PRELIMINARY HAZARD ANALYSIS

WARWICK FARM PRINTING PROJECT

WARWICK FARM

INDEPENDENT PRINT MEDIA GROUP PTY LTD

PREPARED FOR:	**Andrew Orum**
	IPMG

DOCUMENT NO:	**J20307-001**
REVISION:	**0**
DATE:	**2 October 2008**

Sherpa Consulting Pty Ltd (ABN 40 110 961 898)
Phone: 61 2 9412 4555
Fax: 61 2 9412 4556
Web: www.sherpaconsulting.com

DOCUMENT REVISION RECORD

REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	METHOD OF ISSUE
DRAFT	09/09/2008	Draft for information	O Alim	-	-	-
A	24/09/2008	Draft for client comment	P Johnson/ O Alim	P Johnson/ S Chia	S Chia	Email [PDF]
B	26/09/2008	Revised to address Client's comments	O Alim	P Johnson/ S Chia	S Chia	Email [PDF]
0	02/10/2008	Final Issue	O Alim	J Polich	P Johnson	Email [PDF]

RELIANCE NOTICE

This report is issued pursuant to an Agreement between SHERPA CONSULTING PTY LTD ('Sherpa Consulting') and INDEPENDENT PRINT MEDIA GROUP PTY LTD which agreement sets forth the entire rights, obligations and liabilities of those parties with respect to the content and use of the report.

Reliance by any other party on the contents of the report shall be at its own risk. Sherpa Consulting makes no warranty or representation, expressed or implied, to any other party with respect to the accuracy, completeness, or usefulness of the information contained in this report and assumes no liabilities with respect to any other party's use of or damages resulting from such use of any information, conclusions or recommendations disclosed in this report.

Title:	QA Verified:
PRELIMINARY HAZARD ANALYSIS **WARWICK FARM PRINTING PROJECT** **WARWICK FARM**	J POLICH
	Date: 2 October 2008

CONTENTS

TABLES

FIGURES

ABBREVIATIONS

ARTC	Australian Rail Track Corporation Ltd
AS	Australian Standard
BCA	Building Code of Australia
DG	Dangerous Good(s)
DGR	Director General's Requirement
DoP	Department of Planning
DP	Deposited Plan
EA	Environmental Assessment
EPA	Environmental Protection Agency
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HIPAP	Hazardous Industry Planning Advisory Paper
HSIS	Hazardous Substances Information System
IPMG	Independent Print Media Group
IRPA	Individual Risk Per Annum
JST	Japan Science and Technology Agency
LFL	Lower Flammability Limit
MARS	European Major Accident Reporting System
MSDS	Material Safety Data Sheet
NSW	New South Wales
PHA	Preliminary Hazard Analysis
SEPP	State Environmental Planning Policy
SMS	Safety Management System
UFL	Upper Flammability Limit
VRU	Vapour Recovery Unit
1×10^{-2}	0.01
1×10^{-4}	0.0001
1×10^{-6}	0.000001

1. EXECUTIVE SUMMARY AND RECOMMENDATIONS

1.1. Purpose and Scope

Independent Print Media Group (IPMG) is in the process of seeking project approval for the development of a printing facility at Warwick Farm, New South Wales (NSW), under Part 3A of the *Environmental Planning and Assessment Act, 1979 (*EP&A Act). The proposal will have a development cost exceeding $30 million and is therefore a 'major project' to which Part 3A of the EP&A Act applies. As such, it will be determined by the Minister for Planning.

IPMG advised Sherpa that the Director General's Requirements (DGRs) for the proposed facility include the following requirement:

Hazards and Risk – including a Preliminary Hazard Analysis (PHA) in accordance with Hazardous Industry Planning Advisory Paper No 6 – Guidelines for Hazard Analysis

IPMG has engaged Sherpa Consulting Pty Ltd (Sherpa) to undertake the PHA for the development.

1.2. Study Objectives

The need for a PHA was triggered by the DGRs, and the process was conducted in accordance with the Department of Planning (DoP) Hazardous Industry Planning Advisory Paper (HIPAP) No 6 – Guidelines for Hazard Analysis Ref. (1) and Multi Level Risk Assessment Ref. (2).

1.3. PHA Process

The Multi-level Risk Assessment Guideline Ref. (2) was consulted to identify the most appropriate level of risk assessment.

This PHA is based on a Level 2 Risk Assessment where the results are sufficiently quantified to allow an assessment of the offsite risk levels against acceptance criteria.

The risk assessment process and risk acceptance criteria set out in HIPAP No. 6 Ref. (1) and HIPAP No. 4 Ref. (3) were followed.

1.4. Limitations

- This PHA is based on data supplied by IPMG Ltd and Peter W Stephenson & Associates Pty Ltd Ref. (4). Distances to the site boundary and bund dimensions were interpreted from the preliminary site layout plans.
- This report contains assumptions relating to site layout and process conditions. These assumptions are identified in the report.
- The DGRs for the site included the preparation of a PHA in accordance with Multi-level Risk Assessment Guideline Ref. (2); hence, this document does not include a comprehensive review against SEPP 33; however, Section 4 provides a

discussion of SEPP 33 issues relating to Dangerous Goods (DG) transport. It was found that a Route Selection Study was not required due to the low volume of vehicle movements proposed to transport DGs to and from the site.

1.5. Findings and Conclusions

1.5.1. Hazardous Incidents

A Hazard Identification (HAZID) review meeting was held to identify potential incident scenarios, their causes, consequences and safeguards in place in the design. A set of scenarios with the potential for offsite impact was carried forward for consequence analysis. These include:

- Toluene leak from storage vessels, pipeworks and pumps, decanting tank and leak during road tanker loading/unloading leading to pool/bund fires, if ignited.
- Bulk paper storage fire due to arson, forklift truck fault, electrical fault, lightning and unauthorised smoking.

