	10 in a million per year
Middle of Kwinana Beach	1 200 m	3 in a million per year
Furthest house from site in Kwinana Beach	1 700 m	1 in a million per year

These levels are illustrated in Figure 3. The variation between indoor and outdoor levels of risk is due to restricted ventilation rates within buildings. Indoor concentrations of chlorine may be substantially lower than the outdoor concentration for short duration releases (CWL, p 5-3).

The Authority has adopted an individual risk standard of up to 50 in a million per annum within industrial zoned areas. Figure 3 indicates that the proposed chlor-alkali plant would be below that risk level and therefore the proposed site would be acceptable, in view of the industrial zoning of the area. However, residential land use at Kwinana Beach lies within an area that would be subject to individual risks that would exceed 1 in 1 million per year.

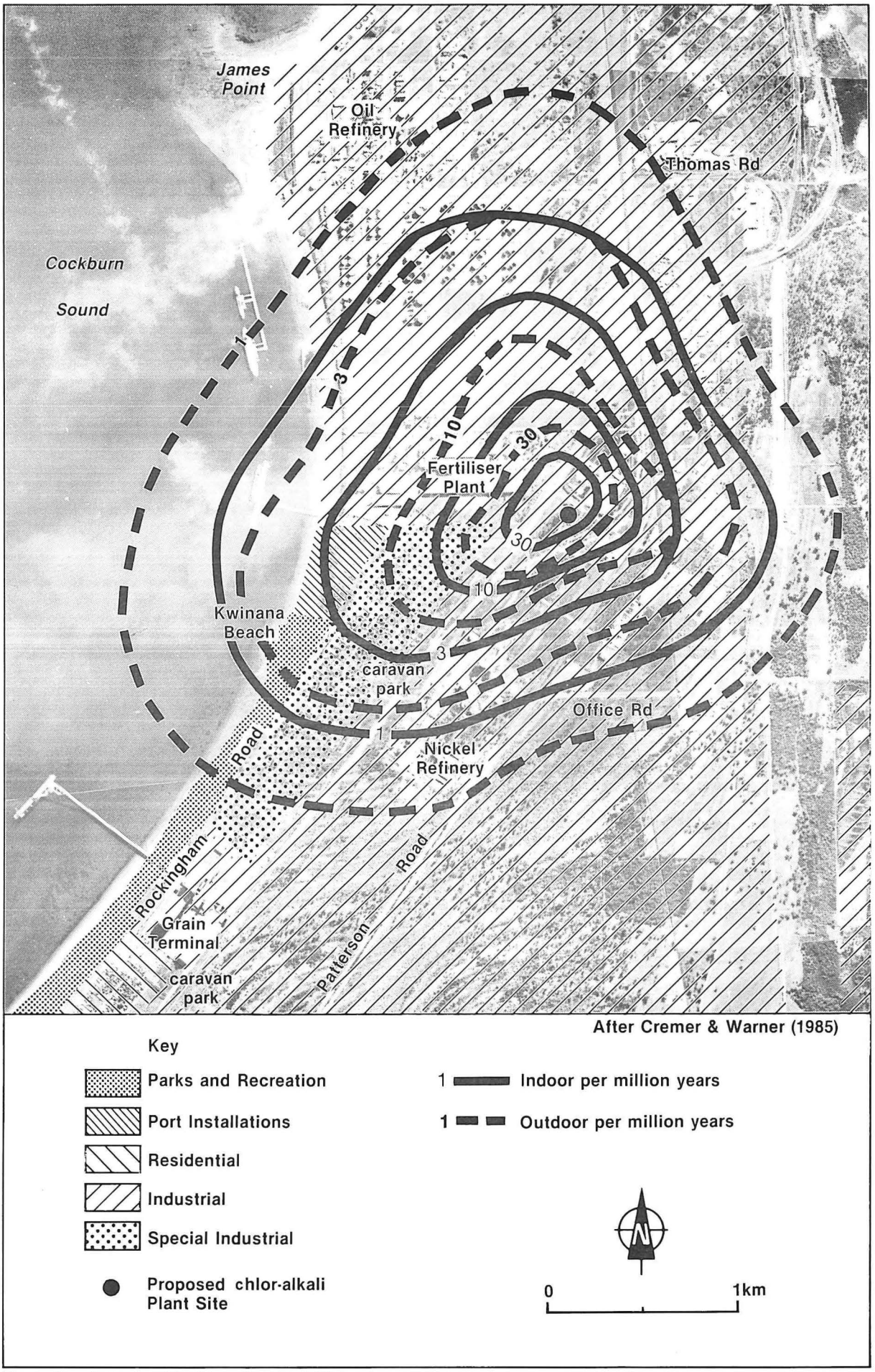


Figure 3 — Indoor and Outdoor Levels of Risk

Recommendation 4

The EPA recommends that the risk level associated with the proposed chlor-alkali plant would be acceptable given the industrial land use zoning of the area.

The Authority recognises that a conflict would exist for residents living at Kwinana Beach and emphasises that this recommendation should be read in conjunction with Recommendation 1 of this Assessment Report.

5.1.5 Cumulative Impact

Risk assessment is a relatively recent component in the environmental impact assessment and decision-making process. The Authority believes that it would be appropriate to place today's assessments in the context of the whole industrial area. A number of submissions, notably that from the Shire of Rockingham, raised the issue of cumulative impact from the existing and proposed hazardous industries in the Kwinana Industrial Area. The Authority is aware of the cumulative risk impact studies undertaken in the UK (the Canvey Studies, 1978 and 1981) and in Holland (The Rijnmond Study, 1982) and believes that a cumulative hazard and risk assessment study should be undertaken for the Kwinana Industrial Area, encompassing not only the present situation, but also anticipated proposals.

