7.0 Environmental impact assessment

7.1 Issue identification

A preliminary assessment of environmental (PEA) issues associated with the project was undertaken to determine which issues were likely to be of significance in respect to the proposed facility. In accordance with the purpose and the objectives of Part 3A of the EP&A Act, this section provides detailed assessment of the key environmental considerations with respect to environmental impact assessment.

In addition, on 19 May 2008 a Planning Focus meeting was held in Port Kembla, Wollongong with relevant stakeholders which resulted in discussion and the subsequent issuing of the DGRs for the purpose of this Environmental Assessment. The key issues identified in the PEA and the DGRs included:

- air quality
- energy and sustainability
- hazards and risks
- traffic and transport
- ecological and water quality impacts
- noise emissions
- waste management
- heritage
- economic and social
- visual
- soils
- water.

The identified impacts will be addressed in the order provided for above. The issues of key environmental significance will be addressed followed by an assessment of the matters which are considered to be of moderate significance with respect to environmental impact.

7.2 Air quality

7.2.1 Introduction

This section of the report assesses the potential impacts on air quality of the proposed SPBP facility. The potential for air quality impacts is affected by many factors, including weather conditions, topography, existing air quality and local and regional land uses. The purpose of this study is to assess the potential for air quality impacts from the proposal.

7.2.2 Relevant Legislation and Guidelines

There are various regional, State, and National regulations and initiatives regarding air quality. A brief summary of key information is given below.

Protection of the Environment Operations Act

The *Protection of the Environment (POEO) Act 1997* commenced operation on 1 July 1999, repealing the following Acts:

- *Clean Air Act 1961*
- *Clean Waters Act 1970*
- *Environmental Offences and Penalties Act 1989*
- *Noise Control Act 1975*
- *Pollution Control Act 1970.*

The POEO Act enables the NSW Government to detail protection of the environment policies (PEPs), which set environmental standards, goals and guidelines. It provides a single licensing arrangement to replace the different licences and approvals that were required under the separate Acts listed above. Integration of Environment Protection Authority (EPA) licensing with development approval procedures provides for public participation in the environmental assessment of activities that may be licensed by the EPA[69].

The *Protection of the Environment (Clean Air) Regulation 2002* provides the regulatory framework for licensing and specifies maximum (100th percentile) concentration limits for air pollutants. In 2005, amendments to the Regulation were finalised, allowing for review of the adequacy of older emissions standards that apply to existing industry, and introducing new emission standards for future industry and equipment. In 1999, load-based licensing was introduced, which links licence fees to the amount of pollution discharged, thus providing a financial incentive to achieve discharges below the required minimum performance[70].

Approved methods for the modelling and assessment of air pollutants

The NSW Department of Environment and Climate Change (DECC) has specified methods for modelling and assessment of air pollutants from stationary sources[71]. This document provides details on the air quality assessment methods and pollutant criteria. The relevant pollutant criteria have been reproduced within **Table 18** for ease of reference.

Table 18 DEC air quality assessment criteria

Pollutant	Averaging period	Concentration		Source
Carbon monoxide (CO)	15 minutes	87 ppm	100 mg/m^3	WHO (2000)
	1 hour	25 ppm	30 mg/m^3	WHO (2000)
	8 hours	9 ppm	10 mg/m^3	NEPC (1998)
Sulphur dioxide (SO_2)	10 minutes	25 pphm	712 µg/m^3	NHMRC (1996)
	1 hour	20 pphm	570 µg/m^3	NEPC (1998)
	24 hours	8 pphm	228 µg/m^3	NEPC (1998)
	Annual	2 pphm	60 µg/m^3	NEPC (1998)
Nitrogen dioxide (NO_2)	1 hour	12 pphm	246 µg/m^3	NEPC (1998)
	Annual	3 pphm	62 µg/m^3	NEPC (1998)
Photochemical oxidants (as ozone)	1 hour	10 pphm	214 µg/m^3	NEPC (1998)
	4 hours	8 pphm	171 µg/m^3	NEPC (1998)
PM_{10}	24 hours	–	50 µg/m^3	NEPC (1998)

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[69] NSW Department of Environment and Climate Change (DECC), www.environment.nsw.gov.au, November 2007.

[70] NSW DECC, www.environment.nsw.gov.au, August 2008.