From the consequence analysis, it was found that:

- No events were found that could impact sensitive, residential or active open space land uses.
- For the pool fires, the following events may lead to some offsite impacts to adjacent industrial land uses due to heat radiation. They were therefore carried forward to frequency and risk analysis. These events include:
    - 1.01 PF: Bulk Storage – Fire in the Toluene Storage Bund
    - 1.02 PF: Bulk Storage – Pump Area Toluene Pool Fire
    - 1.03 PF: Bulk Storage – Road tanker Loading/Unloading Toluene Pool Fire
- Fires from the bulk storage paper warehouse do not have offsite impact
- Jet fires from pump leaks do not have offsite impact
- Whilst there is a potential for escalation between the tanks in the Toluene storage area, the offsite consequences would be no worse than the full surface bund fire modelled.

1.5.2. Safeguards

For all scenarios carried forward for quantification, hardware safeguards aimed at reducing the likelihood and/or consequence of an incident are included. Key controls include:

- Level gauge, high level alarm and automatic shutdown on high level to prevent toluene overfill of storage vessel.
- Crash barrier and interlock-to-automatic shutdown are in place to prevent road tanker collision with filling infrastructure and drive-away respectively.

1.5.3. Conclusions

An assessment was carried out to determine the fire frequency for the pool fires having the potential for offsite impact. It was found that the total frequency of fires that may affect the adjacent industrial land use was 16 $\times 10^{-6}$ (16 chances in a million) per year.

The total frequency of fires was then compared against the risk criteria suggested by the NSW Department of Planning which regulates the approval for new developments. The key results were:

- The 50 x 10^{-6} per year (50 chances in a million per year) individual fatality risk criterion (maximum fatality risk criterion at site boundary) was not reached as the maximum frequency of events with potential impacts outside the site boundary was found to be 16 x 10^{-6} per year (16 chances in a million per year).
- There were no events with potential to affect residential, active open space, commercial and sensitive land uses. Therefore, the development complies with the HIPAP 4 individual fatality criteria for all land uses Ref. (3).

DoP guidelines suggest an injury risk criterion of 50 x 10^{-6} per year (50 chances in a million per year) for a heat radiation level of 4.7 kWm^{-2} at locations zoned as residential. No events were identified along the site boundary which could affect residential areas therefore the proposed development complies with the injury risk criteria.

In addition, a 2-metre high precast concrete wall was proposed, which is not taken into account in this preliminary study. The proposed concrete wall could be incorporated into the final hazard analysis and would be expected to significantly reduce the predicted offsite impact to the small industrial units on the eastern boundary of the proposed site.

Overall, the proposed facility meets all NSW DoP quantitative risk criteria for land use planning and the offsite risk is therefore found to be low and acceptable.

1.6. Recommendations

As the design develops the project is generally required to complete a number of other safety and risk studies in accordance with the NSW Department of Planning Seven Stage Approval Process and as requested by the Director General, viz.:

Project Phase	Safety Study
Design Stage	Hazard and Operability Study
	Final Hazard Analysis (updating this PHA)
	Fire Safety Study
	Emergency Plan
Construction/Commissioning Stage	Construction Safety Study
Operational Stage	Safety Management System
	Independent Hazard Audit

1. It is recommended that the HAZOP should include a determination as to whether sufficient safeguards are in place to prevent toluene ingress to the boiler. It is also recommended that the HAZOP covers the timing sequence of the carbon beds in the VRU to ensure that overheating is prevented.
2. It is recommended that the operator develop a Safety Management System in accordance with HIPAP 9 Ref. (5).
3. It is recommended that the operator develop an Emergency Plan in accordance with HIPAP 1 Ref. (6).
4. The final layout design for the Toluene storage tank bunds should confirm compliance with the separation distances required under AS1940-2004 (i.e. separation to site boundary, protected places, etc.).
5. The Fire Safety Study should account for any enhanced fire systems in place.
6. It is recommended that the latest revisions of the appropriate Australian Standards (including those identified in this document, viz.: AS 1940, AS 3961, Building Code of Australia, AS60079.10) are consulted during the Design Stage.
7. It is recommended that the possible overpressure generated by an explosion in the pump room be verified at detailed design stage to ensure no offsite injury potential due to overpressure.

2. SITE AND PROCESS DESCRIPTION

2.1. Site Description

The proposed printing facility is to be located at 23 Scrivener Street, Warwick Farm, New South Wales (NSW). The 7.94 hectare site is located in an industrial area at Warwick Farm in the Liverpool local government area. The site is identified as Lot 1 of Deposited Plan (DP) 750896. The site is bounded by the Main Southern railway on its western side, Manning Street to the north, Scrivener Street and small industrial units to the east, and the Liverpool Hospital car park to the south. Figure 2.1 shows the location of the site and its surroundings.

The site contains a large warehouse type building, approximately 35 000 m^2 in area, currently owned and operated by Kimberley Clark for the manufacture, storage and distribution of paper products. The current operation is winding down and Kimberley Clark is relocating elsewhere. The existing building was built in the early 1970s and extended in the 1980s. It has been very well maintained, has a full sprinkler type fire-fighting system, has double insulation in the roof areas and the manufacturing areas are air conditioned.

Surrounding land uses include a range of large industrial operations (including Visy Australia), light industrial units, stables associated with Warwick Farm Racecourse (currently zoned residential 2(b) Racecourse), and ancillary buildings and parking associated with Liverpool Hospital. Further away lies Liverpool Girls High School, Liverpool Boys High School and Liverpool Hospital. Distances from the site boundary to the closest point of the other relevant land uses are given in Table 2.1.

TABLE 2.1: SURROUNDING LAND USES

Boundary	Land-use	Type	Distance (m)
West	Playing Field	Active Open Space	70
West	Liverpool Boys High School (buildings)	Sensitive	270
West	Liverpool Girls High School (buildings)	Sensitive	250
South west	Liverpool Hospital	Sensitive	60
South	Liverpool Hospital Car Park	Sensitive [a]	At site boundary
East	Light Industrial Units and Visy	Industrial	At site boundary
North	Stables	Residential	30
North East	Rosedale Park Oval	Active Open Space	30
(a) Classified as sensitive, although not connected directly with the hospital.			