The Authority believes that it would be more appropriate for Government to undertake a cumulative risk analysis for existing and proposed developments in the Kwinana Industrial Area than to impose this task on proponents.

Recommendation 5

The EPA recommends that Government requires a study of cumulative risk impact of the Kwinana Industrial Area.

5.2 Construction Phase

The PER provided no information on the impacts of constructing the chlor-alkali plant, such as dust generation and servicing requirements, nor did it specify any means of minimising the impacts. While it is likely that any construction impacts will be limited, the proponent should ensure that appropriate management techniques are put in place.

5.3 Air Emissions

The earlier discussion on risks discussed the possibility of accidental releases of chlorine gas into the environment. It is essential that the plant be designed to minimise the possibility of equipment failure or accidental spillage.

CSBP proposes to control the emission of gaseous chlorine by the following means:

> "All vents throughout the plant which may contain traces of chlorine, for example the tail gas from the liquefaction process, the vent from the chlorine storage, and the vents required for maintenance purposes, will be routed to the sodium hypochlorite production unit where it reacts with caustic soda. An induced draft fan will maintain a negative pressure in the headers and thus provide the driving force across a packed bed, caustic scrubber before venting gases to atmosphere." (CSBP, p 25).

Some atmospheric emissions are proposed from the plant. Treated gaseous chlorine would be discharged from the caustic soda scrubbing tower, at a level of less than 1 ppm of chlorine. Hydrochloric acid would also be released to the atmosphere, at a level of less than 0.205 g/m^3. Excess hydrogen gas may be vented to the atmosphere.

None of these discharges would be expected to present hazardous, irritational and odour problems, provided the proposed levels are not exceeded.

The proponent has made a commitment to undertake a regular monitoring programme of all chlorine-containing discharges into the atmosphere to ensure compliance with the licence that would be issued under the Clean Air Act and to maintain a high standard and efficiency of plant operation (Appendix D). This monitoring programme should be prepared with the assistance of the Department of Conservation and Environment and the results of the monitoring should be regularly provided to the Department.

5.4 Liquid Waste

A bleed of brine from the brine purification circuit was the only liquid waste indicated in the PER. Some discussion was given about acidic and alkaline liquors and sulphuric acid in Section 4.6.2 of the PER, but not with any reference to disposal.

Further clarification of the nature of liquid wastes has been provided by CSBP:

- The major liquid waste generated by the plant would be a 10 m^3/day of brine purge containing 18% NaCl and 6.0 g/L Na_2SO_4. Additional liquid effluent arises from the regeneration of ion exchange resins.

- Liquid effluent would be collected, pH adjusted to the range 6.0-8.0 and then discharged through the submarine pipeline into Cockburn Sound.

- There would be a small amount of bleed-off from the cooling tower consisting of clean water (bore or scheme water) which will be pumped to the gypsum ponds located on CSBP land.

The PER does not present full details of the collection, treatment and disposal of the liquid waste generated by the plant. This is a matter that should be subject to further assessment, particularly the treatment and disposal of chlorine contaminated liquid effluents. CWL indicate that the possibility of interaction between chlorine and other effluents must be investigated, as the interaction may lead to the evolution of chlorine in the effluent mains (CWL, p 4-17). Use of Cockburn Sound as a disposal site should also be reviewed. The Authority does not encourage the disposal of effluents into the Sound.

A licence to dispose of liquid waste will be required under the Rights in Water and Irrigation Act, and approval may also be required from the Fremantle Port Authority.

5.5 Solid Waste

The main solid waste generated at the plant would be composed largely of salts of calcium and magnesium, as well as small quantities of barium sulphate. Several alternative methods of maintaining brine purity are mentioned in the PER, although no preference for any of them is indicated.

CSBP has indicated its intention to dispose of these solid wastes at an approved landfill site. Information on the nature, volume and proposed method of disposal of solid wastes should be provided to appropriate authorities.

5.6 Groundwater Contamination

The proposed chlor-alkali plant site is located above a shallow, unconfined aquifer and the soils are permeable (CSBP, p 17). As a consequence, the surficial groundwater is susceptible to contamination (CSBP, p 37).

The Water Authority of WA has indicated that the plant would be located in an area where the shallow unconfined groundwater is used extensively for both domestic and industrial purposes. Any liquid spilt or discharged onto the ground surface would inevitably result in pollution of the groundwater.

The Water Authority noted that no monitoring or emergency procedures are detailed in the PER to detect or eliminate the impact of pollutants on the groundwater system in the event of a major leak or spill. An action plan should be incorporated into the emergency procedures to limit the spread of contaminated groundwater in the event of a leak or a spill.

CSBP have indicated a preparedness to consider implementing a groundwater monitoring programme, if required (Appendix D). However, no management programme to prevent spillages contaminating the groundwater has been prepared nor has consideration been given to separating run-off from product or effluent. Such a management and monitoring programme should be prepared.

5.7 Water Resources

Up to 80 000 m^3 of water would be required by the plant. Water would be demineralised and added to the brine solution. Table 3 in the PER suggests that this water would be obtained from local groundwater sources or from scheme water. Access to either source by CSBP would need to be negotiated with the Water Authority of WA.

5.8 Handling and Storage of Chemicals

Little detail is provided in the PER about the handling, storage and transport of the range of hazardous chemicals that are part of a chlor-alkali plant. The various regulations and standards to be complied with are mentioned in Section 4.5 of the PER.

