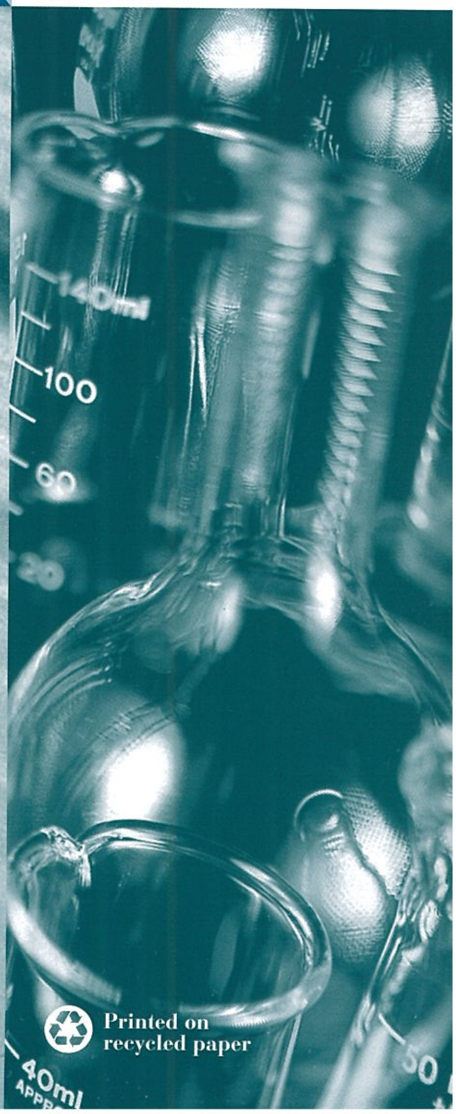
Appendix C

Moore Consulting and Engineering's Preliminary Hazard Analysis



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PRELIMINARY HAZARD ANALYSIS

Waste Chemical and Treatment Facility

At 40 Christie St, St Marys, New South Wales

CHEMSAL PTY LTD

ABN. 73 976 683 109

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Unless otherwise advised, the parties who have undertaken the Review and Endorsement confirm that the information contained in this document adequately describes the conditions of the Chemsal, Storage and Waste Treatment Plant, St Marys, New South Wales

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Table of Contents

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List of Tables

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List of Figures

Executive Summary

Background

Chemsal Pty Ltd (Chemsal) proposes the development of a facility to store and treat wastes at 40 Christies St Marys. As part of the Environmental Assessment (EA), Chemsal Pty Ltd and Associates have engaged MCE to carry out a Preliminary Hazard Analysis (PHA) in accordance with the requirements of NSW Department of Planning and specifically State Environmental Planning Policy (SEPP) 33 "Hazardous and Offensive Development Application Guidelines".

Methodology

MCE following the framework provide by the NSW Department of Planning have undertaken a PHA for the proposed development

This analysis comprised of several distinct stages summarised as follows:

1) Compilation of a profile of the dangerous goods storage on site and evaluation of the quantities and classes against those published in Table 3 of State Environmental Planning Policy (SEPP) 33, indicating that the development is "Potentially Hazardous" in accordance with this criteria;

2) As the development was determined to be "Potentially Hazardous" further analysis of the potential offsite consequences and probability of major accidents was undertaken utilising the IAEA (1993) manual for classification and prioritisation of risks due to major accidents in process and related industries. This analysis indicated that some activities had the potential to produce off site risks with probability numbers in excess of 1×10^{-7} indicating further detailed assessment required.

3) Identification of the hazardous events was undertaken using a word diagram.

4) Modelling was undertaken to quantify the consequences of hazardous events.

5) The frequency of a hazardous event was determined for events where the consequences could have on off-site impact.

6) The risk was estimated and compared against the criteria in DUAP *Risk Criteria from Land Use Safety Planning – HIPAP No.4,* to determine the suitability of the development.

Conclusion

The proposed development was examined against the risk criteria in DUAP *Risk Criteria from Land Use Safety Planning – HIPAP No.4*. It was found that the developments did not exceed any established criteria for individual, societal or bio-physical risk.

1 Introduction

Chemsal Pty Ltd (Chemsal) is undertaking an Environmental Assessment (EA) process for the development of a waste storage and treatment facility at 40 Christie Street, St Marys New South Wales. This EA is being prepared by Peter J Ramsey and Associated. Moore Consulting and Engineering (MCE) have been engaged by Chemsal Pty Ltd to undertake a Preliminary Hazard Analysis (PHA) of this activity and facility. The following section describes the objectives, study scope and methodology employed in the PHA

1.1 Project Background

Chemsal is a leading Australian company in the area of waste management and resource recovery. They offer a range of chemical waste related services including hazardous waste collection and disposal, recycling and chemical treatment. Chemsal was established in 1981 and currently have facilities located at Wetherill Park, NSW and at Laverton North, Victoria. Chemsal receive, sort, de-package and treat spent or surplus products from a range of varied industries, as well as from households and schools, laboratories and hospitals. Chemicals are collected, segregated and stored, and options for re-use explored. Mechanical and chemical treatment methods are utilised to optimise resource recovery. Only when no such suitable treatment options are available will the waste be disposed of.

The proposed waste chemical storage and treatment facility in St Marys will provide Chemsal with significantly greater capacity in NSW to continue to effectively and soundly manage chemical waste in Australia. The waste chemical storage and treatment facility will have a focus on resource recovery and reuse. Where this is not possible they undertake effective waste treatment and management.

The facility will operate 12 hours per day 7 days per week and is expected to employ 30 people after two years.

1.2 Objectives

The objective of the study is to apply SEPP33 to the proposed development. It includes:

- Consideration of inherently safe design principles and identification of areas where the facilities design can be further enhanced.
- Preparing a PHA of the Chemsal Storage and Waste Treatment Facility, with Hazardous Industry Planning Advisory Paper (HIPAP) No. 6, "Hazard Analysis Guidelines" (Ref 2).

1.3 Study Scope

The scope of this PHA includes the facilities and operations for storage and handling of trade wastes at 40-48 Christie Street, St Marys New South Wales.

1.4 Method

The proposed facilities has been considered as potentially hazardous since it has exceeded the threshold levels for dangerous goods stored on site, which is set out in the *State Environmental Planning Policy (SEPP 33).* SEPP 33 requires that once these threshold limits are exceeded that a more detailed analysis be undertaken.

This report presents the Preliminary Hazard Analysis was conducted for John Ramsey Pty Ltd by Moore Consulting and Engineering (MCE), using the Department of Urban Affairs and Planning (DUAP) *Multi-Level Risk Assessment,* and *Guidelines for Hazard Analysis – Hazardous Industry Planning Advisory Paper (HIPAP) No.6.*

The development of the PHA included the following steps

1. Identifying the potential hazards by evaluating the chemicals and processes undertaken on the site. Identifying each of the hazards and potential sources of loss that are associated with their storage and production.
2. Estimate the consequences of major hazardous events were determined quantitatively.
3. Evaluate the effects of these consequences to determine if their effects would pose an off-site risk
4. Estimate the frequency of the hazardous incident occurring.
5. Evaluate the risks for the major hazardous incidents against the guidelines in the DUAP *Risk Criteria from Land Use Safety Planning – HIPAP No.4*

2 Site Description

This section describes the site location and layout for the Chemsal Waste Storage and Treatment Facility. The facility will be located at 40 Christie Street, St Marys, New South Wales. The location is shown below in Figure 2.1.

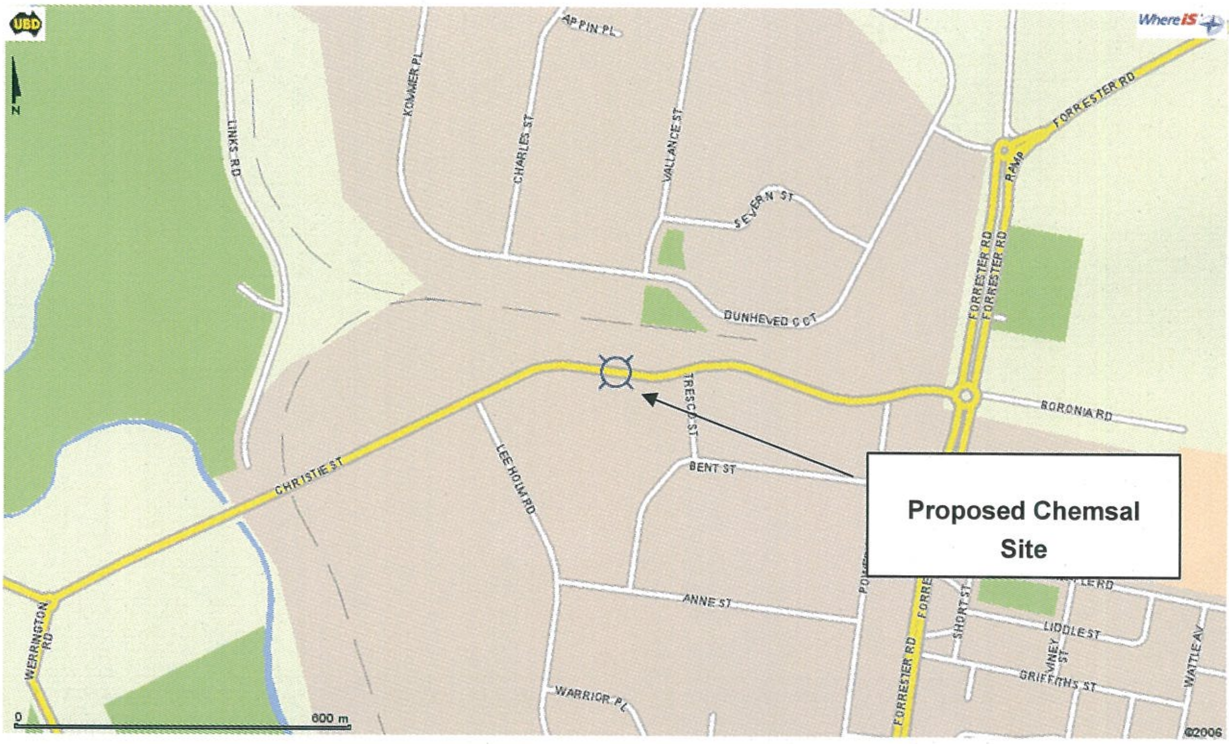

Figure 2.1 Site location

2.1 Site Layout

The site layout for Chemsal is shown below in Figure 2.2. The site is approximately one hectare and comprises a warehouse building of approximately 4000 m^2. This building will house the majority of the storage and processing operation.

The internal building will contain bunding to prevent to release of hazardous materials form one area to another. The decanting operations undertaken for Class 6.1 and class 8 materials will have induced air flow through the area and the air exiting these decanting operations will be scrubbed.

A separate area will be constructed for the storage of class 3 PGII material. The Class 3 package area will contain Intermediate Bulk Containers (IBC) up to 1000 litres and drum storage. The class 3 tank storage area is bunded and will have fire rated walls on the east, south and western walls. The tanks will be contained in a bund designed to AS 1940.

The neighbouring land use is predominantly industrial. The NSW Fire Brigade, Dunheved Station is located to the North, and industrial sites to the south, east and west.

The closest residential property is approximately 600m to the east of the site. No sensitive receptors were identified closer than 1,000m from the Chemsal Site.

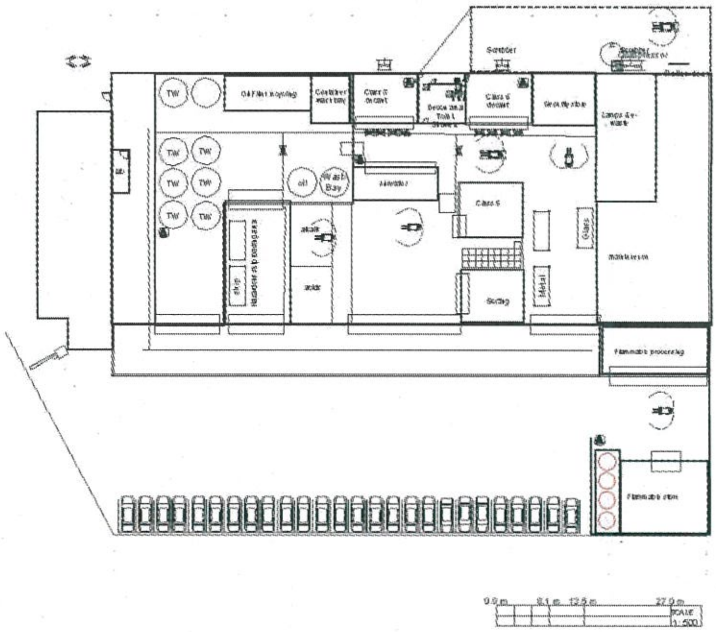

Figure 2.2 Site Layout

Figure 2.3 Ariel View of Site

3 Transportation

Chemsal will initially operate a fleet of five vehicles at the St Marys site. It is expected that after two years the Chemsal fleet will consist of eight vehicles. The Chemsal fleet comprises the following types of vehicles:

- Tautliner with dog trailer (capacity of 22 pallets);
- Rigid tautliners (capacity of 12 pallets);
- Demountable tautliners (capacity of 12 pallets);
- Open trays (capacity of 12 pallets);
- Skips (capacity of 23 cubic meters);
- Vacuum tankers (capacity of 13,000 litres);
- Two of two (2) tonne pandeck; and
- Two utes.