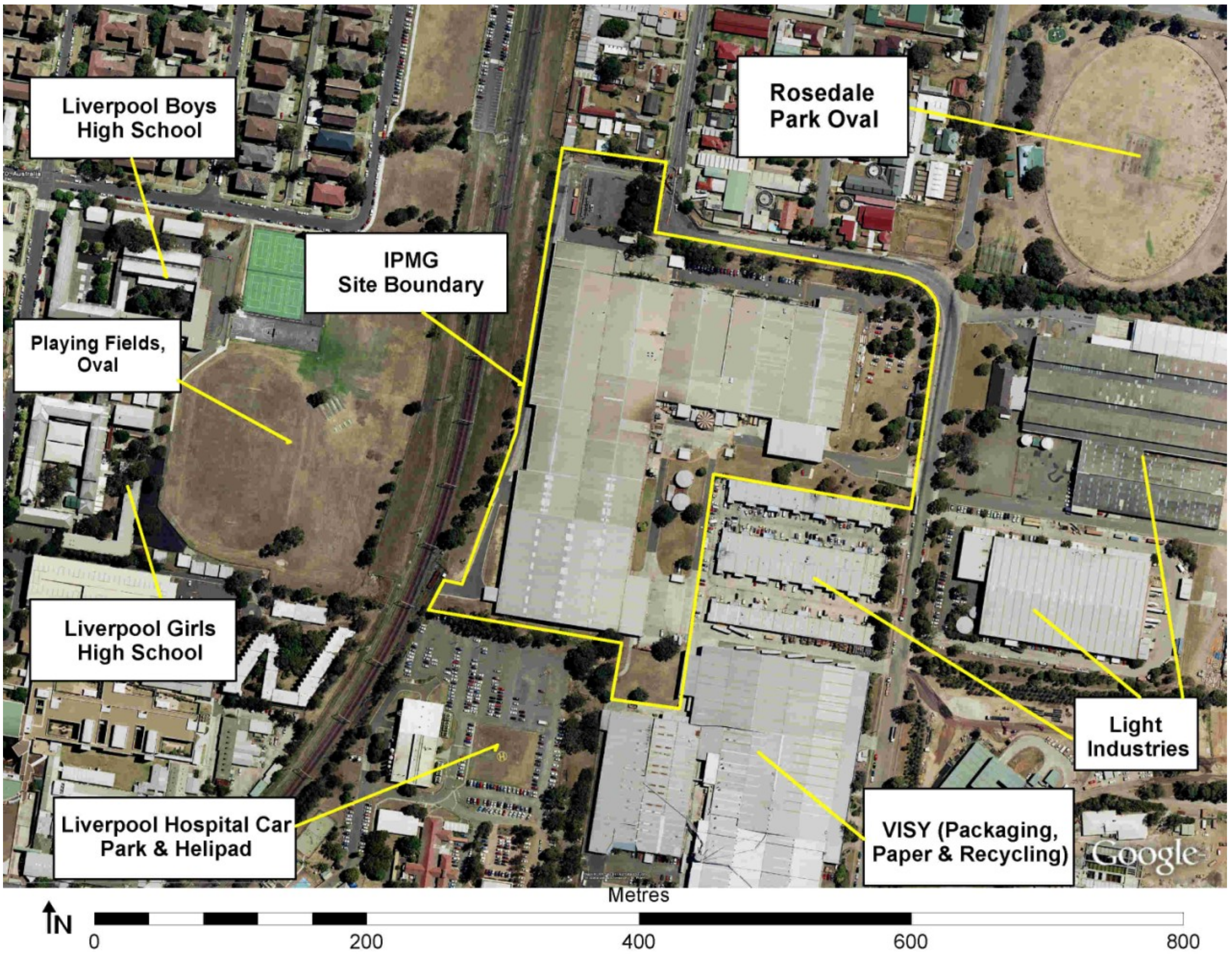

FIGURE 2.1: SITE LOCATION

2.2. Project Description

2.2.1. Proposed Development

The project involves the modification, refurbishment and extension of an existing manufacturing plant into a new 40 250 square metres plant for printing, warehousing and distribution. The capital investment value of the project will exceed $100M.

The development will involve the following modifications and additions to the site, refer to Figure 2.2 for the location of each plant area:

- Refurbishing and fitting out the existing 35 230 square metres building to incorporate:
  - A press room and bindery – approximately 13 400 square metres (Areas B, C and G);
  - Materials storage and distribution areas – approximately 19 120 square metres (Areas A, F, J and K); and
  - Offices and amenities – 1 900 square metres (Area N).
- Raising part of the existing roof from 8 to 14 metres
- Constructing an extension of 4 000 square metres in total for a future warehouse (Area L).
- Constructing new compensatory flood storage (Area U).
- Installing a vapour recovery and ink supply system (Area D).
- Constructing a waste paper collection area of 630 square metres (Area I).
- Relocating fire service tanks and pumps (Area M).
- Extending the internal road system to create a circular truck access route.
- Installing three rotary printing presses (Area C).
- Constructing a new 2-metre high concrete wall (Area R) on the eastern boundary adjacent to the small industrial units.

A range of raw materials will be stored on site including around 22 750 tonnes of paper rolls (at any one time), as well as ink, solvent, acid, alkaline and plating materials. Construction is expected to commence in late 2008 or early 2009 with completion and commissioning by late 2009. Further detail is provided in the Environmental Assessment (EA) Report.

2.3. Printing Process Description

2.3.1. Step 1: Paper Receiving and Storage

The 7 000 square metre paper store (Area A) is capable of storing 22 750 tonnes of paper at anytime.

Paper is delivered in rolls by semi trailer to the south east factory apron where it is unloaded by forklift to the paper store. The rolls are up to 3180 mm in height, 1350 mm in diameter and up to 5.3 tonnes in weight. The paper is stacked up to 9.54 metres high in four blocks of 25 rows.