The Water Authority of WA submission noted that

> "safety systems such as sealed and bunded areas should be designated to prevent infiltration of chemicals into the groundwater system. Storage dam designs would need to be approved (by the Water Authority) to ensure the potential for overfilling or leakage is minimised."

The EPA believes that these matters need to be addressed by the proponent.

5.9 Noise

A chemical operation such as a chlor-alkali plant uses equipment, such as compressors, that has the potential to create considerable noise. The PER indicates that

> "noise levels generated by plant operations nor those derived from vehicular movements are expected to increase background levels presently detected at the residences located closest to the proposed site" (CSBP, p 44).

No quantification of existing background noise levels is provided in the PER.

This project will need to comply with both the Noise Abatement Act and the Noise Abatement (Hearing Conservation in Workplaces) Regulations.

5.10 Aesthetics

The proposed site is located away from local roads and is generally screened by the trees planted along the eastern boundary of the CSBP property. Consideration should be given by the proponent to establishing a full screen of trees around the site.

6. ENVIRONMENTAL MANAGEMENT AND MONITORING

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

6.1 Environmental and Risk Management Outlined in the PER

The PER states that the potential impacts of the chlor-alkali plant would be minimised in the following ways:

"(i) by the adoption of state-of-the-art process and control equipment;

(ii) by adopting well proven codes of practice and safety specifications in manufacture and product distribution;

(iii) through comprehensive training of plant operators; and

(iv) by the development of a site emergency plan." (CSBP, p 45).

The document then presents details of specific measures proposed in the areas of plant design, operator training, emergency procedures and product transport.

Subsequent to the release of the PER, CSBP has provided the Authority with a list of commitments by the company. This list is presented in Appendix D of this Assessment Report.

6.2 Design State and Risk Management

The review of the chlor-alkali proposal carried out by Cremer and Warner Ltd, was based on a preliminary process design package, which meant that not all aspects of the specific project were examined. On the basis of preliminary information and assumptions which relied on experience and industry standards, the salient risks associated with the plant were identified and quantified.

CSBP has indicated that a hazard and operability study (HAZOP) will be carried out on the final plant designs (Appendix D). The Authority notes this commitment, and believes that the analysis and results should be provided to Government prior to commencement of construction of the plant.

The HAZOP analysis proposed by CSBP should lead to some reduction in individual risk to the public by a process of reviewing the design specification of the plant. Where potential hazards are identified, they would be reviewed as part of the plant design or operating procedures.

Hazards would be present throughout the operational life of the plant. As a consequence, the Authority believes that annual reviews of the hazards should be carried out by the proponent.

Recommendation 6

The EPA recommends that details of the design stage hazard and operational study be provided, to the Department of Industrial Development, before the construction stage. In addition, the proponent should carry out an annual hazard audit, the results of which should be made available to all relevant government agencies.

6.3 Environmental Management and Monitoring Programme

At the time that the PER was released, no decision had been made as to final plant design, although the production technique (membrane cells) had been selected. In addition, some changes resulted from the risk analysis by Cremer and Warner Ltd. Details of management and monitoring programmes were not provided in the PER, but the proponent has given commitments to prepare several. Others have been indicated in Section 5 of this Assessment Report.

These matters, which are relevant to the assessment of the environmental impacts of the project, need to be addressed in a consolidated report, an Environmental Management and Monitoring Programme, and submitted to the EPA prior to comissioning of the plant.

Recommendation 7

The EPA recommends that the proponent prepare an Environmental Management and Monitoring Programme (EMMP) which addresses all relevant issues including the following:

- *any amendment to the proposal as described in the PER which would significantly impact on the environment and increase risk associated with the project;*

- *matters identified in this Assessment Report as needing consideration in the EMMP;*

- *proposals for environmental monitoring and management including contingencies; and*

- *details of emergency procedures.*

The Authority is satisfied that the technology and appropriate safeguards exist in relation to chlor-alkali plants, as indicated in the Cremer and Warner assessment, and once implemented, would make the proposed plant environmentally acceptable.

7. CONCLUSION

This Assessment Report is submitted to State and Local Government to provide an environmental input to decision making on the proposed 10 000 tpa chlor-alkali plant at Kwinana. In preparing this Report, the Authority has considered a range of documentation, and has been assisted by contributions from the public and from other Government agencies.

The Authority believes that the proposed development is acceptable at the proposed location given the industrial zoning of the Kwinana area. However, the Authority notes that due to historical reasons, the Kwinana Beach area is also used for residential purposes. These land use conflicts need to be resolved, and attention paid to social consequences and their management.

Recommendation 8

The EPA recommends that the proposed chlor-alkali plant proposal is acceptable on environmental grounds, and has a level of risk appropriate to the zoning of the area, subject to the proponent's commitments (both in PER and given to EPA) and the recommendations of this Assessment Report.

SUMMARY AND RECOMMENDATIONS

The Environmental Protection Authority (EPA) has concluded an assessment of the chlor-alkali plant Public Environment Report (PER). This report is presented to state and local Government in order to assist the decision making process.

DOCUMENTATION

The draft PER was submitted to the EPA on the 30th May. The Authority found the document to be deficient in content and form and informed the proponent that the document was unsuitable for public release. In general, the Authority was concerned that the document had not adequately described the process and had not discussed the nature and extent of issues and impacts involved in the project. Notwithstanding this advice, the proponent released the document for public review. Subsequently, further information from the proponent was sought and a number of meetings held between the relevant Government departments and the proponent. The Authority now has adequate information on the project to make an assessment.