The proposed development will have 30 truck movements per week of incoming chemicals and 12 truck movements per week of outgoing chemicals, making a total of 42 trucks movements each week.

4 Threshold Screening

This section lists the anticipated inventories of hazardous material to be held at the facilities that have exceeded the threshold limits as described by SEPP 33 (Ref. 4). The complete table of hazardous goods anticipated in at the facility is shown in Appendix B. The methodology used to arrive at these hazardous inventories is described in Appendix B.

4.1 Fixed Facilities Thresholds Levels

A review and comparison with the threshold limits for storage quantities as indicated by SEPP 33 was undertaken and shown in Appendix B. The chemical inventories that exceeded the threshold limits are shown in Table 4.1. These chemicals for fixed facilities will undergo further analysis as part of this PHA

Class	Chemical Description	Location	Quantity	Distance from Site Boundary
3 PG II	Flammable Liquids	Tank Storage and Packaged Storage	100,000 L	3 m
6.1	Toxic Substances	Class 6.1 Storage	30,000L	17 m

Table 4.1 Inventory of Hazardous Material Above SEPP33 Threshold

4.2 Transportation Thresholds

A review of the transportation servicing the Chemsal site was undertaken in Appendix B. The hazardous chemicals that exceeded the transportation thresholds as indicated by SEPP33 (Ref 4) are shown in Table 4.2. These chemicals for transportation will undergo further analysis as part of this PHA

Class	Chemical Description	Number of Loads (Cumulative Annual)
3 PGII	Flammable Liquids	1323
6.1	Toxic Substances	643

Table 4.2 Transport of Hazardous Material above SEPP 33 Thresholds

5 Process Description

The facilities will undertake a number of limited processes on site. These processes are described in the following section.

5.1 Class 3 Storage and Processes

The handling of class 3 material will take the form of bulk storage, packages storage and the HazPak operating plant. Class 3 Dangerous Goods will also be decanted at the site. Class 3 Dangerous Goods contained in packages smaller than 200 L will be decanted to larger containers to enable efficient resource recovery. The flammable areas will be protected by a six (6) metre fire wall.

5.1.1 Bulk Storage

Class 3 material is received by Chemsal and transferred to a bulk storage facility. This storage will consist of four (4) tanks each containing 15,000 litres of Class 3 PGII and PG III material. The area is bunded and surrounded by a six (6) meter fire wall, but this wall is inclusive of the packaged area.

5.1.2 Packaged Storage

Class 3 materials is received by Chemsal and reused as a packaged good. These packaged goods will be stored awaiting transportation. It is intended to store 30,000 litres of Class3 PGII and PG III material in the package flammable storage area. The area is bunded and surrounded by a six (6) meter fire wall.

5.1.3 HazPak

HazPak is an ultra high pressure densification device that is used to separate packaging materials from their contents. A HazPak unit will be utilised at the St Marys site to separate paint from used paint cans, forming steel "billets" (a compacted cluster of crushed cans) with less than 1% paint residue. Approximately 15 paint cans form a steel billet, which is the size of one paint can that has not been crushed. The steel billets are sought after as a premium feedstock for steel recyclers and the paint separated from the paint can is used for energy recovery.

Aside from paint cans, HazPak units can also be applied to resource recovery from aerosol cans, gas containers and oil filters, and can process anything from a small pharmaceutical asthma puffer, though to a 205 L steel drum. At this stage however, the unit at St Marys is only proposed to be used for paint tins. The volume of flammable liquids in the HazPak area is small and does not exceed the threshold in SEPP 33.

5.2 Class 6.1 Storage and Processes

Chemsal will handle class 6 dangerous goods at the site. This will take the form of storage and decanting.

5.2.1 Class 6.1 Storage

The site will include storage of class 6.1 material. This material will be in the warehouse building. No Class 6.1 Subsidiary Risk Class 3 material will be stored in this area. The typical storage will take the form of IBCs up to 1000 litres. The storage levels is anticipated to 30,000 litres

5.2.2 Class 6.1 Subsidiary Risk Class 3

Materials received at the site are diverse and some material will include the group Class 6.1 Subsidiary Risk Class 3. This material is to be stored separate to the class 6.1 material reducing the likelihood of a fire commencing in the area. The material of this class will be stored in two (2) cabinets under awning at the front of the building. The total quantity stored on the site will be small (< 2000 litres)

5.2.3 Class 6.1 Decanting

The decanting of class 6.1 materials is to allow the effective collection and later disposal of small volumes. The quantity of material stored in this area is small.

5.3 Class 8 Storage and Process

Chemsal will handle class 8 at the site. This will take the form of storage and decanting. Only a small volume of class8 material will be stored in the decanting area.

5.3.1 Class 8 (Acid) Storage

There will be 15 tonnes of class 8 (Acid) storage available in the main warehouse. This storage will normally take the form of IBCs up to 1000 litres. The facility will store 15 tonnes of class 8 (Acid) in this area

5.3.2 Class 8 (Alkali) Storage

There will be 15 tonnes of class 8 (Alkali) storage available in the main warehouse. This storage will normally take the form of IBCs up to 1000 litres. The facility will store 15 tonnes of class 8 (Alkali) in this area

5.3.3 Class 8 Decanting

The decanting of Class 8 materials is to allow the effective collection and later disposal of small volumes. The quantity of material stored in this area is small.

5.4 Florescent Lamp Resource Recovery

Chemsal will undertake fluorescent lamp processing at the St Marys facility in order to recover valuable resources such as glass and metallic end caps from fluorescent lamps. The lamps are processed to recover the glass and aluminium components as well as phosphor containing mercury. The mercury is then recovered from the phosphor by distillation for reuse.

5.5 Operating Personnel

The proposed development will operate from 6am to 6pm seven days per week. The initial number of employees at the facility will be 14. It is anticipated that the site will eventually employ 30 personnel.

6 Risk Classification and Prioritisation Method

This section is drawn from *Multi-Level Risk Assessment* (Ref 3). The method used is a modified version of the "Manual of Classification of risks due to Major Accidents in Process and Related Industries", (IAEA, 1993). The outcomes help provide classification and prioritisation of risks for hazardous events.

The calculations required for this method are shown in Appendix C. These results are presented graphically below in Figure 6.1

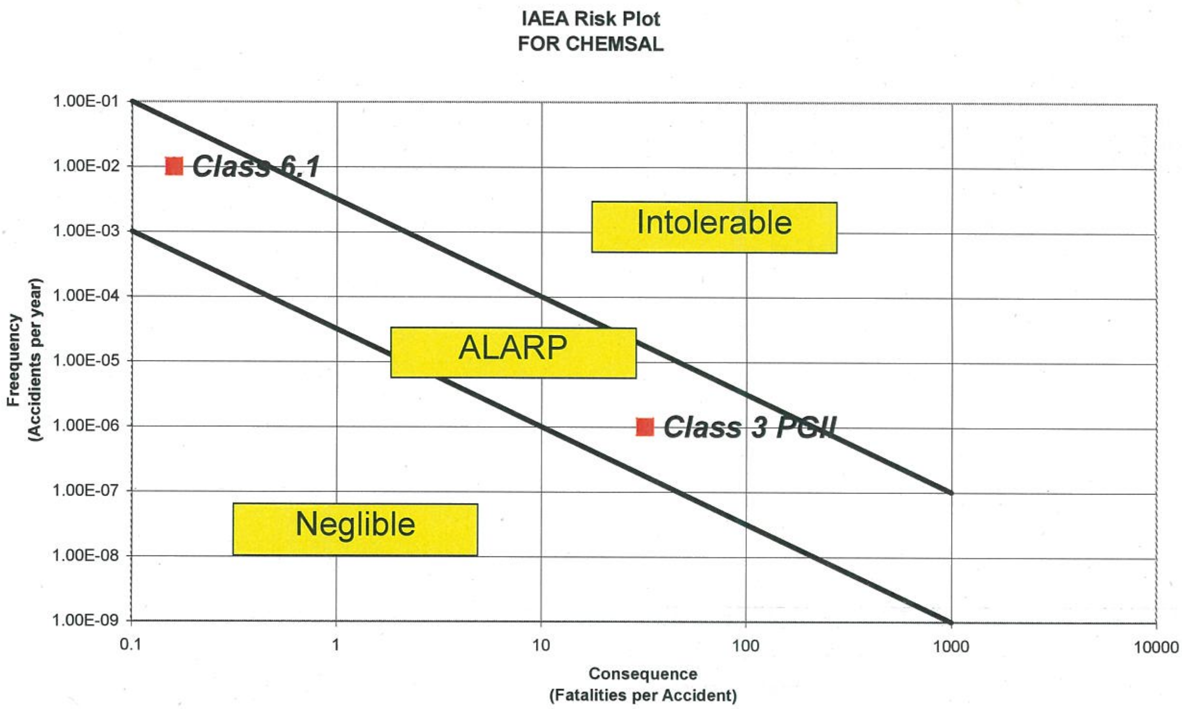

Figure 6.1 F-N Curve Individual (IAEA)

As Figure 6.1 reveals both activities fall in the ALARP (As Low As Reasonable Practical) region.

The class 6.1 storage has a higher frequency of occurrence and lower consequences. The consequences for the class 6.1 falls outside the normal limits used in IAEA method (with the value being less than 1). It has been included to give understanding that the higher frequency of this event requires further development and analysis.

The DUAP guidelines for *Multi-Level Risk Assessments* (page 17) recommend that "quantification should be carried out on any component of the risk classification and prioritisation which has an off-site consequence at a frequency of greater than 1×10^{-7}." Both activities have frequencies above 1×10^{-7} and the hazard identification is undertaken in section 7.

7 Hazard Identification

The hazard identification examines further those activities that have been identified as potentially hazardous after application of screening thresholds and examination with the Manual of Classification of risks due to Major Accidents in Process and Related Industries, (IAEA, 1993).

Table 7.1 Summary Hazard Identification Table

Ref. No	Activity	Event	Cause	Possible Consequence	Proposed Prevention and Mitigation/Control Measures
1	Transport to and from Site	Loss of Containment of materials	Vehicle Accident Loss of Unsecured Material in transit	Ignition of Class 3 materials and potential pool fire Toxic Cloud formation with release of toxics and flammable goods simultaneously and fire Mixing of incompatible chemicals on Mixed transport was release Release of Flammable or Toxic Liquid to environment	Maximise transportation to be via main thoroughfares and not through residential areas Training of drivers Appropriate spill containment kits and fire fighting equipment Identification of material
2	Unloading of Materials	Loss of Containment of materials from Pallet	Loss of Unsecured Material in transit Forklift damages equipment	Ignition of Class 3 materials and potential pool fire Toxic Cloud formation with release of toxics and flammable goods simultaneously and fire Release of Flammable or Toxic Liquid to environment	Use of correct containers Training of drivers Appropriate spill containment kits and fire fighting equipment Identification of material is made at the site point of collection

Ref. No	Activity	Event	Cause	Possible Consequence	Proposed Prevention and Mitigation/Control Measures
3	Class 3PGII Tank Storage	Loss of Containment of materials	Maintenance of Tanks Overfilling of Tanks Catastrophic failure of tank Escalation of the fire in the packaged goods area	Release of Flammable Contents into bund Fire in bunded area Escalation of the fire in the packaged goods area	Tanks and bunded manufactured to meet or exceed industry and statutory requirements: AS 1692 and AS 1940 Monitoring of interstitial space between tank and outer bund Regular maintenance and inspection Bund sized for adequate containment Fire fighting equipment will be provided Personal protection and spill equipment to be provided Appropriate materials of construction for service. Training, procedures and audits. Control of ignition sources on site. Hot work controlled via hot work permits. Emergency response actions for fire fighting (site crew), rescue, First Aid etc Firewall 240/240/240 around the flammable Goods Area

Ref. No	Activity	Event	Cause	Possible Consequence	Proposed Prevention and Mitigation/Control Measures
4	Class 3PGII package Good	Loss of Containment of materials	Damage by Forklift Deterioration of Containers	Release of flammable materials into the environment Fire in packaged area Fire escalates into the tanks storage area	Protection of Roof to prevent rocketing drums leaving the Area Fire fighting equipment will be provided Personal protection and spill equipment to be provided Appropriate materials of construction for service. Training, procedures and audits. Control of ignition sources on site. Hot work controlled via hot work permits. Emergency response actions for fire fighting (site crew), rescue, First Aid etc Firewall 240/240/240 around the flammable Goods Area
6	Class 3 PGII Decanting	Loss of Containment of materials	Ignition of Drum in Decanting Area	Fire escapes decanting Area and escalates into bulk or packaged storage Area	Control of Ignition Sources Static Straps for Decanting HW Permit System Separation distance form other flammable goods stored

Ref. No	Activity	Event	Cause	Possible Consequence	Proposed Prevention and Mitigation/Control Measures
6	Class 6.1 Storage	Ignition of combustible Material	Ignition of Material in warehouse Rocketing Drum from Class 3 PG II area fire Propagation from Fire in Other area of Warehouse	Toxic material released into environment and waterways Fire generates toxic cloud	Class 3 PGII Area roof to be prevent rocketing drums leaving the Area Segregation of Class 6.1 from Class 6.1 (sub Class 3) material to reduce the fire risks Maintenance of Good Housekeeping
7	Loading Truck for Transport	Loss of Containment of materials from Pallet	Loss of Unsecured Material in transit Forklift damages equipment	Ignition of Class 3 materials and potential pool fire Toxic Cloud formation with release of toxics and flammable goods simultaneously and fire Release of Flammable or Toxic Liquid to environment	Use of correct containers Training of drivers Appropriate spill containment kits and fire fighting equipment Identification of material is made at the site point of collection

8 Consequence Analysis

This section discusses the potential consequences of the hazards identified in section 7.