2.3.2. Step 2: Cylinder Preparation

Printing cylinders electromechanically engraved with the image to be printed onto an electroplated copper cylinder 3.2m wide (see Area B). Following engraving, the cylinder is hard chrome plated and stored, ready for distribution to the press room.

The cylinder etching and preparation equipment machine is capable of processing up to 5 400 printing cylinders per year.

2.3.3. Step 3: Printing Process

Printing takes place on three[1] 8 unit Rotogravure presses located side by side – see Area C.

Each press is capable of processing over 45 000 tonnes of paper annually and producing up to 112 000 items per hour for catalogue and magazine production.

The paper rolls are automatically delivered from the paper store to the reel loaders at the rear of the press where they are prepared for unwinding. They are then mounted on the reel stand and the press pulls the paper from the rolls into the printing units located at the back of the reel stand. The paper is then printed in full colour in a continuous process.

The folder then slit cuts the printed web of paper into smaller width ribbons and folds them into smaller sizes ready for stacking. The folder is capable of delivering various permutations of folded product depending on the style of magazine or catalogue being produced.

2.3.4. Step 4: Vapour Recovery

The purpose of the Vapour Recovery Unit (VRU) (Area D2) is to remove the ink carrier solvent produced by the ink drying process at the printing presses.

The unit consists of 5 vessels, each 3.5 metres in diameter and 17 metres in length, located at the southern wall of the factory. Solvent laden air is forced through the vessels sequentially and then beds of activated carbon, located in the centre of the vessels, recover the solvent allowing cleaned air to exhaust.

After each process cycle (of approximately 40 minutes) the carbon is cleaned and reactivated by pumping steam through the tank supplied from two boilers located near to the VRU.

Solvent is recovered from the steam first by cooling, and then by phase separation where the water is recovered, polished and then returned to the boiler.

[1] Initially there will be two presses; an additional press will be installed at a later date.

Recovered solvent is stored and reused in the print process, or can recovered for reuse by ink manufacturers, so creating a closed loop supply chain.

2.3.5. Step 5: Stacking and Storage

Folded product is conveyed from the folder to the stacking equipment located to the north of the presses (see Area E).

The stackers take the individual pieces of folded product and place them one on top of the other forming a log of product consisting of 600 to 1 200 pieces. Product is strapped and placed flat on pallets for storage awaiting collation with other magazine sections.

Product that does not require collating with other sections can be stitched/glued and trimmed at the press prior to stacking in bundles of 50 to 300, as required, to suit customer needs. They are then palletised at the stackers ready for local or interstate dispatch.

Product from the presses is stored in the intermediate racked storage area (Area F) whilst other sections of the same magazine are printed.

2.3.6. Step 6: Binding

Two high speed collating and stitching lines (see Area G) process the stored product from the presses, collate up to 7 printed sections together, stitch (staple) them, and then trim the folded edges away from the collated sections to create a magazine with 3 open sides and a stapled spine ready for distribution.

Each stitching machine can produce in excess of 25 000 items per hour.

2.3.7. Step 7: Waste Paper Management

Paper waste and dust is conveyed via fan and duct to the waste paper system located next to the southern driveway (Area I). The equipment in this area separates any paper dust and bales the paper off-cuts ready for transport to external recycling.

The waste paper bailers are capable of handling up to 6 tonnes of material per hour.

2.3.8. Step 8: Dispatch

Finished product from the press room and binding section is stored and dispatched onto trucks for delivery by road out of the plant (from Areas H, K and L).

Publications which are to form mixed bundles are sent for collation to Area J where other magazines and materials are collated and packed with other items for distribution to newsagents and others as required.

(Source: Google Earth Pro, © Map Data Sciences Pty Ltd, PSMA, Image © Sinclair Knight Merz, Fugro)

FIGURE 2.2: PROCESS PLANT LAYOUT

<u>Map Legend</u>

A	Bulk Paper Store	H	Finished Goods Dispatch
B	Cylinder Production	I	Waste Paper Collection
C	New Printing Presses	J	Finished Goods Storage and Packing Area
CS1	Chromic Acid Storage	K	Existing Warehouse
CS2	CO_2 Storage	L	Proposed New Warehouse Extension
D1	New Ink Storage	M	Fire Service Tanks and Pumps
D2	Vapour Recovery Unit	N	Existing Two Storey Office
E	Stacking and Palletising	P	Gatehouse
F	Racked Storage for Work in Progress	R	New High Precast Panel Fence
G	Binding Area	U	New compensatory Flood Storage

2.4. Transportation of Goods

It is intended that shipment of raw materials to the site and distribution of finished products as well as waste removal will be by road. Proposed commercial vehicle movements will average a total of 44 vehicles per day (in and out) – half that of the current Kimberley Clark average of 98 vehicles per day Ref (7). These commercial vehicles include B-double road tankers, semi-trailers, small and large trucks and couriers. There may be potential in the longer term for goods to be transported by rail. However, this is subject to detailed negotiation with, and planning by, Australian Rail

Track Corporation Ltd (ARTC) and RailCorp. This is not contemplated at present and is not part of this project.

2.5. Employment and Hours of Operation

The site will operate on a 24 hour, 7 days per week basis and will employ approximately 150–190 full time equivalent staff over three shifts. Of these, approximately 70 people will be on site at any one time.

2.6. Hazardous Materials

Hazardous substances handled at the site include:

- Toluene, used as a carrier for the printing ink
- Sulphuric Acid, used in the cylinder plating operation
- Chromic Acid, used in the cylinder plating operation
- Carbon Dioxide, used in the fire-fighting system

In addition, paper is included due to its combustion potential for large scale fires, and high pressure steam is considered due to the potential for steam boiler explosions. The approximate quantities of each substance to be stored on site are given in Table 2.2.