SUITABILITY OF PREFERRED SITE

The PER identified four potential sites. The preferred site chosen was at Kwinana, in the vicinity of Kwinana Beach area.

While the Authority finds that the proposed development is compatible with the Industrial zoning of the Kwinana Beach area, the Authority notes that for historical reasons, it contains a residential component. The Authority believes that these land-use conflicts need to be resolved.

The proponent proposes on on-site inventory of 50 tonnes of chlorine, stored in 2 x 25 tonnes tanks. In addition, there would be approximately 100 tonnes of chlorine stored, on-site, in one tonne drums. The Authority believes that while this quantity of chlorine stored on-site would be acceptable, any increase in on-site inventory should require further risk assessment.

RISK IMPACT

Risk impact is the major issue in this proposal. The PER contained a risk analysis as an Appendix. Risk Assessment consists of comparing the measured risk against an acceptable criteria. The Authority found that no risk criteria exist in the state. This report recommends a risk criteria based on land use zoning. Adopted risk criteria for assessing proposals are as follows:

Fatality Risk Criteria

Land Use	Fatality Risk Criteria per million per person per year
Residential	Up to 1
Open Space	
Passive	Up to 10
Active	Up to 5
Commercial	Up to 5
Public Roads	Up to 20
Industrial	Up to 50 (per employee)

The risk levels to be generated by the proposed development would be acceptable for industrial land use zoning of the surrounding area but would exceed criteria recommendations by the Authority for residential land use, such as the nearby Kwinana Beach area.

Another related issue is risk the cumulative impact from the existing and proposed hazardous industries in the Kwinana Industrial area.

The Authority belives that Government should undertake a cummulative risk analysis for the existing and proposed developments in the Kwinana Industrial Area.

OTHER ENVIRONMENTAL IMPACTS

The Authority notes that the PER did not contain details of how the environmental impacts of air emissions, liquid and solid waste treatment and disposal, among others, would be managed. The EPA has recommended that the proponent should provide further information in the form of an Environmental Management Programme (EMP). The EPA is satisfied that appropriate safeguards exist and once implemented, would make the plant, environmentally acceptable.

CONCLUSION

The Authority believes that the chlor-alkali proposal is acceptable at the proposed location given the industrial zoning of the Kwinana Beach Area. However the Authority notes that due to historical reasons, the Kwinana Beach area is also used for residential campers. The risk levels to be generated by the proposal would exceed the criteria for residential zoning adopted by the EPA.

The land use conflicts need to be resolved, and attention paid to social consequences and their management.

RECOMMENDATIONS

Recommendation 1

The EPA recognizes that there are residents living in industrial zoning at Kwinana Beach. In order to minimise the conflict, the Government should provide opportunities for these residents to relocate to other areas.

Recommendation 2

The EPA recommends that the quantity of chlorine on-site (inventory) does not exceed that stated in this Assessment Report. Any increase in on-site chlorine inventory would require a further risk analysis.

Recommendation 3

The EPA recommends that for impact assessment in Western Australia, an individual risk standard in residential zones should be up to 1 in a million per year (1×10^{-6} per year).

In addition, the Authority adopts the following standard of assessment for fatality risk for other land uses.

Land Use	*Fatality Risk Standard per million per person per year*
Recreation	
Passive	*Up to 10*
Active	*Up to 5*
Commercial	*Up to 5*
Public Roads	*Up to 20*
Industrial	*Up to 50*

Recommendation 4

The EPA recommends that the risk level associated with the proposed chlor-alkali plant would be acceptable given the industrial land use zoning of the area.

Recommendation 5

The EPA recommends that Government requires a study of cumulative risk impact of the Kwinana Industrial Area.

Recommendation 6

The EPA recommends that details of the design stage hazard and operational study be provided, to the Department of Industrial Development, before the construction stage. In addition, the proponent should carry out an annual hazard audit, the results of which should be made available to all relevant government agencies.

Recommendation 7

The EPA recommends that the proponent prepare an Environmental Management and Monitoring Programme (EMMP) which addresses all relevant issues including the following:

- *any amendment to the proposal as described in the PER which would significantly impact on the environment and increase risk associated with the project;*
- *matters identified in this Assessment Report as needing consideration in the EMMP;*
- *proposals for environmental monitoring and management including contingencies; and*
- *details of emergency procedures.*

Recommendation 8

The EPA recommends that the proposed chlor-alkali plant proposal is acceptable on environmental grounds, and has a level of risk appropriate to the zoning of the area, subject to the proponent's commitments (both in PER and given to EPA) and the recommendations of this Assessment Report.

REFERENCES

Cremer and Warner Ltd (1985). Proposed Chlor-Alkali Plant at Kwinana, Western Australia - Assessment of Site Suitability with Respect to Safety. In: CSBP & Farmers Ltd (1985) Public Environmental Report - Chlor-Alkali Project.

CSBP & Farmers Ltd (1985). Public Environmental Report - Chlor-Alkali Project.

Department of Environment and Planning (1985). A Risk Assessment Study for the Botany/Randwick Industrial Complex and Port Botany. Sydney.

Feilman Planning Consultants Pty Ltd (1978). Cockburn Sound Recreation Survey: A Report to the Cockburn Sound Study Group. Department of Conservation and Environment, Western Australia.

Health and Safety Executive (1978). Canvey: An Investigation of Potential Hazards from Operations in the Canvey Island/Thurrock Area. HMSO, London.