8.1 Fixed Facilities

lSection 4 identified two (2) potential hazards of significance. These hazards were the Class 3 flammables storage (including tank storage) and the storage of class 6.1 materials. This section examines the potential consequences of the hazardous events associated with these identified hazards.

8.1.1 Large Fire in Flammable Area

The storage of flammable good represents the potential for a fire to occur. The facilities presently include tank storage and packaged area. The packaging area will contain both drums and IBCs up to 1000 litres. The following is the heat radiation effects for a fire in the packaged area and a fire in the tank bunded area.

	Distance to		
Hazardous event	23 kWm^{-2}	12 kWm^{-2}	4.7 kWm^{-2}
Fire in Bunded Area	7.7	10.9	20.4
Fire in warehouse	7.6	11.8	22.9

Table 8.1 Heat Radiation Levels (Warehouse or Bund Fire)

It is plausible that both hazardous events would be occurring simultaneously in both the tank bund area and in the flammable packaged area. In either event there will be enough radiant heat energy from the preceding event to initiate the escalation of the event to include storage in the opposite area. The results for the escalated fire are shown in Table 8.2

	Distance to		
Hazardous event	23 kWm^{-2}	12 kWm^{-2}	4.7 $kW.m^{-2}$
Fully developed Fire	8.8	14.8	29.8

Table 8.2 Heat Radiation Levels (Warehouse and Bund Fire)

The flammable storage has fire wall installed to on the southern, eastern and western walls. In Figure 8.1 the heat radiation contours have been plotted. This plot includes protection provided by the fire rated walls. As this figure shows the effects of a fire will not extend beyond the site boundaries.

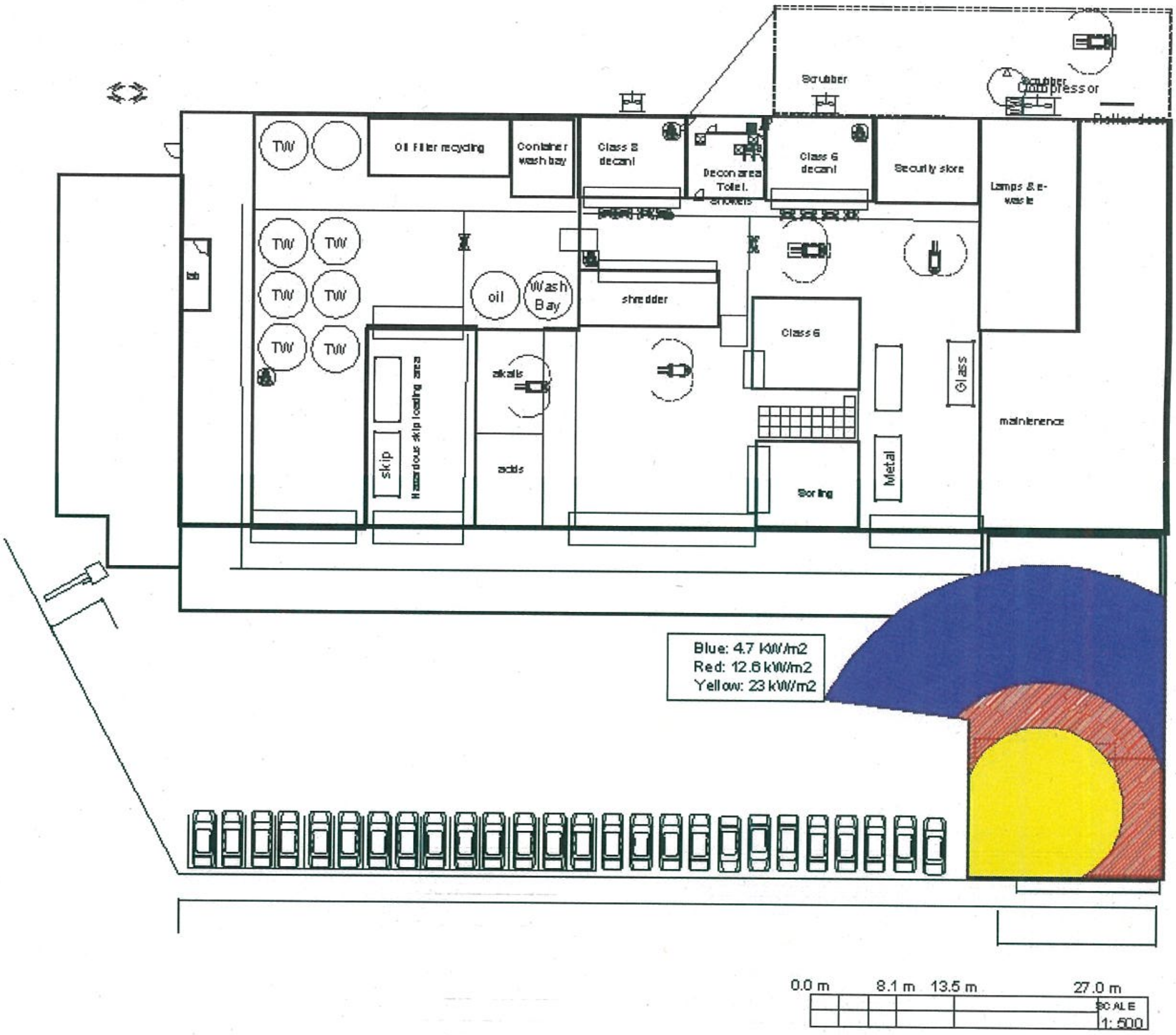

Figure 8.1 Heat Radiation Effects

8.2 Unloading and Loading Activities

The spillage of materials while loading and unloading of flammable goods may result in a pool fire. A release of 1000 litres was modelled and the heat radiation levels are shown in Table 8.3

	Distance to		
Hazardous event	**23 kWm^{-2}**	**12 kWm^{-2}**	**4.7 $kW.m^{-2}$**
Unloading, Loading Pool Fire	1.5	3.6	7.7

Table 8.3 Heat Radiation Levels Small Pool Fire

These heat radiation levels will be contained within the site boundaries.

8.2.1 Fire in Class 6.1 Storage

The hazardous incident of concern for the storage of Class 6.1 material is a fire. This fire could generate a smoke cloud which could contain both unreacted toxic chemicals and toxic combustion products. There are a number of different methods for assessing the possible consequences of toxic cloud, and due to the complex nature of the chemicals and fire a precise model is difficult to establish.

For this facility modelling was undertaken using the fire combustion products hydrochloric acid and sulphur dioxide. The assumptions and development of this model are discussed in Appendix E.

The modelling was undertaken to establish the distance to ERPG – 2. The definition and toxic concentration levels for ERPG – 2 are shown in Appendix I

The maximum distance to ERPG -2 are shown in the Table 8.4

Chemical	ERPG-2 Concentration Distance Downwind (m)
Hydrochloric Acid	944
Sulphur Dioxide	440

Table 8.4 Distances to ERPG -2

As Table 4.1 reveals the distance to concentrations below ERPG – 2 is a maximum of 943 m. Concentrations closer to the facility were used to establish the probability of death established by a Probit equation. Probits are described in Appendix F.

8.3 Transportation

The transportation of material to and from the facilities will involve the transport of class 3 PGII material and class 6.1 materials.

8.3.1 Transportation – Class 3 PGII Fire

In the event of a accident involving the transport, Class 3 material could be released. If this class 3 material was able to find a source of ignition a fire could result. The heat radiation generated by a fire was modelled. The assumptions are shown in Appendix D. The results are present in Table 8.5.

	Distance to		
Hazardous event	23 kWm^{-2}	12 kWm^{-2}	4.7 kWm^{-2}
Release of Flammable in Truck Accident and Fire	1.5 m	3.6m	7.7m

Table 8.5 Pool Fire Transportation

As this table shows the effects of a pool fire resulting from a transportation incident is small and limited to the localised area around the accident.

8.3.2 Transportation – Toxic Cloud Formation

A transportation accident involving Class 6 material could result the generation of a toxic cloud. This event was examined and the distances to the ERPG – 2 concentrations established for Hydrochloric Acid. The modelling assumption are discussed in Appendix D

Chemical	ERPG-2 Concentration Distance Downwind (m)
Hydrochloric Acid	162

Table 8.6 Consequence Effects of a Toxic Cloud for Transportation

The effects of the toxic cloud extend some distance from the source. In order to further assess this potentially hazardous incident the frequency of this event is examined in section 9.2.

9 Estimation of the Likelihood of Hazardous Events

This section discusses the frequencies of the hazardous events for the facilities and transportation.

9.1 Fixed Facilities

The frequency for the hazardous incidents identified in section 7 for the fixed facilities are established in this section.

9.1.1 Fire in Flammable Area

Chemsal will implement the following controls in order to reduce the likelihood of ignition occurring in the flammable area. These will include:-

- Physical Separation
- No Smoking on site
- Training of Personnel
- Induction of Visitors
- Housekeeping and inspection
- First Response Fire fighting
- Hot Work Permit System
- Flameproof Forklifts
- Grounding of Road Tankers, Drums and Decanting Vessel
- Intrinsically Safe Equipment in Hazardous Zones

These controls will reduce the likelihood of the ignition of material in the flammable goods area.

The DUAP, *Multi-Level Risk Assessment Guidelines*, page 17 states

> *"Where the risk appears to be low, quantification need only be continued to the extent needed to demonstrate that no combination of events is possible that would lead to the relevant risk criteria being exceeded. For example, the modelling of the main events show that all the consequences are confined within the site or that the events with off-site consequences are sufficiently unlikely to pose a significant risk"*

In section 8.1.1 effects fires that could potentially be hazardous at the site were examined. The use of fire walls to prevent significant heat radiation effects being felt off-site means the consequences are contained with the facility. This is the essence of the guidelines given in DUAP, *Multi-Level Risk Assessment Guidelines*. As such no frequency has been established for a fire developing in the flammable goods warehouse.

9.1.2 Fire in Class 6.1 Storage

In Appendix F the frequency for a warehouse fire and toxic cloud being generated in the class 6.1 storage area was established at 5 $x10^{-4}$ p.a. This estimation is believed to be conservative as the warehouse will be handling dangerous goods and the operators have a fundamental understanding of the risks associated with its operations. The facility will

- Separate all Class 6.1 Sub class 3 material from the Class 6.1 material.
- Protect the Flammable (Class 3) storage and handling area is protected by a fire wall.
- Prevent "rocketing drums" of flammable liquid exiting through the roof of the flammables storage area to contain a fire occurring in the flammable storage.

The consequence of a fire in the Class 6.1 warehouse could potentially reach residential properties to the east. The frequency of the smoke plume potentially containing toxic combustion in the direction towards the nearest residents is shown in the Table 9.1 below

Direction of Plume	Overall Frequency
North East	18.5 $x10^{-6}$ p.a
East	11.5 x 10^{-6} p.a
South East	13.5 x 10^{-6} p.a

Table 9.1 Frequency of Toxic Clouds (Class F1.5)

In section 8.2.1 it was established that the plumes shapes are narrow and long and do not fill the entire contents of the sector. This makes the frequency dependent on the number of sectors used in the wind analysis. Only eight wind directions have been used in determining the frequencies shown in Table 9.1 . The small number of wind directions makes the estimation of the frequency of occurrence conservative.

9.1.3 Unloading and Loading Hazardous Incidents

In section 8.2 the consequences of a small pool fire was established as being small and contained within the site. However this initial incident could escalate into a fire involving class 6.1 materials generating a toxic cloud. Using a fault tree (Figure. F-1) it is established that the frequency of this hazardous incident was 5.6 x 10^{-7} p.a.

This result is then used in conjunction with the consequences to examine this incident against guidelines presented in HIPAP 4.