[71] NSW DEC, *“Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales”,* 2005

Pollutant	Averaging period	Concentration		Source
	Annual	–	30 µg/m^3	EPA (1998)
Total suspended particulates (TSP)	Annual	–	90 µg/m^3	NHMRC (1996)
Deposited dust[a]	Annual	2 g/m^2/month[b]	4 g/m^2/month[c]	NERDDC (1988)
n-hexane[d]	1 hour	0.9 ppm	3.2 mg/m^3	Victorian Government Gazette (2001)
Methanol[d]	1 hour	2.4 ppm	3.0 mg/m^3	Victorian Government Gazette (2001)

Source: NSW DEC, (2005), “Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales”

Notes:
a - Dust is assessed as insoluble solids as defined by AS 3580.10.1–1991 (AM-19)
b - Maximum increase in deposited dust level
c - Maximum total deposited dust level
d - Gas volumes are expressed at 25°C and at an absolute pressure of 1 atmosphere (101.325 kPa)

National Environment Protection Measure for ambient air quality

National Environment Protection Measures (NEPMs) outline agreed national objectives for protecting or managing various aspects of the environment. The NEPM for Ambient Air Quality (AAQ NEPM) outlines the national objectives for air quality. Compliance monitoring is reported annually by each jurisdiction.

The NSW DECC 2006 air quality compliance report discusses the compliance or otherwise of air quality in NSW against the AAQ NEPM standards. As previously mentioned, meeting the AAQ NEPM goals for ozone and fine particles will continue to be a challenge for the major urban areas of NSW, given the pressures from a growing population, urban expansion and associated increase in motor vehicle use[72]. Various air quality strategies and regulations are in place, including ‘*Action for Air*[73] and licences limiting industrial emissions. These measures, together with stricter motor vehicle emission standards, tighter fuel regulations, and NSW Diesel NEPM programs will help move NSW towards meeting the NEPM goal for ozone in the longer term.

7.2.3 Existing environment

Background meteorological conditions

Meteorological conditions and topography are important in the transmissions of atmospheric emissions. Of the meteorological parameters stability class, wind speed, and direction are among the most important. A basic review of predominant conditions can provide an indication of likely emissions behaviour.

A meteorological dataset was procured from the NSW EPA. The data set was recorded at the Kembla Grange monitoring station approximately 8 km from the site of the proposed facility and included all five parameters that are essential for calculating a boundary layer scaling set. These are:

- wind speed
- wind direction
- wind direction standard deviation
- temperature
- solar radiation.

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[72] NSW DECC, “AAQ NEPM Annual Compliance Report 2006”, 2007.

[73] NSW DECC, *‘Action for Air’*, 2006

The data was recorded continuously for the period from 1 January 2006 to 31 December 2006. This data set was the most recent data range that has been subjected to the internal quality assurance procedure of the NSW EPA. Accordingly, it was used in this analysis to ensure integrity of the meteorological data (as opposed to using more recent data that has not yet been subjected to the internal quality procedures of the NSW EPA).

Wind speed

High winds tend to disperse the airborne material more effectively than low winds which, can result in minimal mixing and dispersion. Therefore, low winds are likely to result in greater impacts downwind of the source. Turbulence can also increase dispersion and dilute airborne material within the atmosphere. However, low turbulence which is often combined with a stable atmosphere (increasing atmospheric temperature with height above the ground) also reduces the potential for mixing and dispersion. These periods tend to occur during the night and early morning periods particularly during clear still nights.

Based upon the data obtained from the NSW DECC, C&M Consulting Engineers have developed wind roses to graphically illustrate the annual frequencies of wind speed and direction. **Figure 40** below shows the frequency of winds as a function of wind direction as measured at the Kembla Grange monitoring station. **Figure 41** gives the mean wind speeds as a function of wind direction.