Health and Safety Executive (1981). Canvey: A Second Report - A review of potential hazards from operations in the Canvey Island/Thurrock area three years after publication of the Canvey Report. HMSO, London.

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

Rijnmond Public Authority (1982). Risk Analysis of Six Potentially Hazardous Industrial Objects in the Rijnmond Area, a Pilot Study. D. Reidel Publishing Co., Holland.

Royal Commission on Environmental Pollution (1976). 6th Report - Nuclear Power and the Environment. HMSO, London.

Woods, P.J. and Searle, D.J. (1983). Radiocarbon Dating and Holocene History of the Becher/Rockingham Beach Ridge Plain, West Coast, Western Australia. Search, 14(1-2): 44-46.

APPENDIX A

CHLOR-ALKALI PLANT - CSBP

EPA GUIDELINES FOR THE PUBLIC ENVIRONMENTAL REPORT

1. SUMMARY

2. INTRODUCTION

The introduction should include
- Background
- Scope of the Proposal
- The Proponent
- Timing
- Relevant statutory requirements and approvals
- The EIA Process and the purpose of PER
- Format of the PER

3. NEED FOR THE PROPOSAL

This should include
- Background
- The Market, Current and Future
- The broad costs & benefits at local and State levels

4. SITE SELECTION

This should include
- Site Selection Criteria
- Alternative Sites
- The Selected Site

5. DESCRIPTION OF THE PROPOSAL

This should include
- Alternate Technology
- Process Description
- Process Inputs
- Products - Handling and Distribution
- Design and Operational Safeguards
- Waste Streams
- Manning Levels
- Plant Construction
- Possible Sources of Interaction with the Environment

6. THE EXISTING ENVIRONMENT

This should include
- The Bio-physical Environment
- The Social Environment

7. IMPACT ASSESSMENT

This should include:

. Construction Impact
  - bio-physical and social

. Operational Impact
  - risk analysis of site operations
  - effluent disposal

8. ENVIRONMENTAL MANAGEMENT

This should include

. Plant Design - Safety Measures
. Operator Training
. Emergency Procedures
. Odour Control
. Solid Waste Management

It is important that specific commitments are given to all components and procedures of the management programme.

CONCLUSION

An assessment of the environmental acceptability of the project in terms of its overall environmental impact and in the context of the proposed management programme should be given.

REFERENCES

Glossary - (definitions of technical terms, abbreviations)

PER Guidelines

Appendices

APPENDIX B

VARIATIONS BETWEEN THE PUBLIC ENVIRONMENTAL REPORT AND THE PROPOSED PLANT

Variations to the proposed plant have occurred since the submission of the Chlor-Alkali Public Environmental Report. These have been provided by CSBP to the Authority.

The following is a list of variations to the assumptions that were adopted by Cremer and Warner Ltd in its analysis of the proposal, as presented in Appendix VI of Appendix 1 of the PER.

A1 Initial operation to be 5 000 tpa chlorine gas ex cells with provision for extension to 10 000 tpa.

A2 Chlorine export to be via 1 tonne drums and 70 and 33 kg cylinders. Road tanker transport of chlorine is deleted.

B1 The membrane cell room will initially consist of 12 only ICI FM 21 electrolysers of 26 anodes each. Hydrogen storage and compression is to be replaced with low pressure compression for off-site transfer.

B3 All electrolyser cells are coupled to a common header which is serviced by a brine head tank.

C1 On site storage is 50 t made up of 3 x 25 t vessels one of which will be an emergency standby vessel. Other storage will exist in transportable 1 t drums and 70 and 33 kg cylinders.

C3 Storage vessels are located inside a concrete bund approximately 11 x 12.5 m. The facility is to be sited inside the plant complex with access only via service roads.

Chlorine pipe runs, gas or liquid, will be as short as possible. Liquid chlorine will gravitate from the liquefier to storage tanks.

C4 Storage vessels are to be constructed for liquid storage at $-34^{o}C$. Liquid transfer from storage will be via air padding with a let down of pressure on completion of drum filling.

C6 Road tanker export is deleted.

C7 Excess flow valves will be fitted on drum and cylinder filling lines.

C8 As for C6.

C9 All drum and cylinder filling will be carried out on day shift only.

C10 Anticipated plant manning: 2 shift operators
1 assistant - days
1 filling attendant - days

D1 Two chlorine scrubbing towers will be operated in series, each with a circulating pump and heat exchanger for cooling.

D3 Emergency power supplies are supported by existing CSBP generation equipment (1 off 5 MW and 1 off 4 MW) with chlor-alkali plant having the highest priority protected by electronic load shedding equipment.

Power to the electrolysis cells will have lower priority than plant auxiliaries.

APPENDIX C

SUBMISSIONS FROM THE PUBLIC AND GOVERNMENT DEPARTMENTS

A total of 19 submissions were received on the Chlor-Alkali Public Environmental Report; 15 from government agencies and 4 from the public. The main issues addressed in these submissions were summarised in Table 2.

The following is a more detailed analysis of the issues raised and comments made in these submissions.

CRITICISM OF THE PER

- several government departments commented on the quality of the PER,and most of these considered the document to be adequate for their purposes.

- however, three submissions considered the PER to be inadequate as a whole.

CRITICISM OF THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS

- two public submissions commented on the EIA process (including the role of the EPA)

  - suspect that the proponent had already received official approval from Government to go ahead with the plant and intended to order plant and equipment prior to 30th June, 1985, in order to take advantage of the Commonwealth Government's investment allowance, thus making the purpose of the PER a 'farce'.