9.2 Transportation

The frequency of transportation incidents occurring is assessed in this section. There are two (2) areas of concern. Fires caused by the release of Class 3 materials

9.2.1 Class 3 Fire

A class 3 fire during transportation had small distances to significant consequences. Using the DUAP guidelines previously mentioned (Section 9.1.1). A class 3 fire from a transportation accident is unlikely that this event will pose significant effects away from the immediate around the accident site.

9.2.2 Fire and Toxic Cloud

During transportation of the hazardous goods a fire could occur after an accident. This fire could engulf class 6.1 material and generate a toxic cloud. Using a fault tree (Figure. F-2) it is established that the frequency of this hazardous incident was 3.8×10^{-6} p.a. This result is then used in conjunction with the consequences to examine this incident against guidelines presented in HIPAP 4.

10 Risk Assessment

This section examines the risk to individuals resulting from potentially hazardous releases.

10.1 Individual Risk for Fixed Facilities

In section 8 we examined the effects of potentially hazardous incidents and in section 9 we established frequencies of these events. The significant hazardous event is the generation of a toxic cloud in the warehouse. Using the methodology in Appendix G a risk contour has been generated as is shown in Figure 10.1.

Figure 10.1 Individual Risk Contour

This figure is used as the basis for comparison with the criteria in HIPAP 4 (Ref 2). Figure 10.1 reveals that the 50 x 10^{-6} p.a individual risk contour does not extend beyond the industrial zone land.

10.2 Comparison with DIPNAR Guidelines

The DUAP Risk Criteria for Land Use safety Planning presents a number of criteria that a new facility should achieve. The criteria is compared to the results of the PHA in Table 10.1

Description Risk Criteria	Criteria	Results	Meets Criteria
Fatality risk to sensitive uses, including hospitals, schools, aged care	0.5×10^{-6} per year	As Figure 10.1 reveals there is no sensitive receivers are exposed to a risk level of 0.5×10^{-6} p.a	Yes
Fatality risk to residential and hotels	1×10^{-6} per year	As Figure 10.1 reveals there is no residential or hotels are exposed to a risk level of 0.5×10^{-6} p.a	Yes
Fatality risk to commercial areas, including offices, retail centres and entertainment centres	5×10^{-6} per year	As Figure 10.1 reveals As Figure 10.1 reveals there no commercial are exposed to a risk level of 5×10^{-6} p.a	Yes
Fatality risk to sporting complexes and active open spaces	10×10^{-6} per year	As Figure 10.1 reveals As Figure 10.1 reveals there no active open space are exposed to a risk level of 10×10^{-6} p.a	Yes
Fatality risk to contained within the boundary of an industrial site	50×10^{-6} per year	As Figure 10.1 reveals the risk contour the 50×10^{-6} p.a is contained within industrial areas	Yes
Injury risk – incident heat flux radiation at residential areas should not exceed 4.7 kW/m^2 at frequencies of more than 50 chances in a million per year or incident explosion overpressure at residential areas should not exceed 7 kPa at frequencies of more than 50 chances in a million per year	50×10^{-6} per year	The use of firewall contain minimises the consequence of the event affecting nearby areas. Distances to residence of 600 metres are larger than the generated heat radiation levels.	Yes
Toxic exposure - Toxic concentrations in residential areas which would be seriously injurious to sensitive members of the community following a relatively short period of exposure	10×10^{-6} per year	Fixed Facilities: Dispersion modelling has established the distance to ERPG-2 will not reach identified sensitive receptors	Yes
		Loading and Unloading: The frequency of a toxic cloud formation was found to be 5.6×10^{-7}p.a. Dispersion modelling has established the distance to ERPG-2 will not reach identified sensitive receptors	

Description Risk Criteria	Criteria	Results	Meets Criteria
		Transportation: The frequency of a toxic cloud formation was found to be 3.8 x 10^{-6} p.a.	
Toxic exposure - Toxic concentrations in residential areas which should cause irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community	50 x 10^{-6} per year	Fixed Facilities: Dispersion modelling has established the distance to ERPG-2 will not reach identified sensitive receptors. The frequency of toxic cloud moving towards residential areas for plumes in the NE, E and SE direction are below 50 x 10^{-6} p.a	Yes
		Transportation: The frequency of a toxic cloud formation was found to be 3.8 x 10-6 p.a.	Yes
Propagation due to Fire and Explosion – exceed radiant heat levels of 23 kW/m2 or explosion overpressures of 14 kPa in adjacent industrial facilities	50 x 10^{-6} per year	The use of firewall contains the minimises the likelihood of the event onto adjacent facilities	Yes

Table 10.1 Comparison with Risk Criteria

As Table 10.1 reveals the criteria established in HIPAP No.4 (ref 2) has been met by the proposed development for both fixed facilities and transportation.

10.3 Societal Risk

The societal risk was represented in section 6. This placed the generation of a toxic cloud in the ALARP region. It is considered unlikely that multiple fatalities off-site would result form the hazard identified in this study. .

10.4 Biophysical Environment

Some of the materials handled at the facility could have an impact on the natural environment. There are chemical which could harm aquatic, bird and plant life if a spill was to find its way into a water course. HIPAP No.4 criteria for the assessment of risk to the biophysical environment are related to the threat to the long term viability of a species or eco system. This threat must be would occur after an accidental event and not from the result of continuous operations.

The varied quantity and types of goods handles at the site make sit difficult to conduct a detailed quantative assessment of the risk to the biophysical environment. There is uncertainty in the consequences to the bio-physical environment of any accidental event

The primary potential incidents that could affect the bio-physical are examined in the following paragraphs.

Loss of Stored Flammable Liquids could have a localised impact within the area. The surrounding land use is industrial, design will be to AS1940, and all flammable areas are bunded. It is considered unlikely that a release of this material would have significant impact on the local biophysical environment above the levels already being in existence.

Loss of Containment during Transport. The volumes of material being transported to and from the facility are relatively small. The loss of containment could result in a release in to adjacent waterways. This could have impact on at a localised level. It is considered that the level of release would be capable of threatening an eco-system.

Fire in class 6.1 Warehouse. The generation of a toxic cloud will have both non-combusted and combustion by products. These could have an effect of the local environment. Concentration of the combustion products modelled revealed that effects (to EPRG – 2) would extend a distance from their source. The facility, however are within an extensive industrial site located at St Marys. It is considered that any consequences generated would not impact on the eco-system any further than the present level of modification that has been undertaken by previous developments.

Release of Class 6.1 into Waterways from the Site. Any scenarios that could occur at the proposed facilities will be captured by the first flush system installed for treatment of stormwater and spill incidents.

11 Conclusions

The proposed development was identified as having material above the threshold levels using the guidelines in SEPP33. The chemical storage identified as potentially hazardous were further examined. A word diagram was used to identify hazardous events. These events were then examined to establish their consequences. A frequency and risk analysis was then conduct to further examine the risks associated with these hazardous events.

The off site risks of the proposed facilities will be within the guidelines given by DUAP 1997, Risk Criteria for Land Use Planning, Hazardous Industry Planning Advisory Paper No. 4.

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12 References

1. DUAP 1996, Guidelines for Hazard Analysis, NSW Department of Urban Affairs and Planning: Hazardous Industry Planning Advisory Paper No. 6

2. DUAP 1997, Risk Criteria for Land Use Planning, NSW Department of Urban Affairs and Planning: Hazardous Industry Planning Advisory Paper No. 4

3. DUAP 1997, Multi – Level Risk Assessment, NSW Department of Urban Affairs and Planning

4. DUAP 1997, Applying SEPP 33, NSW Department of Urban Affairs and Planning; Hazardous and Offensive Development applications Guidelines

5. American Industrial Hygiene Association (AIHA). 1991. Current ERPGs. AIHA Publications, Akron, OH.

6. HSE (2006) Safety report Assessment Guide : Chemical Warehouse – Hazards

7. NTIS publication No. PB-94-195047 Documentation for Dangerous to Life of Health Concentrations \

8. http://www.sra.org/resources_glossary.php

9. AICHE 2000, Guidelines for Chemical Process Quantative Risk Assessment, 2nd Edition

10. QEST (2005), PHA Intermodal Logistics Centre at Enfield

Appendix A. Applying SEPP33

The following flowchart displays the methodology of applying SEPP33

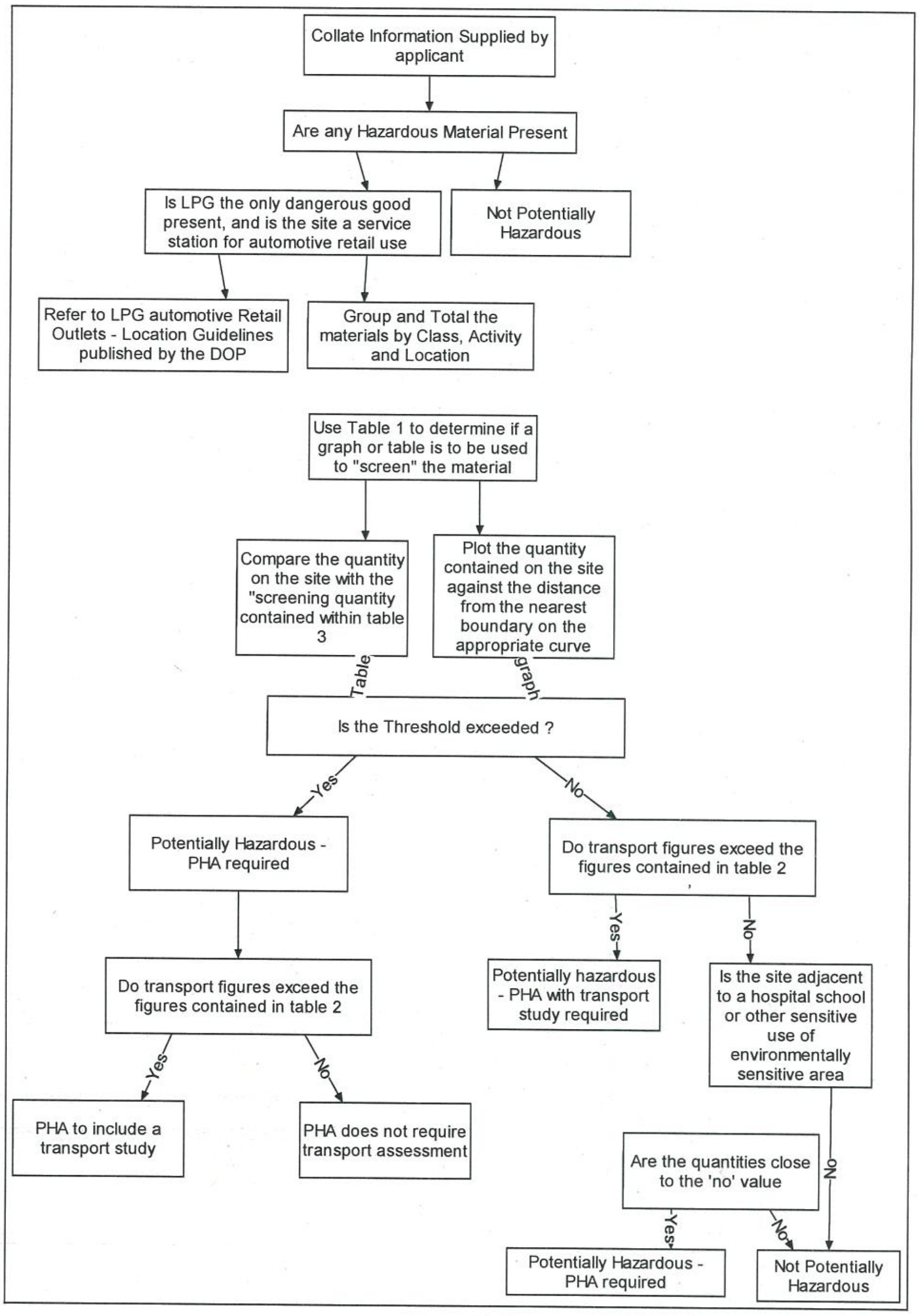

Figure. A-1Flowchart Applying SEPP33

Appendix B. Identification of Hazardous Materials

This section applies the hazard identification and threshold testing in Applying SEPP 33 to establish those hazards requiring further analysis,

Fixed Facilities

Chemsal will operate at resource recovery centre at 40-48 Christies St Marys. The business will have number of hazardous materials on the site. The nature of the business is to recover hazardous material from users, combine the volumes and then send the material for re-use or further processing before disposal. This variation in Hazardous material received high precision in the description of materials on the site is difficult. Quantities in the section have been established using previous historical information supplied by Chemsal and are shown in the following Table. B-1 Hazardous Inventory at Chemsal.

Inventory control is provided at the "pick up" location. Any collection of hazardous goods involves the identification of the material at the site. This is provided by the customer and by a chemist employed by Chemsal. The material is then labelled to allow management of the hazardous material through the facilities.