TABLE 2.2: QUANTITIES OF HAZARDOUS SUBSTANCES STORED AT SITE

Material	UN No	DG Class	PG	Quantity	Unit
Toluene[(a)]	1294	3	II	145	m^3
Sulphuric Acid (concentrated)	1830	8	II	2	m^3
Chromic Acid Solution[(d)]	1755	8	II	2	m^3
Chromium Trioxide[(d), (b)] (Chromic Acid, Solid)	1463	5.1 (8)	II	180[(b)]	kg
Carbon Dioxide	1013	2.2	-	25 000	kg
Paper[(c)]	Not classified			22 750 000	kg
Steam	Not classified			10	tonnes/hr

(a) $80m^3$ stored as recovered toluene, $40m^3$ stored as ink carrier, 25 m^3 stored as varnish constituent.
(b) 8 x 22.5kg bags
(c) Approximately 20 000 000kg in paper warehouse; 2 750 000kg 'work in progress'
(d) May be stored as solution or solid.
(e) Ink is delivered pre-mixed with toluene. No pigment powders are handled at the site.

The location of each substance is shown in Table 2.3, using areas identified in Figure 2.2.

TABLE 2.3: LOCATION OF HAZARDOUS SUBSTANCES

Area	Stored Substances
Paper Warehouse (Location A)	Paper
Work in Progress and finished product stores (Location F, G, J, K, L)	Paper
Chemical Storage (Location CS1)	Sulphuric Acid Chromic Acid / Chromium Trioxide Solid
Ink Storage and Vapour Recovery (Location D)	Toluene
Boiler House (Location D - west) CO_2 Store (Location CS2)	Steam CO_2

2.7. Design Standards and Safety Systems

Although the design of the facility is at a preliminary stage, the following philosophy is to be adopted with respect to design of fire/ emergency measures and procedures:

Design of all systems shall be in compliance with the appropriate Australian Standard.

With respect to fire protection, extensive use will be made of *AS 1940-2004 Storage and handling of flammable and combustible liquids*, which covers the flammable liquids stored at the site (toluene). This standard has the following pertinent sections:

- Section 10: Emergency Management;
- Section 11: Fire Protection;
- Appendix J: Fire Exposure Protection; and
- Appendix N: Emergency Planning and Management.

NOTE: *An assessment of the adequacy and survivability of the proposed fire protection system will be undertaken in the Fire Safety Study (see Section 8.2) in accordance with NSW DoP HIPAP 2 Ref.* (8).

IPMG has also indicated that their insurance company has specified fire protection requirements over and above those required under the Building Code of Australia (BCA) and AS 2118. IPMG will comply with these requirements.

Other relevant standards include:

- *AS 2444* for the location of fire extinguishers; and
- The Building Code of Australia for fire protection of buildings.
- Classification of hazardous areas for flammable gas and dust will be carried out using *AS 60079.10* and *AS 2430.3*.

Sherpa has made recommendations consistent with the DoP seven stage approval process for appropriate reviews when the design is finalised.

3. HAZARD IDENTIFICATION

3.1. Overview

The hazard identification exercise comprised:

- A review of hazards implicit in the chemicals and materials handled at site;
- A review of significant incidents in the printing and paper processing industry; and
- A hazard identification review between IPMG and Sherpa, based on available information.

The identified hazards were then extended and developed into hazardous scenarios which could be carried forward for further analysis.

3.2. Hazardous Substance Review

For each substance, chemical and hazardous properties were obtained from relevant Material Safety Data Sheet (MSDS) information, the Australian Hazardous Substances Information System (HSIS) Ref. (9), Emergency Response Information published by the UK Health Protection Agency Ref. (10) and US Department of Transport Emergency Response Guidelines Ref. (11). Full details are presented in APPENDIX 3.

3.3. Review of Significant Incidents

A review of past incidents at similar facilities was undertaken, using:

- The Australian Government Emergency Management Australia Disasters Database Ref (12)
- Japan Science and Technology Agency Failure Knowledge Database Ref (13)
- European Major Accident Reporting System Ref (14)

A table of incidents at printing facilities is included in APPENDIX 1, and this is discussed below.

3.3.1. Printing Incidents

There have been toluene fires at printing facilities caused by:

- Electro-static discharge; and
- Contact of ink with the dryer.

It would appear that the incidents described in the accident databases relate to facilities with older technology than the proposed development. Electro-static arcing has been largely eliminated as a cause of ignition in the printing process by the replacement of ‘static bars’ with a system that utilises the rotation of the roller to self-generate an electro-static charge.

Ignition due to ink (containing toluene) contacting the hot drying section should not happen due to the separation of the inking and drying sections.

The proposed development also includes an automatic CO_2 fire-fighting within the printing enclosures, so in the unlikely event that there was a fire, it should be quickly detected and extinguished.

The following, relevant incident information was also obtained:

- Ingress of toluene to the boiler leading to an explosion; and
- Spark due to mechanical impact igniting paper rolls.

Ingress of toluene into the boiler is minimised by a decanting tank and air stripper. It is recommended that a HAZOP study be conducted at a later stage in the project to determine whether sufficient safeguards are in place to prevent toluene ingress to the boiler from process upsets.

The incident causing ignition of a paper roll may not be relevant in this case, it is unclear from the incident report exactly how the mechanical scraper caused the spark that led to the fire. However, fires within the printing machine should be mitigated by the proposed automatic CO_2 injection system.

One incident was found in a carbon filter bed involving overheating and fire in the bed containing aromatics including toluene. It is recommended that the HAZOP covers the timing sequence of the carbon beds in the VRU to ensure that overheating is prevented. For this PHA, however, it was considered that releases of liquid toluene from the storage, loading and distribution systems would be the worst case.

3.3.2. Toluene Storage Incidents

No relevant incidents were found in the Australian Government Disaster Database or the MARS database, however, one incident was found in the JST database covering a toluene leak caused by a coupling error when draining a concentrator. No ignition was reported and the estimated loss was minor.

3.3.3. Warehouse Incidents

From Hazardous Industry Directorate Chemical Warehouse Guidelines Ref (15), (16) it has been determined that the most common causes of fires in warehouses are arson, mal-operation of equipment, poorly controlled hot-work, static ignition of flammable liquids, poor electrical installation and smoking. Control of ignition sources in work areas and equipment will be done by appropriate work procedures and equipment design. Control of ignition by an external party is through permanent site occupation, perimeter fencing, permanent security guard coverage and CCTV cameras.