  - feel that the environmental impact assessment the project is seen by the proponents as merely an "inconvenient formality".

ECONOMIC AND SOCIAL ISSUES

LAND USE PLANNING AND RESIDENTIAL AMENITY

- the plant site should be selected with due regard to future urban development and industrial requirements.

- objection from residents who do not want any more chemical or other pollution producing industries around the industrial strip.

- concern that residential development (in Rockingham) could be adversely affected by promotion and marketing of the project.

- there may be a risk to future recreational and accommodation facilities in the Kwinana area.

. consideration, in total, should be given to the developments proposed for the Kwinana Industrial Area, regarding servicing and land needs.

COSTS/BENEFITS TO THE COMMUNITY

. side effects having a "direct financial cost on the local community including blighted residential areas,and reduced land values".

. promotion and marketing of the project could adversely affect tourism development (in Rockingham).

. would create difficulty in interesting the private sector in the tourism industry.

. the increased use of natural resources, particularly, electricity is a cost rather than a benefit.

SITE SELECTION

. requests that a more suitable site be found.

. minimal attempt made to distinguish the Kwinana site from the other three sites as being most suitable.

. other site selection criteria should include:

  * "minimisation of nearby populations;
  * nature of underlying aquifers and the potential to manage contamination problems;
  * potential for damage of environmental values such as forests, and estuaries;
  * presence of nearby industries, which in combination with the plant could cause environmental damage in the event of a major malfunction in any of the plants."

. site appears to be very small.

. the proposed site lies within the Kwinana Industrial Area which is zoned Industrial under the Metropolitan Region Scheme.

. suggests that future chemical plants be built in a new industrial area 50-60 kilometres north of Perth.

PLANT DESIGN AND OPERATION

<u>PLANT DESIGN, PROCESS AND TECHNOLOGY</u>

. concern as to whether the internal cell pressure is greater or less than ambient pressure, the

number of cells the plant will contain and whether an explosion in one cell would damage nearby cells.

- concern as to whether there will be sufficient distance in the layout between the hydrogen treatment area and the chlorine handling areas in order to reduce the hazards of a hydrogen/ oxygen explosion.

- concern over the risks associated with the startup and shut-down of the plant.

- there should be a description of the liquefaction process.

- the caustic washing tower should have sufficient capacity to neutralise all chlorine in the production section, including the electrolysis cells and cooling and drying facilities.

- concern over the implication of loss of containment of chlorine, a major hazard, and the loss of containment of caustic soda and sodium hypochlorite.

- concern over the possibility of ammonia contamination in the electrolyte and the need to know the measures to be taken to monitor and maintain ammonia concentrations within acceptably safe limits.

- information is needed on the measures to be taken to prevent possible sudden loss of liquid feed to the electrolysis cells (risking explosion) - the plant should include an emergency brine back-up supply.

- concern that dangerous hydrogen contamination of the chlorine could happen in the event of cell membrane failure.

- concern over the risk of nitrogen gas reacting with chlorine gas to form NCl_3, an explosive agent.

- concern as to whether cell membranes are strong enough to withstand earthquake-induced stresses rupture of membranes could lead to an explosion.

- information is needed on how the hydrogen concentration in the chlorine gas will be monitored in order to prevent excessive build-up in the liquefaction tail gas.

- an emergency chlorine storage bullet should be incorporated into the plant design.

BUFFER ZONE

. concern about the sufficiency of 0.5 ha of land as a buffer zone in the case of explosions from within the plant or from nearby operations.

. criteria for determining an 'adequate' buffer zone were not discussed and no minimum desirable dimension given.

HANDLING AND STORAGE OF HAZARDOUS MATERIALS

. either the chlorine gas should be stored at normal atmospheric pressure or minimal quantities of pressurised gas only be allowed.

. consideration should be given to the hazards of storage in small tanks.

. concern about the danger of insufficient storage capacity - materials and quantities should be specified as well as storage location and methods

. query the storage capacity of only 50 tonnes, if a total chlorine storage capacity of 200 tonnes was required for commercial reasons.

. concern about the method of transfer of liquid chlorine from storage.

. concern that there is potential for a serious accident in the chlorine storage area which could affect adjacent areas.

. handling and storage of noxious materials on site is not discussed in detail.

OPERATIONAL SAFETY/RISK ANALYSIS

. no discussion given of hazards to plantworkers.

. recommends that a site safety co-ordinator be appointed.

. safeguards should be incorporated into tanker and tank filling facilities.

EMERGENCY PROCEDURES/CONTINGENCY PLANS

. adequate provision should be made for a trained and experienced emergency group (eg fire brigade) to operate outside the plant in event of a disaster.

. emergency situations and contingency plans not adequately addressed to deal with: releases of

hazardous chemicals; product transport; storage of hazardous materials.

. concern over false monitor alarms which may be ignored in an emergency.

. emergency procedures (incorporating an Action Plan) are required to limit the spread of contaminated groundwater in the event of a leak or spill.

PLANT FAILURE

. concern over failure of electricity supply, but unlikely that caustic flow to the absorption tower would cease before standby electric power was brought into use.

. non-electrical points of failure would include the chlorine cooling refrigerator, the caustic soda circulating pump, the forced draught fans and the chlorine liquefaction compressors - however the deliberately over-designed absorption system together with chlorine monitoring devices coupled to plant shutdown systems should cope adequately.

NOISE

. no existing background noise levels given and no quantitative data provided to prove that existing background levels will not be affected.