Un Number	Correct Shipping Name	Class	Subsidiary Risk	HAZCHEM Code	Packing Group	location	Quantity	Units	Other Comments
1993	Flammable Liquid N.O.S	3		3[Y]E	PG I, PGII or PG III	Flammable Processing	1,000	Litres	Inclusive of Paints and Flammable Liquids
1993	Flammable Liquid N.O.S	3		3[Y]E	PG I, PGII or PG III	Flammable Store Packages	25,000	Litres	
1263	PAINT	3		3[Y]E	PG I, PGII or PG III	Flammable Store Packages	5,000	Litres	
1993	Flammable Liquid N.O.S	3		3[Y]E	PG I, PGII or PG III	Flammable Store Tankage	50,000	Litres	
1263	PAINT	3		3[Y]E	PG I, PGII or PG III	Flammable Store Tankage	10,000	Litres	
1263	PAINT	3		3[Y]E	PG I, PGII or	HazPak Area	500	Litres	

Un Number	Correct Shipping Name	Class	Subsidiary Risk	HAZCHEM Code	Packing Group	location	Quantity	Units	Other Comments
					PG III				
2929	Toxic Liquid, Flammable, Organic N.O.S	6.1	3	3WE	PG I or PGII	Class 6.1 Flammables Storage Area	8,000	kg	PG II Only
3287	Toxic Liquid, Inorganic N.O.S	6.1		2X	PG I, PGII or PG III	Class 6.1 Storage Area	13,500	kg	PG II Only
2810	Toxic Liquid, Organic N.O.S	6.1		2X	PG I, PGII or PG III	Class 6.1 Storage Area	5,500	kg	PG II Only
3287	Toxic Liquid, Inorganic N.O.S	6.1		2X	PG I, PGII or PG III	Class 6.1 Decanting Area	>500	kg	PG II Only
2810	Toxic Liquid, Organic N.O.S	6.1		2X	PG I, PGII or PG III	Class 6.1 Decanting Area	>500	kg	PG II Only
2811	Toxic Solid,	6.1		2XE	PG I,	Class 6.1	Small	kg	PG II Only

Un Number	Correct Shipping Name	Class	Subsidiary Risk	HAZCHEM Code	Packing Group	location	Quantity	Units	Other Comments
	Organic, N.O.S				PGII or PG III	Storage Area			
3288	Toxic Solid, Inorganic, N.O.S	6.1		2X	PG I, PGII or PG III	Class 6.1 Storage Area	Small	kg	PG II Only
2024	Mercury Compound, Liquid, NOS	6.1		2X	PG I, PGII or PG III	Fluorescent Lamp Recovery	3,000	kg	PG II Only
1634	Mercury Compound, Solid, NOS	6.1		2X	PG I, PGII or PG III	Class 6.1 Storage Area	< 10kg		PG II Only
3278	Organophosphorus Compound, Toxic, NOS	6.1		2X	PG I, PGII or PG III	Class 6.1 Storage Area	1,500	kg	PG II Only
3266	Corrosive Liquid, Basic, Inorganic N.O.S	8		2X	PG I, PGII or PG III	Acid Store	7,500	Litres	

Un Number	Correct Shipping Name	Class	Subsidiary Risk	HAZCHEM Code	Packing Group	location	Quantity	Units	Other Comments
3267	Corrosive Liquid, Basic, Inorganic N.O.S	8		2X	PG I, PGII or PG III	Acid Store	7,500	Litres	
3264	Corrosive Liquid, Acidic, Inorganic N.O.S	8		2X	PG I, PGII or PG III	Alkali Store	8,000	Litres	
3265	Corrosive Liquid, Acidic, Organic N.O.S	8		2X	PG I, PGII or PG III	Alkali Store	7,000	Litres	
3264	Corrosive Liquid, Acidic, Inorganic N.O.S	8		2X	PG I, PGII or PG III	Decanting Area	<500	Litres	
3265	Corrosive Liquid, Acidic, Organic N.O.S	8		2X	PG I, PGII or PG III	Decanting Area	<500	Litres	
3266	Corrosive Liquid, Basic, Inorganic	8		2X	PG I, PGII or	Decanting Area	<500	Litres	

Un Number	Correct Shipping Name	Class	Subsidiary Risk	HAZCHEM Code	Packing Group	location	Quantity	Units	Other Comments
	N.O.S				PG III				
3267	Corrosive Liquid, Basic, Inorganic N.O.S	8		2X	PG I, PGII or PG III	Decanting Area	<500	Litres	
	Oil	C1 or C2				Oil Recovery	5,000	Litres	
3161	Liquefied Gas, Flammable, NOS	2.1		2WE			<100kg		Small quantities for example a portagas Bottle
1325	Flammable Solid, Organic, N.O.S	4.1		1[Z]	PGII or PGIII		<50kg		
	Substances liable to Spontaneous Combustion	4.2					<50kg		
	Substances That in contact with water will emit flammable gases	4.3					<50kg		

Un Number	Correct Shipping Name	Class	Subsidiary Risk	HAZCHEM Code	Packing Group	location	Quantity	Units	Other Comments
1479	Oxidising Solids, NOS	5.1		1Y			<100 kg		Typically Pool Chlorine.
	Aerosol Cans	9					<100 kg		

Table. B-1 Hazardous Inventory at Chemsal

Grouping of Hazardous Materials

In Table. B-1 Hazardous Inventory at Chemsal the quantities of hazardous materials are presented. These are now grouped by class and location to further understand the hazards associated with the facilities

Class	Subsidiary Risk	location	Quantity	Units
2.1			Minor	
3PG II		Flammable Processing	<1.5	m^3
3PG II		Flammable Store Packages and Tank Storage	100	m^3
3PG II		HazPak Area	<0.5	m^3
4.1			Minor	
4.2			Minor	
4.3			Minor	
5.1			Minor	
6.1		Class 6 Decanting Area	1	m^3
6.1		Class 6 Storage Area	30	m^3
6.1	3	Class 6.1 Flammables Storage	<2	m^3
8		Fluorescent Lamp Recovery	<0.1	Tonne
8		Acid Store	15	m^3
8		Alkali Store	15	m^3
8		Class 8 Decanting Area	1	m^3
C1		Oil Recovery	5	m^3

Table. B-2 Grouped Hazardous Materials

The information in Table. B-2 Grouped Hazardous Materials can now be applied to the threshold limit testing in Apply SEPP33 (Ref 4).

Threshold Testing

Class 2.1 The threshold lest for class 2.1 as per SEPP 33 is $16m^3$ if stored above ground. Chemsal has small volumes of Class 2.1 goods handled on the site. These typically take the form of portagas bottles. Typically there is less than 100kg on the site at any point in time. They are not stored in the flammable store. They are stored in a caged area under the awning on the western side of the main warehouse. The storage is temporary and they transportation within a short period of time. This volume is below the threshold limit and care is taken to isolate these goods from being the initiator of another hazardous incident. With these considerations the storage of the class 2.1 at Chemsal is considered not hazardous (as applies to SEPP 33)

Class 3. Class 3 material at the facilities will involve the collection of both Class 3 PGII and Class 3 PGIII goods. For this purpose threshold testing all the material has been assumed to be Class 3 PGII. There are four areas that will have class 3 PGII material in them. The HazPak and flammable handling area located in an area together protected by fire rated walls to the north, east and south. It is approximately 13 meters from the packaged flammables storage area. The total tonnage in the area will be less than 2 tonnes.

The other two areas will be the packaged flammables goods storage and the flammable material tank storage area. These two areas are located to the west of the flammable goods area and are protected by firewalls to the north, west and south. The flammable tank storage and flammable packaged goods will be in close proximity to each other and for the purposes of the SEPP 33 threshold testing have been combined. This combined volume is approximately 100,000 litres. The volumes given have been converted to tonnes by using a specific gravity of 1.0 and are plotted on Figure. B-1 Class 3 PGII Threshold Testing.

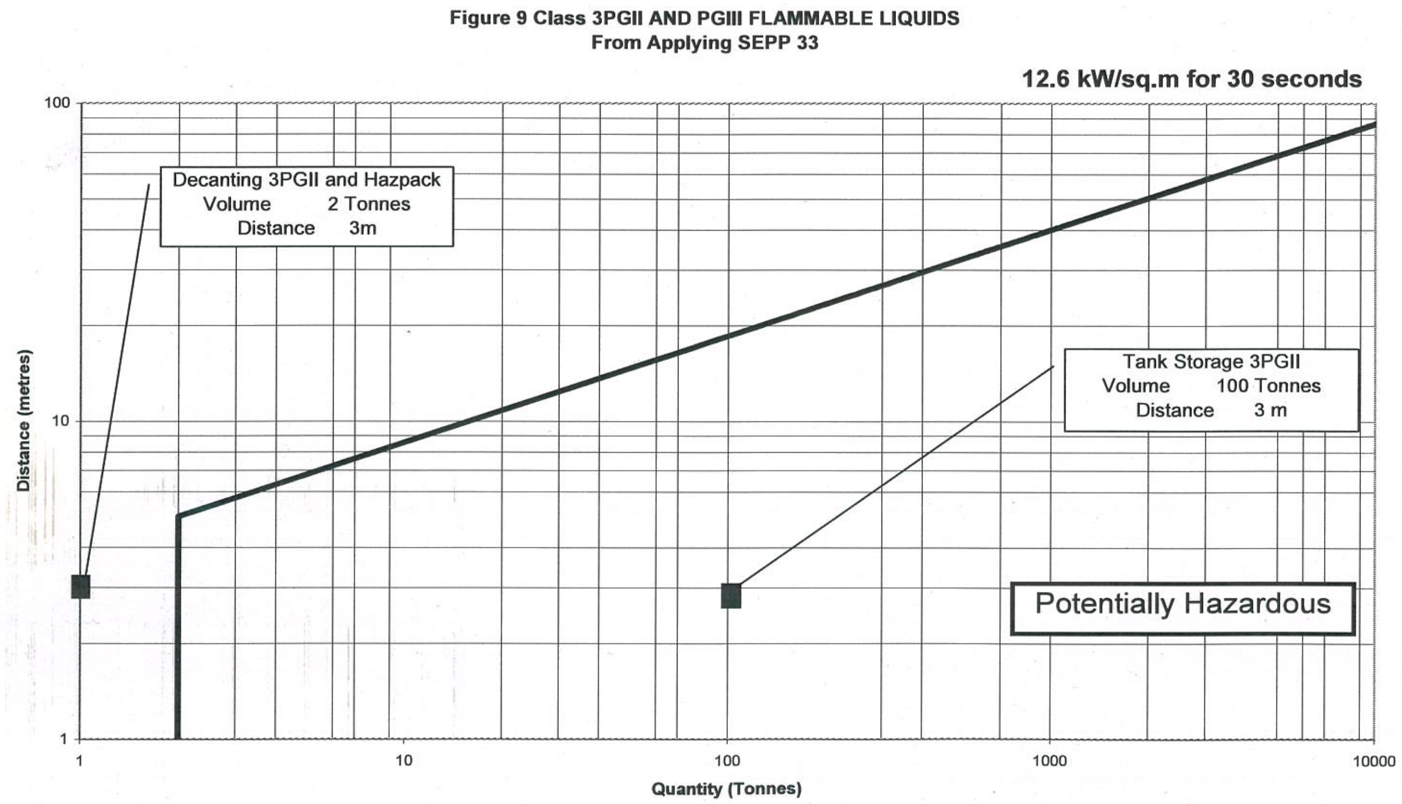

Figure. B-1 Class 3 PGII Threshold Testing

As seen by Figure. B-1, the material being held in the flammable tank storage and flammable packed goods area exceed the threshold limits of SEPP 33 and are considered potentially hazardous. The low storage amounts in the HazPak and flammable handling area are small and would not be considered hazardous in isolation.

Class 4 The facilities will have small volumes of class 4 material. The threshold as applied by SEPP 33 is shown in the Table. B-3

Identifier	SEPP 33 Threshold	Chemsal Storage	
Class 4.1	5 Tonnes	<1 tonne	Not identified as potentially hazardous
Class 4.2	1 tonne	<500 kg	Not identified as potentially hazardous
Class 4.3	1 tonne	<500 kg	

Table. B-3 Threshold Testing Class 4

As seen in Table. B-3 the storage of class 4 materials at the facilities has not been identified at potentially hazardous by SEPP 33.

Class 5. The facilities typically handle small quantities of Class 5.1. In practice this takes the form of some pool chlorine collected in 25kg bags and stored at the facility. This quantity is not expected to exceed 200 kg.

Identifier	SEPP 33 Threshold	Chemsal Storage	
Class 5.1	5 tonnes	200 kg	Not identified as potentially hazardous

Table. B-4 Threshold Testing Class 5

As Table. B-4 reveals the threshold limit for class 5 material is not exceeded and this material is not identified as potentially hazardous.