3.4. Hazard Identification Brainstorming

The HAZID was conducted by using the Process Plant Layouts supplied by IPMG based on a similar plant in operation in Europe.

The following drawings and report were used:

- SK.02-F – Site Plan

- SK.03 (E-mail received 1 September 2008) – New Printing Presses Plan & Sections
- SK.04-D – Vapour Recovery Plan & Sections
- IBV4780-08 Rev 0 – Ink Storage Plant Plot Plan
- Preliminary Hazard Analysis Report Draft V4 (2008): Independent Print Media Group, Warwick Farm, by Stephenson Environmental Management Australia Ref. (4).

Hazards associated with each section of the plant were discussed at the HAZID, and noted within a Bowtie Diagram for each location/hazard for the agreed incidents. The Bowties are presented in APPENDIX 2.

3.5. Hazardous Incidents Development

Hazardous incident scenarios were developed for each of the hazardous materials and activities at the site. Bow Ties are included in APPENDIX 2 and show all of the scenarios identified. As noted in the Appendix, some potential incidents were considered to have local rather than offsite consequences. These were not carried forward for quantitative analysis. The scenarios not carried forward were:

- Paper dust fire, or explosion in the paper cutting area, due to the many safeguards in place to prevent dust accumulation (extraction system), to prevent ignition (earthing) and to detect and extinguish fire (Minimax CO_2 extinguishing system).
- Steam loss of containment, as effects of this type of event are limited to the immediate vicinity of the release. Steam lines do not run in close proximity to the site boundary.
- Chemicals loss of containment, as all chemicals stored have local corrosive effects and are not toxic at distance (bunding is provided).

The potential for generation of explosion overpressure was identified in the case of the road tanker loading/unloading area and the pump enclosure. On further inspection, it was found that the road tanker unloading area was completely open on two sides, with a lightweight roof and therefore build-up of flammable vapour would be limited and the explosion overpressures generated in this area would be minimal.

The pump enclosure, is shown as enclosed in the preliminary drawing. However, in the current design, this area will be opened to ensure sufficient air change rates though the enclosure. Furthermore, the cladding would be lightweight 'Alucobond' such that any overpressure generated would cause it to fail and thus reduce the magnitude of overpressure generated externally.

It is recommended that the possible overpressure generated by an explosion in the pump room be verified at detailed design stage to ensure no offsite injury potential due to overpressure.

3.6. Scenarios for Further Assessment

Hazardous incident scenarios identified in APPENDIX 1 with the potential for offsite impacts were considered to be ‘significant’ hazardous incidents.

Significant incidents identified in relation to Toluene and paper were consolidated into a set of discrete incidents to allow a quantitative model to be developed. These are summarised in Table 3.1, and consist of toluene pool /spray fires and paper fires.

Consequence analyses undertaken for these scenarios are summarised in Section 5.

TABLE 3.1: MAJOR ACCIDENTS

ID	Plant Area / Activity	Plant Items	Risk Event	Causes	Consequence to be Modelled
1.01	Bulk Storage – Storage Vessels	Toluene Storage Vessels	Total catastrophic tank failure and full-surface bund leak.	Vessel mechanical failure. External impact.	Fire contained within bunded area.
			Full-surface bund fire, if ignited.	Tank overfill due to control system failure, human error whilst loading.	
			Full-surface bund fire, if leak not detected early and ignition occurs.	Equipment failure (corrosion, drain failure, flange leak, etc.) and release to bund.	
1.02	Bulk Storage - Pump Area	Pipework/ Pumps	Toluene release leading to pool fire on ignition.	Pump seal leak, flange leak etc.	Pool fire contained within paved area by kerbing
1.03	Bulk Storage – Road Tanker loading / unloading	Loading / unloading hoses	Release of product from loading point, and pool fire if ignited	Hose failure (faulty) / crimped connection failure Could be caused by wear and tear, defect, etc Operator error making connection	Pool fire contained within paved area by kerbing
2.02	VRU – Decanting Tank	Toluene Decanting Tank	Total catastrophic tank failure and full-surface bund leak.	Vessel mechanical failure. External impact.	Fire contained within bunded area.
			Full-surface bund fire, if ignited.	Tank overfill due to control system failure, human error whilst loading.	
			Full-surface bund fire, if leak not detected early and ignition occurs.	Equipment failure (corrosion, drain failure, flange leak, etc.) and release to bund.	
3.01	Bulk Paper Storage	Bulk Roll Paper Store	Fire	Arson, Forklift truck fault, Electrical fault, lightning, unauthorised smoking	Warehouse fire

4. LEVEL OF ASSESSMENT

4.1. SEPP 33 Screening

To determine whether a proposed development is potentially hazardous and hence requires a preliminary hazard analysis (PHA), the risk screening process in the NSW DoP Applying SEPP33 guideline Ref. (17) considers the type and quantity of hazardous materials to be stored on the site and the distance of the storage area to the nearest site boundary, as well as the expected number of transport movements.

However, the DGRs for the proposed facility already include the following requirement:

Hazards and Risk – including a Preliminary Hazard Analysis (PHA) of the project

Therefore, the screening against the requirements of *Applying SEPP3*3 Ref (17) was not undertaken for the facility.

A *SEPP 33* screening for transport activities associated with the proposed facility was undertaken by Stephenson Environmental Management Australia for IPMG to determine whether a route selection study was required. Stephenson concluded that a route selection study was not required. The basis of this determination has been updated as part of this PHA. The conclusion remains that a route selection study was not required as the number of DG truck movements is below the SEPP33 screening threshold for transport.

Table 4.1 provides an assessment of the estimated vehicle movements associated with the plant against thresholds from Table 2 in *Applying SEPP 33* Ref (17). A route selection study is only required if the quantity of DG transported is above the 'Minimum Quantity Threshold' and the number of movements exceed the 'Movements Threshold'. Therefore, as shown in Table 4.1, the screening thresholds are not exceeded, hence a route selection study is not required for any DG class transported to or from the site.