. no indication that recognition has been given to the requirements of the Noise Abatement Regulations - the plant should be designed for an internal noise level of 80-85 dB(A).

. noise level from the rotary turbo-compressors would be insignificant compared with other noises in the area.

WATER DEMAND

. quantity of water which will be consumed is of concern, as water resources are under increasing demand.

. the source and quantity of demineralised water to be used in the plant is not addressed.

AIR POLLUTION

GASEOUS EMISSIONS INCLUDING CHLORINE EMISSIONS

. concern about gaseous emissions because,"in Wattleup, Rockingham North, Shoalwater and parts

of Safety Bay, SO_2 and other gaseous emissions from BP, CSBP, and CIK are often irritating and smelly."

- concern that gaseous emissions will affect the air quality of the Kwinana region and may cause respiratory problems in downwind residential areas.

- with regard to gaseous emissions, concern that the levels of <1 ppm for chlorine and <0.205 g/m^3 for HCl may be exceeded.

- questions the volume of chlorine gas that will be discharged under "normal operating conditions" and under"abnormal conditions".

- chlorine emission from plant malfunction is unlikely as the whole plant, except the chlorine liquefaction and storage section, is under negative pressure.

- failure of electricity supply would prevent further generation of chlorine and would also cause the chlorine pre-compression chilling system to fail, thus causing escape of additional chlorine gas to the caustic soda absorption tower.

- possibility of slow emission from liquid chlorine storage - however, chlorine gas escaping through pressure relief valves would be absorbed in caustic soda system.

- possibility of chlorine emission due to fracture of storage cylinders - however, it is unlikely that sudden fracture of storage vessels would take place (unless from earthquake, aircraft crash, etc) and precautions have been taken by reducing on-site storage of liquid chlorine - even if a component of the storage cylinder is fractured, the rate of release of chlorine should not pose a threat to life.

- Government should review the maximum penalties that apply under the Clean Air Act for unauthorised emissions (applicable to licensed and unlicensed projects) where carelessness, human error or plant malfunction occurs.

ODOUR CONTROL

- concern that gaseous emissions may be "smelly" and irritating.

- raises the question of "abnormal" operating conditions occurring which may be likely to cause odour.

METEOROLOGY

. Kwinana Air Modelling Study concentrated mainly on Wattleup area, but monitoring should have been done in the Rockingham/Shoalwater areas, as serious pollution would have been found in these areas April-September of each year with frequent north to north west winds.

. concern that light winds producing the worst gas dispersion conditions are most likely to come from the east, increasing the hazard for Kwinana residents and recreationists.

LIQUID AND SOLID WASTES

. liquid and other waste disposal treated too casually in the PER - more details needed.

LIQUID WASTE

. concern regarding the volume of liquid waste and the method of disposal.

. quantities of liquid waste from brine not given.
. the method of disposal of bleed brine is not given.

. it is stated that liquid wastes may be recycled in the process but other options are not clearly defined.

SOLID WASTE

. concern regarding the volume of solid waste.

. suggest that the advantages and disadvantages of the three disposal alternatives given be outlined.

. solid wastes would be small quantities of barium sulphate, and carbonates of calcium and magnesium but they are not quantified.

. quantities of solid waste from brine purification not given and heavy metal content of the raw material is not given.

. suggest finding an alternative to Cockburn Sound for waste disposal.

. disposal of solid wastes (resulting from brine purification) would need to be approved and licensed by the Water Authority.

SOILS AND GROUNDWATER

- concern about possible environmental interactions with underlying soils and groundwater - mention was made but was not elaborated upon.

- concern that groundwater may be polluted as the groundwater aquifer is very permeable and susceptible to rapid infiltration of any liquid spilt or discharged onto the ground surface.

- monitoring or emergency procedures are not detailed to detect the impact of pollutants on the groundwater system in the event of a major leak or spill.

ROAD AND RAIL TRANSPORT

- possible contingency events during transport must be considered and methods of response to such events.

- transport of the chlorine cylinders by road transport should comply with the Explosives and Dangerous Goods Act, Dangerous Goods (Road Transport) Regulations.

- guidelines for transport emergencies as well as a training programme for drivers should be developed.

- transportation for the raw materials could be provided by rail service.

CUMULATIVE IMPACTS OF THE PLANT WITH OTHER INDUSTRIES

- the plant could encourage other industries which use chlorine and pollute the atmosphere - concern over their combined effects.

- lack of consideration given to the cumulative impacts of the plant and other existing and proposed industries (eg proposed cyanide plant).

- synergistic effects with pollutants from other sources is of concern.

- an overall risk and hazard analysis is needed for the region to ensure that the combination of the chlor-alkali plant, cyanide plant, urea plant and LP gas stripping plant, does not present an unacceptable risk to residents.

- consideration, in total, should be given to the developments proposed for the Kwinana Industrial Area.

CHLOR-ALKALI PLANT SUBMISSIONS

The order of names and addresses presented in this Appendix bears no relation to the order of submission in Table 2 of Chapter 3 of this Assessment Report.