Figure 40 Wind frequencies distribution

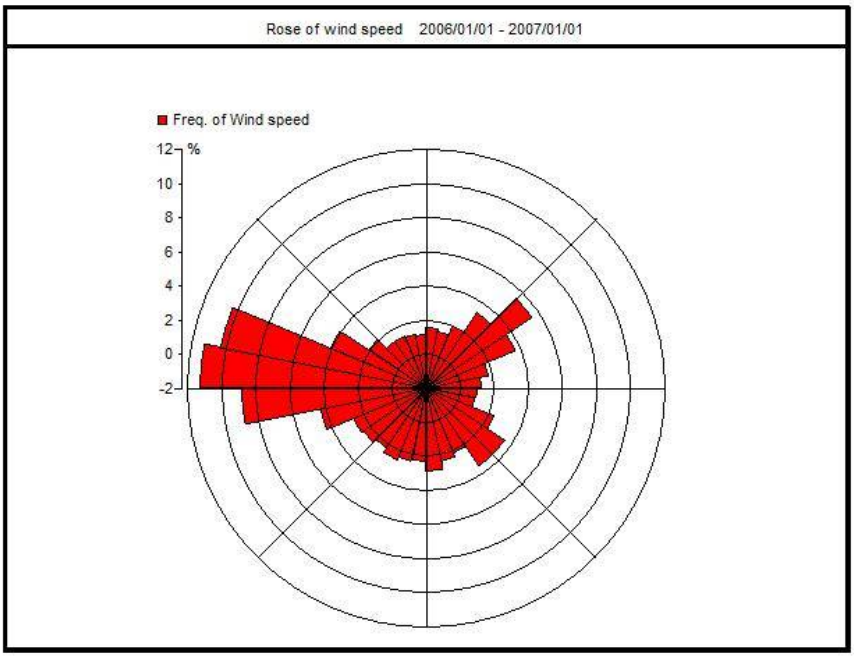
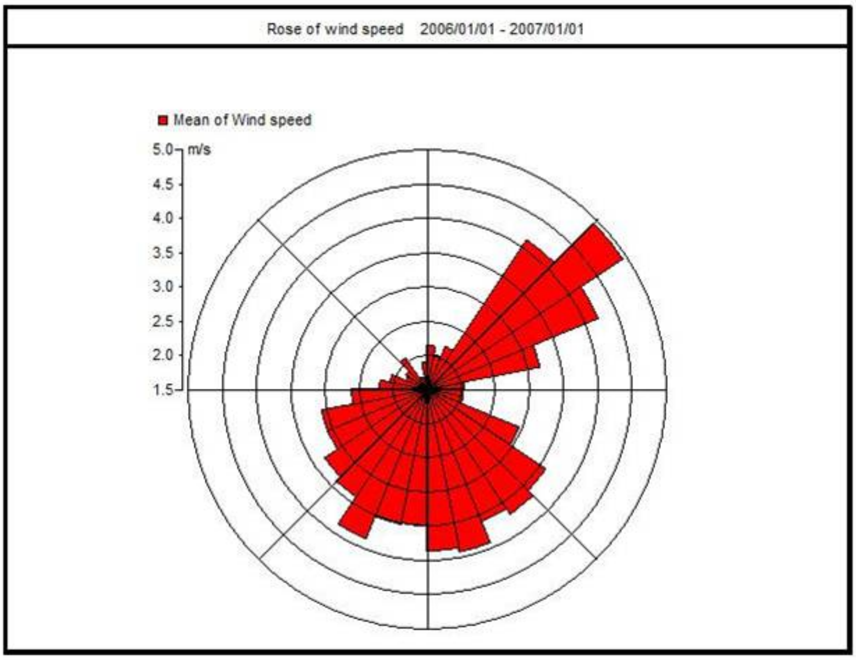


Figure 41 Mean wind speed distribution



From these two figures it can be seen that the predominant wind direction is westerly (approximately 30% in total), but that the general wind speeds a relatively low (less than 3 m/s).

Air quality

Local air quality is influenced by many factors, including meteorological conditions and topography. As previously stated, the Illawarra region is bounded by a steep escarpment to the west and the ocean to the east, both of which influence the air quality of the region.

Background air pollutants concentrations are presented in **Table 19**. Results have been extracted from the NSW DECC Wollongong air quality monitoring site, located north of the site in the main population / commercial centre. Data is also reported for the performance station at Albion Park, located southwest of the site (**Table 20**), Warrawong, immediately southwest of the site (**Table 21**, and Kembla Grange, west of the site (**Table 22**).