TABLE 4.1: GROUPING GOODS BY CLASS AND LOCATION FOR TRANSPORT

Material (DG Class)	Vehicles/ week[(a)]	Quantity per load (tonnes) [(a)]	Threshold		Route Selection Study Required?
			Movements	Minimum Quantity	
Toluene	2	15			
Ink (50% Toluene)	4	7.5			
Total (Class 3)	*6*	*15 (max)*	*> 45/ week*	*3 tonnes*	*No*
Sulphuric Acid (concentrated) (8)	0.25	1			
Chromic Acid Solution (8)	0.25	1			
Total (Class 8)	*0.5*	*1*	*>30/ week*	*2 tonnes*	*No*
Carbon Dioxide (Class 2.2)	*<0.1[(a)]*	*25 (maximum)*	*Excluded from risk screening under SEPP 33*		
(a) Only replenished when used as fire extinguishing agent.					

4.2. Level of Assessment

Multi Level Risk Assessment Ref (2) sets out three levels of risk assessment that may be appropriate for a PHA, as shown in Table 4.2. This document was consulted to identify the level of assessment required in this study.

TABLE 4.2: LEVEL OF ANALYSIS

Level	Type of Analysis	Appropriate if:
1	Qualitative	No major offsite consequences and societal risk is negligible
2	Partially Quantitative	Offsite consequences but with a low frequency of occurrence
3	Quantitative	Where level 1 and 2 are exceeded

Based on the findings of the HAZID, it would not be credible to state that no events had offsite impact without more detailed consequence analysis. Hence a Level 1 Assessment was not considered suitable.

It was decided to follow a Level 2 Assessment and calculate the consequences of the Major Accidents in more detail and use the impairment criteria set in *HIPAP 6* Ref. (1) as a basis for assessing the potential for offsite impact.

4.3. Consequence Criteria

The consequences of incidents are described in Table 3.1, viz.:

- confined pool fire (toluene)
- spray fire (toluene)
- paper fire

The applicable thermal radiation criteria for fires used in the PHA (consequence analysis) are presented in Table 4.3.

TABLE 4.3: THERMAL RADIATION CRITERIA (PAPER WAREHOUSE AND TOLUENE)

Heat Radiation Level (kW/m^2)	Effect	Critical Criteria
4.7	Will cause pain in 15-20 seconds and injury after 30 seconds exposure.	Injury
12.6	Significant chance of a fatality for extended exposure.	Fatality
23	Likely fatality for extended exposure; chance of fatality for instantaneous exposure Unprotected steel will reach thermal stress temperatures which can cause failures	Escalation potential

4.4. Risk Criteria

4.4.1. Individual Risk of Fatality

The risk guidelines provided in the DoP publication Risk Criteria for Land Use Safety Planning Ref. (3) are outlined below.

The individual risk per annum (IRPA) criteria adopted by NSW Ref. (3) are shown in Table 4.4. The figures quoted represent the peak offsite individual risk, which is an onerous measure as it is based on 24 hour-per-day exposure with no allowance for the protection buildings may offer or for the potential to move away (escape) from a developing incident. This can be interpreted as the risk at an offsite location rather than to a particular individual.

TABLE 4.4: NSW INDIVIDUAL RISK CRITERIA

Risk Levels (per annum)	Type (see Table 2.1)	Limit of Exposure at the Following Locations
0.5×10^{-6}	Sensitive	Hospitals, child-care facilities and old age housing developments.
1×10^{-6}	Residential	Residential developments and places of continuous occupancy such as hotels and tourist resorts.
5×10^{-6}	Commercial	Commercial developments, including offices, retail centres, warehouses with showrooms, restaurants and entertainment centres.
10×10^{-6}	Active Open Space	Sporting complexes and active open space areas.
50×10^{-6}	Industrial	Facility. Site boundary

4.4.2. Societal Risk of Fatality

The Department of Planning, Ref. (3), suggests that judgements on societal risk be made on the basis of a qualitative approach rather than on specifically set numerical criteria.

Despite the lack of formal societal risk tolerability criteria in NSW, societal risk estimation is warranted only where significant and potentially vulnerable populations exist beyond the boundary of the proposed development. This does not apply for the Warwick Park site.

4.4.3. Risk of Injury

In addition to the fatality risk levels described above, the NSW guidelines on land use Ref. (3) also set out criteria for injury risk levels. This is in recognition of the fact that society is concerned with the risk of injury as well as death and that certain members of the community are more vulnerable. The injury risk criteria are discussed in more detail in the following paragraphs.

DoP proposes that a heat radiation level of 4.7 kWm^{-2} be considered high enough to lead to injury in people who cannot escape or seek shelter. This level of heat radiation will cause injury after 30 seconds. A risk of injury criteria of $50x10^{-6}$ p.a. is suggested for fire events. Within the guidelines, this is stated as:

- Incident heat flux at residential areas should not exceed 4.7 kW/m^2 at frequencies of more than 50 chances in a million years.

DoP also proposes criteria for the risk of injury from explosion overpressure and toxic gas dispersion. These have not been reproduced here as the HAZID did not identify explosion or toxic release events with potential offsite impacts.

4.4.4. Risk of Accident Propagation

The DoP publication on land use planning Ref. (3) presents criteria covering accident propagation. The guidelines are aimed at ensuring the likelihood of an accident at one plant triggering an accident at another neighbouring plant is low and that adequate safety separation distances exist. The criterion for accident propagation is:

- Incident heat flux radiation at neighbouring potentially hazardous installations or at land zoned to accommodate such installations should not exceed a risk of 50 in a million per year for the 23 kWm^{-2} heat flux level (23 kWm^{-2} is considered the level at which unprotected steel may start to fail).

DoP also proposes criteria for the risk of escalation from explosion overpressure. These have not been reproduced here as the HAZID did not identify explosion events with potential offsite impacts.