Class 6.1 There will be three (3) areas for handling and storage of class 6.1 materials. All the Class 6.1 will be PGII. There is a decanting area located to the east of the building. This decanting area will have less than $2m^3$ contained in it. It is located for enough from other areas to be considered as a different location. There will be storage of Class 6.1 sub Class 3 in cabinets under the awning on the western side of the building. The total volume to be stored will be 2000 litres. The final storage area is the bulk storage of class 6.1 in the warehouse. This storage will contain 6.1 that are combustible but will not contain Class 6.1 sub class 3. This segregation of the material is to reduce the likelihood of the fire commencing in this storage area.

Identifier	SEPP 33 Threshold	Chemsal Storage	
Class 6.1 PGII Decanting	2.5 m^3	<$2m^3$	Not identified as potentially hazardous
Class 6.1 PGII (sub class 3)	2.5 m^3	<$2m^3$	Not identified as potentially hazardous
Class 6.1 PGII Storage	2.5 m^3	30 m^3	Identified as Potentially Hazardous

Table. B-5 Threshold Testing Class 6.1

Table. B-5 shows that the storage of class 6.1 PGII in bulk in the warehouse has been identified as potentially hazardous will be investigated further

Class 8 Chemsal will store class 8 materials in two (2) separate warehouses. These two (2) warehouses will be the acid storage area and the alkali storage area. These will be in two adjacent areas with a wall separating the two (2) storage areas. For the purposes of threshold testing each storage will contain a maximum of $15m^3$ of Class 8 material. Decanting of the class 8 material will also take place in a separate handling area. Recovery of Mercury from fluorescent lights is also carried out in a separate processing area. The quantity of mercury is small (assumed <10kg). All the class 8 material has been designated PGII.

Identifier	SEPP 33 Threshold	Chemsal Storage	
Class 8 Decanting	25 m^3	<2m^3	Not identified as potentially hazardous
Class 8 (Acid Store)	25 m^3	15 m^3	Not identified as potentially hazardous
Class 8 (Alkali Store)	25 m^3	15 m^3	Not identified as potentially hazardous
Class 8 (Florescent Lamp processing)	<10kg	15 tonne	Not identified as potentially hazardous

Table. B-6 Threshold Testing Class 8

As Table. B-6 reveals all four (4) areas have not been identified as potentially hazardous.

Combustible Liquids The will be approximately 5,000 litres of combustible liquids stored on the site. These will be located over 50 metres for the Class 3 storage and handling areas. With the separation distance the combustibles are not combined with the Class 3.

Threshold Testing Summary

The application of the threshold testing in SEPP 33 (ref 4) has revealed two (2) storage quantities that require further analysis in the PHA. These are shown in Table. B-7

Class	Chemical Description	Location	Quantity	Distance from Site Boundary
3 PG II	Flammable Liquids	Tank Storage and Packaged Storage	100,000 L	3 m
6.1	Toxic Substances	Class 6 IBC (up to 1000 litres) store	30,000L	17 m

Table. B-7 Potential Hazardous Activities

Transportation

Chemsal operates of resource recovery operation. This resource recovery operation involves varying volume, materials and number of transportation movements. To give a precise number of movements for each class of hazardous material is difficult and the following section presents the analysis and assumptions used to establish transportation movements that exceed the threshold established in applying SEPP 33 (ref 4).

Anticipated volumes by 2010 were establish from material volumes processed in 2005 and scaled proportionally to 5000 tonnes. These results are shown in the following table

Class	Quantity to be transported (2010)	Percentage of total
3 (PGII)	3260	65%
6.1	1100	22%
8	180	4%
9	190	4%

All class 3 material has been assumed to be Class PGII. There will be a significant proportion of class 3 PGIII transported and processed by Chemsal. This Class 3 PGIII has been assumed PGII as they will be likely transported together and produces a pessimistic total volume.

Information supplied by Chemsal indicated the transportation would involve 1560 inward movements and 360 outwards movements of material each year at peak processing volumes. These transportation movements were used in the estimations of movements for each Hazardous good class.

In order to estimate the number of traffic movements for each class of hazardous material the following methodology has been used. For incoming transportation the proportion of the total volume move has been used to proportion the number of transportation trips required. This is presented as Number of Trucks In (Calculation A). Applying SEPP 33 establishes the quantity of hazardous material required to meet the threshold. For example a bulk transportation of 3 tonnes of Class 3 PGII meets the threshold requirement. This minimum requirement for quantity is used. This is presented as Number of Trucks In (Calculation B). This is presented in Table. B-8

Class of Material	3 PGII	6.1	8	9
Quantity Coming In and leaving	3260	1100	180	190
Number of Trucks In (Calculation A)	1018	345	55	55
Minimum Load as per threshold	3	1	2	Assumed 1 tonne
Number of Trucks In (Calculation B)	1088	1107	89	89

Table. B-8 Transportation of Hazardous Material (Movements in)

As seen by Table. B-9 it is reasonable to use approximately 1088 movements of class 3 material and 89 movements of these hazardous materials. The movements of Class 6.1 materials have a large difference in the calculated movements. In order to establish the total Class 6.1 movements there is also the possibility that goods are received as mixed with Class 6.1 being transported with class 3 materials providing the flammable material. To account for this 20% of the anticipated movements of class 3 will have simultaneous movement with class 6.1. This was added to the Number of trucks in established in Number of Trucks In (Calculation A). Thus

Number of Class 6.1 Movements = 345 + 0.2x1088 = 563 Class 6.1 movements

The number of movements from the Chemsal site was estimated using the proportion of total recovered resources to be transported.

Class of Material	3 PGII	6.1	8	9
Transportation Leaving	235	80	13	13
Total Movements	1323	643	102	102

Table. B-9 Transportation of Hazardous Material (Movements Out and Total)

This number of movements is considered conservative as they account for the potential of mixed movements and do not account for load being smaller than threshold levels in many cases.

Chemsal will also receive small quantities of class 4.2 and Class 5. The quantities of these hazardous goods are very small and the number of transport movements required moving the material will not exceed the threshold limits that can be seen in Table. B-10

These traffic movements are not compared with the threshold limits established in Applying SEPP33 (ref 4)

Transport Threshold Limits

(Applying SEPP33 pg 21 TABLE 2)

Class	Chemsal	Exceed Threshold	Vehicle Movements		Minimum Quantities per load (tonnes)	
			Cumulative Annual	Peak Weekly	Bulk	Packages
1			Contact DOP			
2.1			>500	>30	2	5
2.3			>100	>6	1	2
3PGI			>500	>30	1	1
3PGII	**1323**	**Yes**	>750	>45	3	10
3PGIII			>1000	>60	10	No limit
4.1			>200	>12	1	2
4.2	**<10**	**No**	>100	>3	2	5
4.3			>200	>12	5	10
5	**<10**	**No**	>500	>30	2	5
6.1	**643**	**Yes**	All	all	1	3
7			Contact DOP			
8	**102**	**No**	>500	>30	2	5
9	**102**	**No**	>1000	>60	no limit	

Table. B-10 Transport Threshold Limits

As can be seen there are two (2) classes of hazardous material that exceed the threshold limits. These materials are the Class 3 PGII material and the Class 6.1 material. These results are consistent with these items being the largest quantities being moved into and out of the facilities. This result is presented in Table 4.2 Transport of Hazardous Material.

Appendix C. Risk Classification and Prioritisation Method

This appendix is drawn from Multi-Level Risk Assessment (Ref 3). This method provides a technique of risk classification and prioritisation. The technique used in this section uses a modified version of the "Manual of Classification of risks due to Major Accidents in Process and Related Industries, (IAEA, 1993). In this appendix is presented the calculation of the consequence and the frequency. This work helps further clarify the risks associated with the facility.

Consequence Analysis (IAEA)

The following section investigates the consequences using the method described in Multi-Level Risk Assessment (Ref 3). It has been applied to the two scenarios as identified in Appendix B as having quantities above the SEPP 33 threshold.

The scenario considered in this exercise for the class 6.1 storage is the release of a toxic plume. All the results displayed in the following tables are calculated on this scenario.

Activity Description	Class	Storage	IAEA Table IV	Effect distance	Effect Area	Population Density	Population -Correction Factor	Correction Factor for Mitigation	Est. of external Consequences (fatalities)
					A	d	f_a	f_m	$C_{a,s}$
Class 3 Flammables Storage	3 PGII	100T	BI	25-50	0.8	40	1	1	32
Class 6.1 Storage	6.1	30 T	BII	25-50	0.4	40	0.2	0.05	0.16

Table. C-1 Consequence Analysis (IAEA)

Table. C-1 reveals the IAEA estimation of external consequences. There is a large difference in the consequence of each event. A fire in the class 3 flammable storage has a consequence of fatality at 200 times that of a toxic cloud.

IAEA Frequency Analysis

The IAEA frequency analysis was calculated and the results are summarised in Table. C-2

Description	Class	Storage	Average Probability Number	Correction for Loading Unloading	Correction for flammables	Correction for organisation safety	Correction for Wind Direction	Overall	Converted to P
			$N^*_{i,s}$	n_l	n_f	n_o	n_p	$N_{i,s}$	P
Class 3 Flammables Storage	3 PGII	100T	8	-2	0	0	0	6	$1x10^{-6}$
Class 6.1 Storage	6.1	10 T	3	-2	0	0	1	2	$1x10^{-2}$

Table. C-2 Frequency Analysis (IAEA)

The frequency analysis shown in Table. C-2 highlights

- The likelihood of a hazardous event involving the class 6.1 storage is high.
- Storage of Class 3 PGII material is significantly less likely to occur than a toxic plume from the class 6.1 storage.

These results are inherently correct and can be summarised by the following:-

- The release of a toxic cloud is a higher frequency event but has a smaller consequence.
- A flammable fire is not frequent but would have larger consequences if it was too occur.

Appendix D. Consequence Modelling

This appendix describes the assumptions and models developed to assess the consequences of the hazard identified with the facilities and transportation.

Fire, Class 3 PG II Storage Area

The facilities will have storage flammable storage in two (2) areas. These are the tanks storage and the packaged goods area.

Fire in Tank Bunded Area

A fire in the bunded area was assumed to involve the entire bunded area. The bunded area was assumed to be 13 metres by 5 metres. It was assumed to be entire filled. The chemical that was selected to best represent the chemical within the bund was n-dodecane. This chemical was chosen to represent the mixture that would be present at the facilities. This scenario was modelled using TRACE 9.0 and the results are shown in Table 8.1

Fire in Packaged Area

A fire in the packaged area is difficult to model. For this purposes of this study a pool fire 7 metres by 7 meters was used. TRACE 9.0 was used to model the fire with n-dodecane used as the chemical. The results are shown in Table 8.1

Fire in Both Areas

As discussed in section 8.1.1. there was a plausible scenario where the fire escalated from one section of the flammable warehouse to the other area of storage. For example a fire in the flammable good s warehouse area escalated into a fire in the tank storage area. In order to model this scenario a fire 13 metres by 13 metres was located in the north western location in the warehouse. TRACE 9.0 was used to model the fire with n-dodecane used as the chemical. It was placed as close as practical to the doorway. This gave the largest consequence of distance outside the doorway. The results are shown in Table 8.2.

Small Fire (Unloading, Loading)

The release flammable good will loading and loading could result in a flammable material. The ignition of this liquid could result in a small pool fire. The typical movement of flammable goods on the site will involve the movement of 1 m^3 of flammable liquid. This could be in the form of a IBC (up to 1000 litres) or four (4) 200 Litre containers. In the event of a 1m^3 releases and ignition a pool fire of 3 metres in diameter was modelled. The heat radiation levels were calculated using TRACE 9.0. The material selected was n-dodecane of the fuel.

The resulting heat radiation levels are shown in Table 8.3 Heat Radiation Levels Small Pool Fire

Fire in Class 6.1 Storage

The warehouse containing Class 6.1 material will contain a peak of 25% halogenated solvents. From this the chemical of concern has been identified as hydrochloric acid dispersed in the toxic cloud. The variation in type or material stored in the facilities makes estimation of amounts of hydrochloric acid (HCl) produced in the fire difficult. The release modelled for this report has the major component of hydrochloric acid.

There is approximately 30 tonnes of class 6.1 material stored on the site. It is assumed that 1% of this material by weight is Chloride. This is 300 kg of Chlorine that will form HCl in a fire. The total hydrochloric acid in the smoke plume would then be 309 kg of HCl. This generation of smoke was assumed to occur over a two (2) hour period. This makes the release of HCl 2.57 kg min^{-1} over a 2 hour period.

There are other chemicals that are stored in class 6.1 store. It is reasonable to include some pesticide in this model. For this report the Organo-phosphorous pesticide Chlorphyrifos has been selected as being the minor component of the release.

Using the method described by the HSE (ref 1) the Chlorphyrifos is assumed to form simpler combustion products. It was assumed that the HCl component would be 10% of the HCl release from the organic solvents

Component (chemical)	kg min^{-1}	
Hydrochloric Acid	0.26	Assumed 10% of Acid produced by Halogenated Organics
Sulphur Dioxide	0.16	Calculated using HSE method
Hydrogen Cyanide (HCN)	0.003	Calculated using HSE method
Nitrogen Dioxide (NO_2)	0.006	Calculated using HSE method
Carbon Monoxide (CO)	0.03	Calculated using HSE method

Table. D-1 Release Rates of Combustion Products

The lower release rates of HCN, NO_2, and CO mean that for the purposes of modelling the two largest components HCl and SO2 have been used to establish the distances to ERPG -2 and used in the risk calculations. These release rate are shown in Table. D-2.