PUBLIC SUBMISSIONS

NAME	ADDRESS
L.G. Capill	PERTH WA 6000
W.S. Davidson	PEPPERMINT GROVE WA 6011
Shire of Rockingham	ROCKINGHAM WA 6168
J.P. Vogel	SHOALWATER WA 6159

GOVERNMENT DEPARTMENTS

Co-ordinator General of Transport

Dept of Conservation and Land Management

Dept of Industrial Development

Dept of Occupational Health, Safety and Welfare

Dept of Resources Development

Explosives and Dangerous Goods Branch- Dept of Mines

Government Chemical Laboratories - Mines Dept

Health Department of WA

Main Roads Department

Noise Section Occupational Health Branch

Town Planning Board

WA Police Dept

Water Authority of WA

Waterways Commission

Westrail

APPENDIX D

COMPANY COMMITMENTS

The general commitments CSBP & Farmers Ltd would undertake in respect of the proposed chlor-alkali plant are:

1. To construct and operate a plant using the best practicable technology and safety practices and imposing the minimum possible risk on employees and members of the public.

2. To carry out a hazard and operability study (HAZOP) on the final plant designs in conjunction with Chemetics. The HAZOP Study is a formal procedure which is carefully structured to improve the completeness of hazard identification.

3. To follow good engineering and management practices and employ suitably qualified personnel as part of the total safety package for the design, construction and operation of the proposed plant.

4. To develop detailed written procedures covering all process work, including start-up, shutdown, plant testing, plant modification, inspection and emergency action. These may be inspected by the relevant authorities if they wish.

5. To incorporate the chlor-alkali plant into the existing fire and emergency plan for Kwinana works to take account of both on-site and off-site risks and to update and practise these emergency procedures in conjunction with outside agencies.

6. To ensure rigorous operator and maintenance worker training for the new plant supplemented by specific input from the process licensor.

7. To maintain the process equipment, instrumentation and alarm systems of the plant at a level consistent with safe and reliable operation of the plant.

8. To follow the recommendations of the Chlorine Institute Inc as a minimum requirement covering all aspects of design, operation and handling and generally to implement currently accepted practices and standards. The contractors, Chemetics, are Canadian and more familiar with Chlorine Institute recommendations rather than BITC. As indicated, in the PER page 27, CWL are of the opinion if either Chlorine Institute or BITC guidelines are followed as a minimum requirement, it will be possible to establish a chlorine plant capable of meeting the highest standards of the chlorine industry.

9. To dispose of solid waste arising from impurities in the salt to an approved landfill site.

10. To obtain approval from the Fremantle Port Authority for disposal of a small bleed (10 m^3/d) of brine into Cockburn Sound to allow control of soluble impurities in the brine.

11. To obtain a licence under the Clean Air Act for discharges into the atmosphere from the plant. All discharges into the atmosphere will comply with the standards of the National Health and Medical Research Council.

13. To obtain, following project approval by the Environmental Protection Authority, all necessary permits and licences for construction of the plant from the appropriate authority (e.g. Kwinana Town Council, Shops and Factories Inspector, Fire Brigade, etc).

14 To undertake a regular monitoring programme of all chlorine - containing discharges into the atmosphere to ensure compliance with the licence (Clean Air Act) and to maintain a high standard and efficiency of plant operation.

15. To consider the implementation of a ground water monitoring programme if required. The plant is expected to have no influence on ground water as indicated in the PER (page 31) as there are no planned discharges to the ground and spillages will be collected by the plant drain system.

16. To implement the best practicable technology in the prevention of damage to the electrolyzers as a result of fire and explosion. This will include provision of a brine head tank, automatic cut-off of cell power on brine feed failure and flushing gas lines with nitrogen on shutdown of the cells.

17. To confirm with Chemetics the method of monitoring the concentration of hydrogen in chlorine in the treatment and liquefaction units and to act to prevent the occurrence of high levels of hydrogen.

18. To operate with as low an inventory of liquid chlorine as possible. The pressure in the chlorine tanks will be kept low by using the minimum air padding pressure for drum and cylinder filling and to relieve the pressure on completion of drum and cylinder filling. Drums and cylinders will normally be filled on day shift during the week. One of the 25 tonne liquid chlorine tanks will be kept empty so that the contents of one of the other tanks could be transferred in the event of a mishap. This is current European practice.

19. To have in place procedures and equipment to put a foam blanket on top of any serious liquid chlorine spill to reduce the rate of chlorine vaporization.

20. To install a chlorine scrubbing system consisting of two identical absorption towers connected in series so that the second toweracts as a back-up for the first. The second tower has a larger tank which will contain enough caustic soda to absorb all the chlorine produced at the initial full production rate (15 tpd) for one hour.

21. To ensure the chlor-alkali plant scrubbing system is supplied with the most reliable power available and that the operation of the scrubber will be regarded as essential in any power emergency. The scrubbers will be assigned the highest level of priority on the load shedding equipment controlling power distribution on Kwinana works.

22. To co-operate with the Department of Occupational Health to ensure that the health of workers in the chlor-alkali plant is not impaired as result of their employment.

23. To install very high integrity instrumentation in the control of the plant and in the detection and response to any chlorine release.

24. To establish a monitoring programme for determination of nitrogen trichloride concentration in the chlorine gas and to implement any action required to maintain this within accepted safe levels.

25. To engage in activities which will lead to technical staff having direct liaison with other chlorine producers. This will lead to the exchange of detailed information about small events involving chlorine and which CSBP can use in the preparation and updating of written operating and maintenance instruction. CSBP has already applied to join the Chlorine Institute and is obtaining information on membership of the Bureau International Technique Chlore (BITC).

26. To check that the job descriptions of key staff in the safety management team of Kwinana works cover all aspects of safety arising from the chlor-alkali plant.

27. To update the on-site and off-site emergency plans of Kwinana works to take the chlor-alkali plant into account.

28. To install additional refrigeration plant to reduce the temperature of liquid chlorine to $-34^{o}C$ before storage.