4.4.5. Risk to the Biophysical Environment

The risk tolerability criteria suggested by the Department of Planning Ref. (3) for sensitive environmental areas relate to the potential effects of an accidental emission on the long-term viability of the ecosystem or any species within it. Reference (3) expresses these criteria as follows:

- Industrial developments should not be sited in proximity to sensitive natural environmental areas where the effects of the more likely accident emissions may threaten the long-term viability of the ecosystem or any species within it.
- Industrial developments should not be sited in proximity to sensitive natural environmental areas where the likelihood of impacts that may threaten the long-term viability of the ecosystem, or any species within it, is not substantially lower than the background level of threat to the ecosystem.

Risk to the biophysical environment is discussed in detail in the Environmental Assessment Report, although it should be noted that the HAZID carried out for this PHA did not identify any accident events with potential for serious environmental impacts.

5. CONSEQUENCE ANALYSIS

5.1. Overview

The consequence analyses were undertaken for the events identified in Table 3.1. The Toluene fires are discussed in Section 5.2, and the warehouse fire is discussed in Section 5.3.

5.2. Toluene Consequence Analysis

The toluene fire modelling was carried out using the proprietary consequence modelling package Shell FRED v5, Ref (18). The following assumptions are made for the fire modelling:

- a wind speed of $5ms^{-1}$ is used as it is the annual average day time (3pm) wind speed at Bankstown Airport Weather Station Ref (19).
- the wind direction is taken to be blowing from the fire to the closest site boundary
- the pool fires were limited by the bund area, as a maximum credible fire size
- no account was taken for thermal radiation mitigation from the room walls, or the proposed concrete boundary wall[2].

The modelling input parameters for toluene releases are summarised in Table 5.1, and the findings are reported in Table 5.2 for critical heat radiation levels discussed in Section 4.3.

Table 5.3 gives a summary of the impact of the toluene fires on the adjacent industrial land uses and Table 5.4 gives a summary of the impact of the toluene fires on the sensitive land uses identified in Table 2.1, i.e. the schools and the hospital.

TABLE 5.1: INPUT PARAMETERS – TOLUENE FIRES

ID	Plant Area / Activity	Substance	Fire Source Area (m^2)	Model	Wind Speed
1.01.PF	Bulk Storage – Storage Vessels	Toluene	217	Pool Fire	$5ms^{-1}$
1.02.PF	Bulk Storage - Pump Area	Toluene	85	Pool Fire	$5ms^{-1}$
1.02.SF	Bulk Storage - Pump Area	Toluene	(a)	Spray Fire	$5ms^{-1}$
1.03.PF	Bulk Storage – Road Tanker loading / unloading	Toluene	108	Pool Fire	$5ms^{-1}$
2.02.PF	VRU – Decanting Tank	Toluene	18	Pool Fire	$5ms^{-1}$
(a) Seal leak, based on a 10mm diameter hole and 5 bar(g)					

[2] This is conservative and considered appropriate at the PHA stage. Once design is more advanced, this can be included in the FHA.

TABLE 5.2: CONSEQUENCE RESULTS (TOLUENE)

ID	Plant Area / Activity	Distance (m) to Closest Plant Boundary from Fire Centre	Downwind Distance to Critical Thermal Radiation from Fire Centre		
			4.7 kWm^{-2}	12.6 kWm^{-2}	23 kWm^{-2}
1.01.PF	Bulk Storage – Storage Vessels	30	42	32	29
1.02.PF	Bulk Storage - Pump Area	20	33	25	23
1.02.SF	Bulk Storage - Pump Area	20[(a)]	7[(a)]	-	-
1.03.PF	Bulk Storage – Road Tanker loading / unloading	20	35	27	24
2.02.PF	VRU – Decanting Tank	23	21	16	15
(a) Downwind distance from source release point.					

TABLE 5.3: OFFSITE IMPACT OF TOLUENE FIRES – INDUSTRIAL LAND USE

ID	Plant Area / Activity	Offsite Impact?		
		4.7 kWm^{-2}	12.6 kWm^{-2}	23 kWm^{-2}
1.01.PF	Bulk Storage – Storage Vessels	Yes	Yes	No
1.02.PF	Bulk Storage - Pump Area	Yes	Yes	Yes
1.02.SF	Bulk Storage - Pump Area	No	No	No
1.03.PF	Bulk Storage – Road Tanker loading / unloading	Yes	Yes	Yes
2.02.PF	VRU – Decanting Tank	No	No	No

TABLE 5.4: OFFSITE IMPACT OF TOLUENE FIRES – SENSITIVE, RESIDENTIAL, ACTIVE OPEN SPACE LAND USES

ID	Plant Area / Activity	Offsite Impact?		
		4.7 kWm^{-2}	12.6 kWm^{-2}	23 kWm^{-2}
1.01.PF	Bulk Storage – Storage Vessels	No	No	No
1.02.PF	Bulk Storage - Pump Area	No	No	No
1.02.SF	Bulk Storage - Pump Area	No	No	No
1.03.PF	Bulk Storage – Road Tanker loading / unloading	No	No	No
2.02.PF	VRU – Decanting Tank	No	No	No

It was determined that the toluene spray fire as a result of pump seal leak is a credible scenario (1.02 SF), however, as the pool fire from the same location leads to a worse consequence, in terms of distance to critical thermal radiation, the pool fire scenario was used for comparison against the consequence criteria.

For the pool fires, all events apart from those from the decanting tank may lead to some offsite impact (to industrial land uses). They were therefore carried forward to frequency and risk analysis. No events were found that could impact sensitive, residential or active open space land uses.

The distances, for each scenario, to critical thermal radiation levels shown in Table 5.2 are presented in Figure 5.1, Figure 5.2, Figure 5.3 and Figure 5.4, overlaid on the existing aerial view.

The consequence analysis found that a toluene pool/bund fire may have the potential for offsite impact to the small industrial units situated on the eastern boundary near to Scrivener Street. However, with the proposed installation of a 2-metre high precast concrete wall, the offsite impact to the small industrial units on the eastern boundary of the proposed site will be significantly reduced.