Table 19 Wollongong air quality monitoring results

Pollutant	Year										NEPM Standard
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
CO (ppm)	3.5	2.2	2.4	2.4	4.2	2.3	2.1	2.1	2.6	1.5	*9.0 ppm (rolling 8-hour average)*
NO_2 (ppm)	0.064	0.058	0.062	0.065	0.056	0.056	0.049	0.044	0.058	0.050	*0.12 ppm (1-hour average)*
NO_2 (ppm)	0.011	0.010	0.011	0.010	0.010	0.011	0.010	0.009	0.009	0.009	*0.03 ppm (annual average)*
O_3 (ppm)	**0.120**	**0.105**	0.087	**0.108**	**0.116**	**0.121**	0.097	**0.103**	**0.102**	0.096	*0.10 ppm (1-hour average)*

Pollutant	Year										NEPM Standard
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
O_3 (ppm)	**0.113**	**0.082**	0.073	**0.086**	**0.091**	**0.099**	**0.080**	**0.090**	**0.099**	**0.086**	*0.08ppm (rolling 4-hour average)*
SO_2 (ppm)	0.043	0.033	0.041	0.031	0.030	0.039	0.031	0.053	0.038	0.035	*0.20 ppm (1-hour average)*
SO_2 (ppm)	0.011	0.009	0.006	0.007	0.007	0.008	0.006	0.015	0.006	0.007	*0.08 ppm (24-hour average)*
PM_{10} ($\mu g/m^3$)	**64.8**	**56.9**	40.2	**58.1**	**68.2**	**76.7**	**280.5**	48.1	**54.8**	**62.0**	*50 $\mu g/m^3$ (24-hour average)*

Source: NSW DECC, (2007), “AAQ NEPM Annual Compliance Report 2006”

Note: Bold font indicates years when NEPM Standard (100th percentile) was exceeded

Table 20 Albion Park / Albion Park South air quality monitoring results

Pollutant	Year										NEPM Standard
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
NO_2 (ppm)	0.044	0.081	0.049	0.055	0.051	0.048	0.048	0.044	0.035	0.051	*0.12 ppm (1-hour average)*
NO_2 (ppm)	0.004	0.004	0.004	0.005	0.004	0.004	0.005	0.004	0.004	0.005	*0.03 ppm (annual average)*
O_3 (ppm)	**0.144**	**0.140**	0.090	**0.106**	0.088	0.094	**0.130**	**0.112**	0.067	0.096	*0.10 ppm (1-hour average)*
O_3 (ppm)	**0.124**	**0.116**	**0.081**	**0.083**	**0.082**	**0.083**	**0.111**	**0.092**	0.063	0.078	*0.08ppm (rolling 4-hour average)*
SO_2 (ppm)	0.034	0.055	0.033	0.042	0.034	0.029	0.035	0.034	0.032	0.038	*0.20 ppm (1-hour average)*
SO_2 (ppm)	0.011	0.014	0.009	0.014	0.013	0.009	0.009	0.009	0.011	0.010	*0.08 ppm (24-hour average)*
PM_{10} ($\mu g/m^3$)	**61.6**	**63.6**	48.7	**62.5**	**58.7**	**88.3**	**281.0**	**51.5**	41.8	**60.1**	*50 $\mu g/m^3$ (24-hour average)*

Source: NSW DECC, (2007), “AAQ NEPM Annual Compliance Report 2006”

Notes: Bold font indicates years when NEPM Standard (100th percentile) was exceeded Albion Park monitoring station was closed in January 2005. Albion Park South monitoring station became fully operational in the first quarter of 2006.

Table 21 Warrawong air quality monitoring results

Pollutant	Year										NEPM Standard
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
SO_2 (ppm)		0.058	0.051	0.110	0.162	0.046	0.063	0.088	0.070	0.022	*0.20 ppm (1-hour average)*
SO_2 (ppm)		0.010	0.009	0.010	0.013	0.009	0.012	0.012	0.009	0.007	*0.08 ppm (24-hour average)*

Source: NSW DECC, (2007), "AAQ NEPM Annual Compliance Report 2006"

Note: There were no years identified at the Warrawong receiver station when NEPM Standard (100th percentile) was exceeded

Table 22 Kembla Grange air quality monitoring results

Pollutant	Year										NEPM Standard
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
O_3 (ppm)	**0.124**	**0.137**	**0.101**	**0.117**	**0.119**	0.099	**0.113**	**0.120**	0.091	0.093	*0.10 ppm (1-hour average)*
O_3 (ppm)	**0.099**	**0.117**	**0.081**	**0.089**	**0.092**	**0.083**	**0.107**	**0.100**	**0.084**	**0.081**	*0.08ppm (rolling 4-hour average)*
PM_{10} ($\mu g/m^3$)								**57.6**	**59.0**	**84.3**	*50 $\mu g/m^3$ (24-hour average)*