Combustion Product	Release Rate (kg min^{-1})
Hydrochloric Acid	2.86
Sulphuric Acid	0.16

Table. D-2 Combustion Products Release Rates

In order to assess the toxic exposure criteria in Risk *Criteria for Land Use Safety Planning, HIPAP No.4* ERPG – 2 toxic concentrations were used. The values of ERPG -2 for hydrochloric acid and sulphur dioxide are given in Appendix I

Modelling of the release was undertaken using TRACE 9.0. It was assumed that each chemical of interest was released as a point source and at the rates described in Table. D-2 continuously over a period of 2 hours. Differing wind stability classes were used to establish the furthest distance that the ERPG – 2 Concentration level would be experienced. This is shown in Table. D-3 Distance to ERPG with Different Stability Class

Stability Class	Distance to ERPG – 2 (Metres)	
	Hydrochloric Acid	Sulphur Dioxide
A1.5	221	110
B3	175	37
C3	230	60
D3	315	89
E1.5	617	287
F1.5	944	440

Table. D-3 Distance to ERPG with Different Stability Class

As Table. D-3 reveals the largest distance is associated with the wind stability class F1. This is as expected. The shape of the plume is long but narrow. For example the plume reaching the ERPG – 2 concentration limits is 944m long for a hydrochloric release (Stability class F1) but it is only 66 metres wide at its widest point.

Fire and Toxic Cloud during Loading / Unloading

The unloading and loading of Class 3 material presents a potentially hazardous event. This hazard could be the fire and the propagating a fire involving Class 6.0 material. The volume of material is significantly less than can be generated from a warehouse fire. In this case a release rate of Hydrochloric acid of 0.29 kg per minute was used. This represents $1/30^{th}$ of the release rate assumed in the warehouse fire. The results we modelled using the gas dispersion modelling available in TRACE 9.0. The stability class F1.5 has been modelled. As we have seen previously in this section this will have the greatest distance of effect. The results are shown in

Transportation

Fire

The transportation of Class 3 flammable material has the potentially hazardous incident of a fire. The fire was modelled assuming a pool fire 3m in diameter with the chemical n-dodecane being the fuel source. This is consistent with the release of 1000 litres from an IBC or multiple drums. The heat radiation distance of effects are shown in Table 8.5 and are comparatively small.

Toxic Cloud Release

The transportation of the Class 6.1 material presents the hazardous incident of a fire, combustion of the class 6.1 materials and the release of toxic material in a smoke cloud. The volume of material is significantly less than can be generated from a warehouse fire. In this case a release rate of Hydrochloric acid of 0.29 kg per minute was used. This represents $1/30^{th}$ of the release rate assumed in the warehouse fire. The results we modelled using the gas dispersion modelling available in TRACE 9.0. The stability class F1.5 has been modelled. As we have seen previously in this section this will have the greatest distance of effect. The results are shown in Table 8.6 Consequence Effects of a Toxic Cloud

Appendix E. Consequence Effects

Effects of Heat Radiation

The effects of heat radiation are described below in Table. E-1

Heat Radiation Intensity ($kW.m^{-2}$)	Heat Effects
1.21	Equivalent to heat from the sun at noon
1.6	Minimum level at which pain can be felt. This is the usual maximum for residential areas.
4.7	This is the maximum value for residential areas if the probability is low.
5-8	Will cause pain in 15-20 seconds and at least 2nd degree burns after 30 seconds. 5 kWm^{-2} is the maximum level for brief exposure on an operator if protected by water sprays.
12.5	Hot enough to heat wood to a temperature where pilot ignition (e.g. spark) will start fire. This is also the maximum for areas with public access (e.g. roads) – if the probability is low
25	This intensity is sufficient to spontaneously ignite wood and thin uninsulated steel sections can reach a temperature at which thermal stresses cause failure.
75 >	The chance of fatality at a distance of less than 5m from the fire is 100% within 5 seconds.

Table. E-1 Effects of Heat Radiation

Probit

A Probit is defined as (Ref 8)

> *Probit analysis: A statistical transformation which will make the cumulative normal distribution linear. In analysis of dose-response, when the data on response rate as a function of dose are given as probits, the linear regression line of these data yields the best estimate of the dose-response curve. The Probit unit is y = 5 + Z(p) , where p = the prevalence of response at each dose level and Z(p) = the corresponding value of the standard cumulative normal distribution.*

For the purposes of a risk assessment it provides a methodology of converting a toxic load to a probability of fatality. The Probit for toxic loads is described in the general equation shown below

$$Y = a + b \ln(C^n t_e)$$

Y	is the Probit
a, b, n	are constants
C	is the concentration in ppm by Volume
t_e	is the exposure time in minutes

The following table shows the Probit values used in the determination of the probability of a fatality for the hazardous incident of a toxic cloud. As discussed earlier the estimation of consequences of the toxic concentration is based on hydrochloric acid and sulphur dioxide as these represent the largest components anticipated in the hazardous incident. For all calculations the time of exposure has been assumed to 30 minutes. This time is considered conservative as the releases do not reach residential areas and only affect industrial sites nearby. It would be unlikely that any person standing or working on an adjacent site would remain in a smoke plume generated by this hazardous incident for 30 minutes.

		Probit Constants		
Chemical	**Source**	***a***	***b***	***c***
Hydrochloric Acid	World Bank (1988)	-21.76	2.65	1
Sulphur Dioxide	US Coast Guard (1980)	-15.67	2.10	1

Table. E-2 Probit Values Used

The Probit value established in the equation used above is then converted to a percentage by reference to Table. E-3

%	0	1	2	3	4	5	6	7	8	9
0	—	2.67	2.95	3.12	3.25	3.36	3.45	3.52	3.59	3.66
10	3.72	3.77	3.82	3.87	3.92	3.96	4.01	4.05	4.08	4.12
20	4.16	4.19	4.23	4.26	4.29	4.33	4.36	4.39	4.42	4.45
30	4.48	4.50	4.53	4.56	4.59	4.61	4.64	4.67	4.69	4.72
40	4.75	4.77	4.80	4.82	4.85	4.87	4.90	4.92	4.95	4.97
50	5.00	5.03	5.05	5.08	5.10	5.13	5.15	5.18	5.20	5.23
60	5.25	5.28	5.31	5.33	5.36	5.39	5.41	5.44	5.47	5.50
70	5.52	5.55	5.58	5.61	5.64	5.67	5.71	5.74	5.77	5.81
80	5.84	5.88	5.92	5.95	5.99	6.04	6.08	6.13	6.18	6.23
90	6.28	6.34	6.41	6.48	6.55	6.64	6.75	6.88	7.05	7.33
%	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
99	7.33	7.37	7.41	7.46	7.51	7.58	7.65	7.75	7.88	8.09

Table. E-3 Conversion from Probit to Percentages

Appendix F. Frequency Estimation

Warehouse Fires

Warehouse fires have a large variation in the estimates of their frequency. Some sources are referred to in the following Table

Source	Estimate
HSE – Safety Report Assessment Guide: Chemical Warehouses – Hazards	1×10^{-2} p.a
Environmental Impact Assessment Report for the commission of inquiry into Proposed Manufacturing Plant by WR Grace Australia Ltd.,Kurnell, Sydney October 1987	4.6 x $^{-3}$ p.a
Baldwin, Accident Analysis and Prevention (Vol 6)	1×10^{-3} p.a
PHA – Intermodal Logistics Centre at Enfield environmental Impact Statement, QEST Consulting Pty Ltd 2005	1×10^{-4}p.a to 1×10^{-3}p.a for DG stores

The range of frequencies used is varied and represents an uncertainty in the estimation of the frequency. Many of these warehouses are used to store general chemicals and do not have the protection of control involved in a Dangerous Goods Warehouse. In consideration of this a figure of **5×10^{-4} p.a** for a major fire in the Chemsal facilities has been used. This represents a conservative figure and has been used in the generation of the individual risk contours

Smoke in Toxic Cloud for Residential Area

The formation of a smoke cloud containing toxic chemicals can travel some distance from the source. The nearest residence was established at 600m to the east of the site. As the consequence analysis has revealed there is only one stability class that will extend the required distance to impact on residential area. This stability class is the Class F1.5 Conditions. There are three directions that could reach residence NE, E and SE. Not all directions can simultaneously occur. The frequency for each wind direction is now estimated.

Direction of Plume	Probability of wind Direction and F1.5 Class	Overall Frequency
North East	0.037	18.5×10^{-6} p.a
East	0.023	11.5×10^{-6} p.a
South East	0.027	13.5×10^{-6} p.a

Toxic Cloud Formation Unloading / Loading

A potential hazardous incident could occur with the dropping of a Class 3 material, ignition of the material and the ignition of Class 6.1 material. The result is a toxic cloud involving smaller quantities than that involved in the warehouse fire.

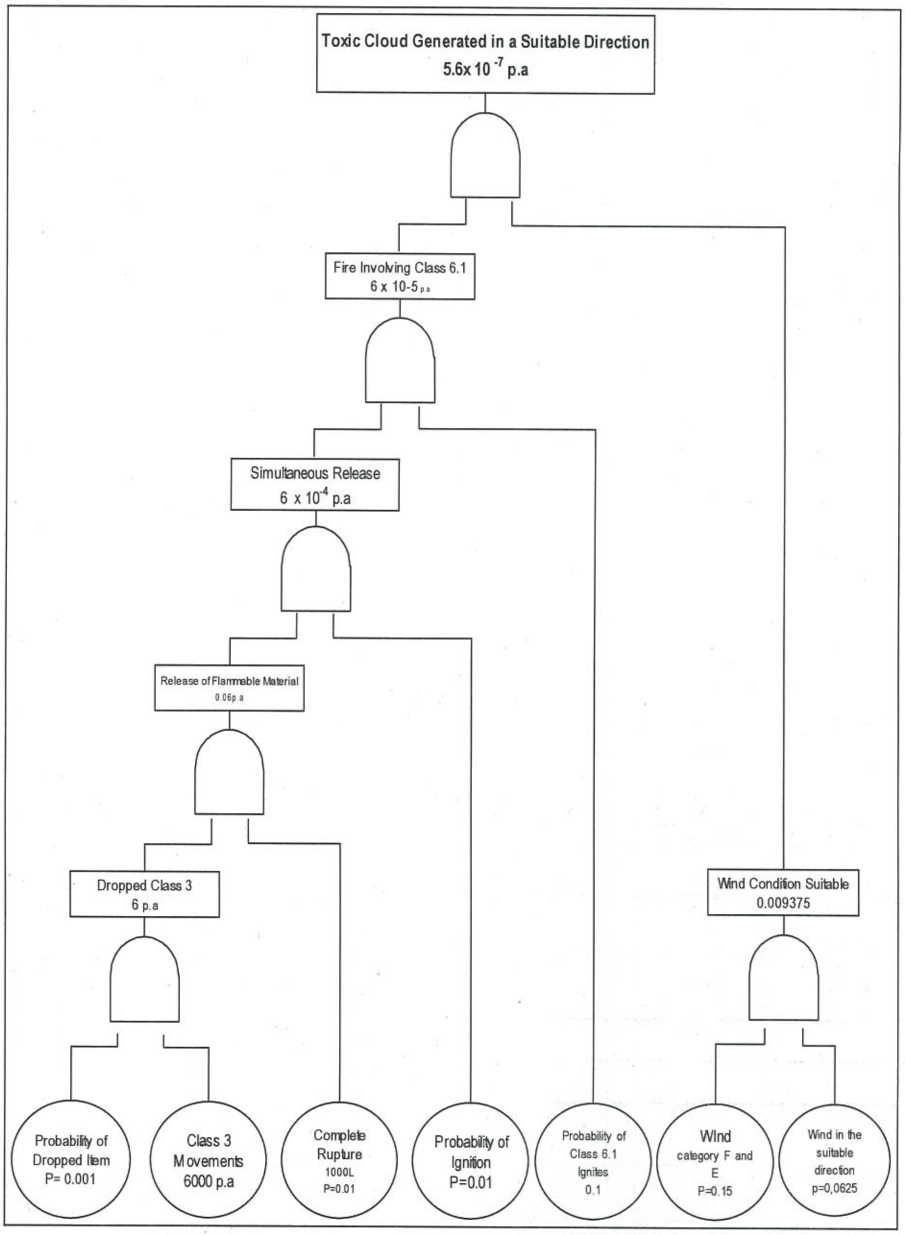

Figure. F-1 Toxic Cloud Formation (Loading and Unloading)

Event	Probability	Basis
Probability of Dropped IBC (up to 1000 litres),	0.001	Taken as the probability of Human Error for "A Complex, less time available, some care needed event" [Brazendale]
Number of Movements Class 3	6000	The number of smaller movements of class 3. Conservative as it assumes all material is moved as IBC's or drums
Probability of Ignition (Class 3)	0.01	The probability of the complete rupture of the Class 3 material, providing the quantity that has been modelled.
Probability Class 6.1 Ignites	0.1	The situation requires that there be class 6.1 nearby or the material is class 6 sub group 3. This is estimated to occur 10% of the time.
Wind Category E and F	0.15	Probability of each E and F. These events typically occur during the evening. This figure is used to represent what would be reasonable to reflect that loading and unloading predominantly take place during daylight hours.
Suitable Wind direction	0.0625	The wind direction is taken as a 1/16th of the available with direction. The plumes are long and narrow and this would represent a probability of the wind being in the correct direction to affect a receptor

Table. F-1 Probabilities Relating to Unloading Loading (Toxic Cloud)

Transportation

This section discusses the transport frequency of hazardous incident occurring. There are a number of source that can be used for the establishment of the road accident frequency. Some of these frequencies are listed in

Source	Estimate
DUAP (1988), City South Freight Strategy	$8 \times 10^{-7} km^{-1}$
UK, M5East Motorway Environmental Impact Study (EIS)	$5.4 \times 10^{-6} km^{-1}$

For the basis of this study the higher frequency used in the M5 Motorway EIS has been used.

Transportation Accident Frequency

Chemsal will collect substances of various from sites and transport them back to there facilities. It will then collect these materials into larger volumes and send for further processing or recovery. The transport frequency for class 6.1 materials was established in section 4.2. There will be approximately 623 movements per year. Some movements are short distance and some will be longer. It was assumed that the average trip undertaken will be 500 km. This will make a total number distance travelled of 300,000 km. When this 300,000 km is multiplied by the accident frequency established earlier there is a likelihood of 1.6 accidents per annum (p.a)

This figure is conservative. Not all trips will carry the quantity of 6.1 modelled, and not all trips will carry flammables simultaneous with class 6.1. This makes the estimation of an accident occurring with both class 6.1 and flammables less likely than 1.6 p.a

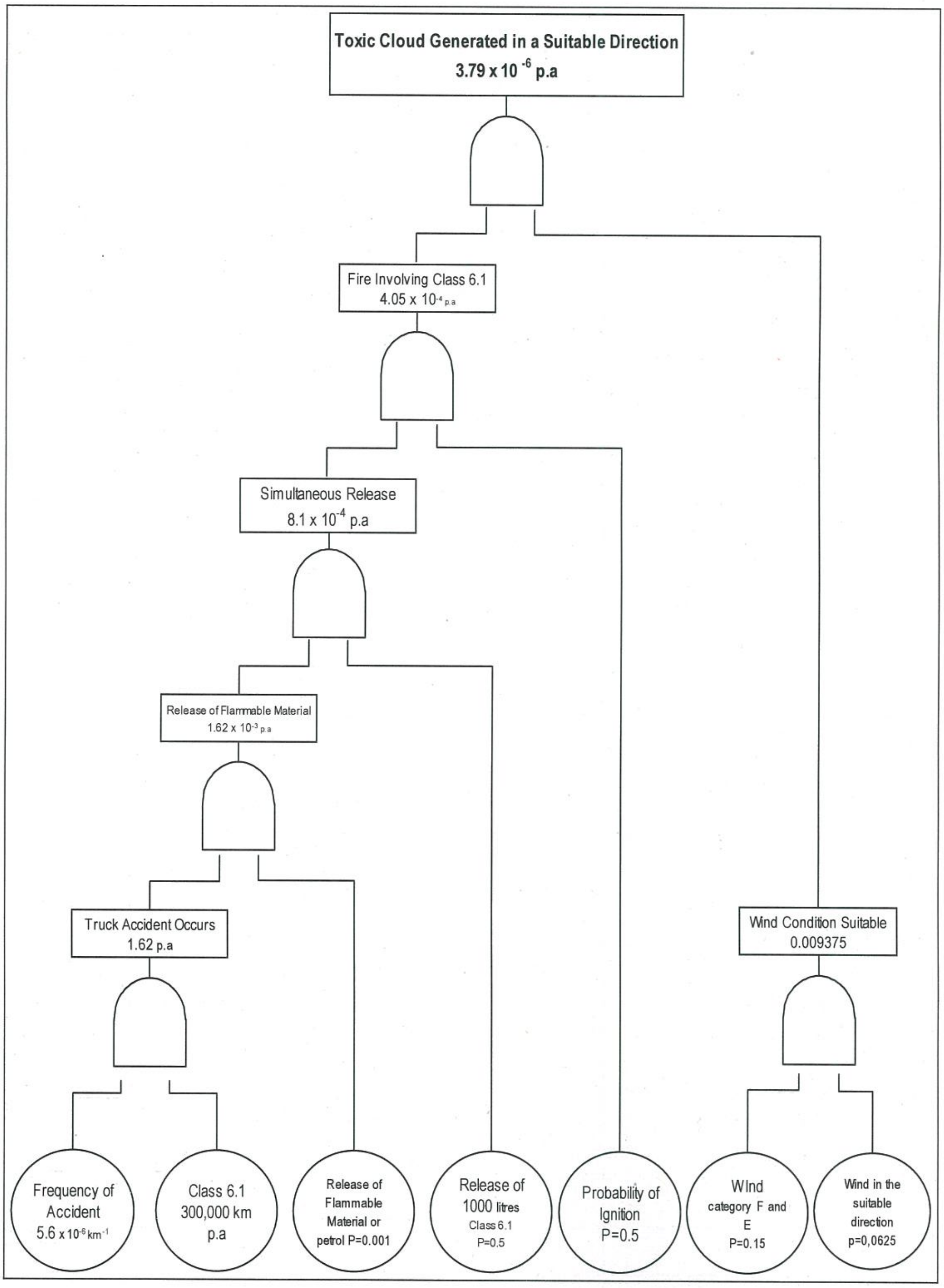

Figure. F-2 Fault Tree Toxic Cloud (Transportation) Frequency

Transportation Hazardous Event Probabilities

In order to calculate the frequency of generation of a toxic cloud from a truck accident a fault tree method has been used. This fault tree is shown in Figure. F-2. The probabilities used in the fault tree are explained in Table. F-2 Probabilities Relating to Transportation (Toxic Cloud)

Event	Probability	Basis
Release of Class Flammable Goods or Petrol	0.001	The accident requires the release of class 3 material of fuel from the vehicle to form the fire. The rupture of the entire contents of an IBC has been estimated at 0.001. This is consistent with the M5 east Motorway study and Ref 10.
Release of Class 6.1 Goods	0.5	Not all accidents will release sufficient quantities of class 6.1 to produce a toxic cloud modelled in Appendix D. It is consider conservative to use the figure of 50% to represent the likelihood of both mixtures being available.
Probability of Ignition (Class 3)	0.5	Once a accidents has occurred and there are sufficient quantities of flammables in the area of the accident the likelihood of the release finding an ignition source is high. It has been assumed to be 50% for this case
Wind Category E and F	0.15	Most of the transportation will be done during daylight hours. However there are period for example early in the morning and evening where these conditions may exists. Some night transportation to other facilities may occur. The probability that 15% these materials transported through the necessary meteorological conditions has been used.
Suitable Wind direction	0.0625	The wind direction is taken as a $1/16^{th}$ of the available with direction. The plumes are long and narrow and this would represent a probability of the wind being in the correct direction to affect a receptor

Table. F-2 Probabilities Relating to Transportation (Toxic Cloud)

As Figure. F-2 reveals the estimated frequency for a transportation accident generating a toxic cloud is 3.8 x 10^{-6} p.a

This frequency is assumed for the entire length of the transportation. It is a realisation that during the transportation of the goods there will be movement through areas where there are no local residences within the effects area and no sensitive receivers.

Appendix G. Risk Calculations

For Fixed Facilities

In order to assess the individual risk from a toxic cloud the following method was used for toxic clouds

$$\textit{Individual Risk (at point A)} = \textit{Frequency of Toxic Cloud Being Generated} \times \textit{Probability of Wind Direction and Wind Class} \times \textit{Probability of Death (established by Toxic load and Probit)}$$

The individual risk is then the sum of each wind class in that direction. Metrological Data for Penrith has been used and is shown in Appendix J

The frequency of the toxic cloud being generated is the same as a warehouse fire 5 x 10^{-4} p.a. This figure is considered conservative. Chemsal is undertaking control which will make the fire occurring in the Class 6.1 unlikely. In the absence of further data the figure for DG warehouse fires has been used.

The probability of death from a toxic release was established using probits. Probits are discussed in Appendix F

The methodology involved using the centreline concentration of the toxic cloud being representative of the entire sector being described by the available metrological data. The dispersion modelling is dominated by the effects of the stability classes F1.5 and E1.5. As previously mentioned in Appendix E the shape of the cloud is long and narrow for classes F1.5 and E1.5. The cloud will not completely film the sector described by centreline concentrations.

For example the modelling of hydrochloric acid with stability class of F1.5. At 510m the width of the cloud is 66m (Measured at ERPG). In order to completely fill the segment the cloud width would have to be 422m wide. This approach of using the centreline concentration will make the risk calculation conservative in its calculation

The fixed facilities flammable good present the risk of a fire and the consequences of these fires have been examined in section 8.1.1. As these results reveals the off-site impacts are negligible and will not significantly contribute to the generation of individual risk outside of the facility.

Appendix H. Risk Criteria

The risk criteria applying to developments in NSW are summarised in Table 15 below (from Ref 2).

Description Risk Criteria	
Fatality risk to sensitive uses, including hospitals, schools, aged care	0.5×10^{-6} per year
Fatality risk to residential and hotels	1×10^{-6} per year
Fatality risk to commercial areas, including offices, retail centres, warehouses	5×10^{-6} per year
Fatality risk to sporting complexes and active open spaces	10×10^{-6} per year
Fatality risk to contained within the boundary of an industrial site	50×10^{-6} per year
Injury risk – incident heat flux radiation at residential areas should not exceed 4.7 kW/m^2 at frequencies of more than 50 chances in a million per year or incident explosion overpressure at residential areas should not exceed 7 kPa at frequencies of more than 50 chances in a million per year	50×10^{-6} per year
Toxic exposure - Toxic concentrations in residential areas which would be seriously injurious to sensitive members of the community following a relatively short period of exposure	10×10^{-6} per year
Toxic exposure - Toxic concentrations in residential areas which should cause irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community	50×10^{-6} per year
Propagation due to Fire and Explosion – exceed radiant heat levels of 23 kW/m2 or explosion overpressures of 14 kPa in adjacent industrial facilities	50×10^{-6} per year

Table. H-1 DUAP Risk Criteria

www.moorece.com.au
Sydney A. PO Box 7922 Baulkham Hills BC NSW 2153 T. 61 2 9894 4551 F. 61 2 9894 1318
Brisbane A. Locked Bag 6 Fortitude Valley BC QLD 4006 T. 61 7 3854 2336 F. 61 7 3854 2337

Appendix I. ERPG-2

In order to assess the toxic exposure criteria in Risk *Criteria for Land Use Safety Planning, HIPAP No.4* we must establish a airborne concentration that is capable of seriously injuring sensitive members of the community or cause acute physiological responses to sensitive members of the community. In this study the toxic concentration indicated by The Emergency Response Planning Guideline (ERPG) level number 2 was used. This is described as ERPG -2.

> *The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action*

The values for the ERPG – 2 used in this study we gathered from American Industrial Hygiene Association (AIHA) and are shown in Table. I-1.

Chemical	ERPG – 2 Concentration
Hydrochloride Acid (HCl)	20 ppm
Sulphur Dioxide	3 ppm

Table. I-1 ERPG - 2 for Chemicals of Interest

Appendix J. Metrological Data

Meteorological Data is required at two (2) stages of the risk assessment. First the wind speed and metrological stability class for modelling consequences must be established. Secondly the impact (risk) calculations require the probability of wind direction and metrological stability class to be included to establish the frequency of the occurrence.

For dispersion modelling suitable wind and stability classes are chosen. The procedure used the combining of wind and stability classes into six (6) wind and stability classes that are differentiated to give sufficient variation in the dispersion modelling.

The data is shown in Table. J-1 is for Penrith and was compiled by PDS Multimedia and Consultancy Service.

Stability Class	Wind Direction %							
	NE	E	SE	S	SW	W	NW	N
A1.5	0.3	0.3	0.5	0.4	0.2	0.1	0.2	0.6
B3	1.2	0.7	1.1	1.6	0.9	0.4	0.8	2.3
C3	1.8	1.2	1.8	3.0	1.4	0.8	1.1	3.1
D3	2.5	2.6	5.1	9.6	5.6	4.7	2.5	3.6
E1.5	1.1	0.9	1.3	3.9	2	1.4	0.8	1.3
F1.5	2.4	1.5	1.9	7.7	3.7	2.3	2.7	3.2

Table. J-1 Metrological Data