Source: NSW DECC, (2007), "AAQ NEPM Annual Compliance Report 2006"

Note: Bold font indicates years when NEPM Standard (100th percentile) was exceeded

The data in **Table 19 – Table 22** indicate that the Illawarra achieved compliance with the AAQ NEPM goals for carbon monoxide, nitrogen dioxide and sulphur dioxide, as levels of these pollutants are consistently below AAQ NEPM standards at all monitoring stations. Compliance with AAQ NEPM goals for fine particles and ozone was not demonstrated[74].

The DECC advised that *"continued severe drought conditions experienced across SE Australia during 2006 have contributed to elevated fine particle levels. Even discounting bushfire and dust storm events, meeting the goal of the Ambient Air Quality NEPM for particles, measured as PM_{10}, presents a challenge for NSW"*[75].

"Ozone in the Illawarra region can occur as a result of photochemical smog produced from local emissions or from smog or precursors transported down the coast from the Sydney region. It appears that most ozone events in the Illawarra occur as a result of the combined effect of these two factors. The sea breeze, generally north-easterly in direction, is the dominant meteorological influence on elevated concentrations of ozone in the region"[76].

"Emissions of NO_x may reduce ozone concentrations on a local scale close to the source by titration. However, at some distance downwind this NO_x can produce more ozone. On many event days this potential is realised by the time the plume arrives at the Albion Park station. Episodes can occur throughout the year, with those in the warmer months generally associated with photochemical smog production and those in the cooler months related to more localised poor dispersion conditions. Both

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[74] NSW DECC, *"AAQ NEPM Annual Compliance Report 2006"*, 2007

[75] NSW DECC, *AAQ NEPM Annual Compliance Report 2006,* 2007

[76] NSW DECC: www.environment.nsw.gov.au, August 2008

local NO_x sources and transport down the coast from Sydney can contribute to nitrogen dioxide in the Illawarra"[77].

The NSW DECC also uses the Regional Pollution Index (RPI) to indicate air pollution levels. The index is based on the findings of the *1998 Metropolitan Air Quality Study*[78] and is reported quarterly using monitoring undertaken by the DECC. Regional air quality is influenced by a range of drivers such as the region's current population, number of vehicles, growth rate in population and/or vehicles, industrial emissions and other point sources, density of population, usage rate of public transport and natural events. The RPI is issued twice daily, with the morning report covering the period from 3pm the previous afternoon to 6am that morning, and the afternoon report for the period 6am to 3pm that day. **Table 23** shows the RPI during 2005 – 2006 and 2006 – 2007 for the Illawarra.

Table 23 Illawarra air quality – regional pollution index summary (number of days)

	Wollongong (AM)		Wollongong (PM)		Albion Park (AM)		Albion Park (PM)	
	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
High	0	2	0	2	0	0	0	2
Medium	32	38	29	35	9	29	6	26
Low	328	321	328	324	130	323	137	328

Source: Wollongong City Council, 2006-07 State of the Environment (SoE) Report, Chapter 6 – Air (mirrir)

Table 23 shows that there were 2 days of high pollution in Wollongong during the 2006 – 2007 reporting period and 2 afternoons of high pollution in Albion Park (which has increased from zero days in 2005 – 2006, and from 1 day in 2004 – 2005).

Table 24 indicates that there was a moderate increase in the number of vehicles registered in Wollongong LGA over the same period. The population of the Wollongong LGA has also continued to increase. Between 2001 and 2006, the population increased from 181,614 to 184,213, a growth of 2.1% over 5 years. This was slightly below the NSW average of 2.8% growth over 5 years[79].

Table 24 Vehicles registered in Wollongong LGA (all vehicle types)

	2004 – 2005	2005 – 2006	2006 – 2007
Wollongong	128,656	131,240	134,126

Source: Roads and Traffic Authority: www.rta.nsw.gov.au, August 2008

During the 2006 – 2007 period, 93 air pollution complaints were received by Wollongong City Council, which is an increase from 84 complaints in the previous reporting period. As shown in **Figure 42**, this increase was in complaints regarding industrial sources, commercial odours, and backyard burning.

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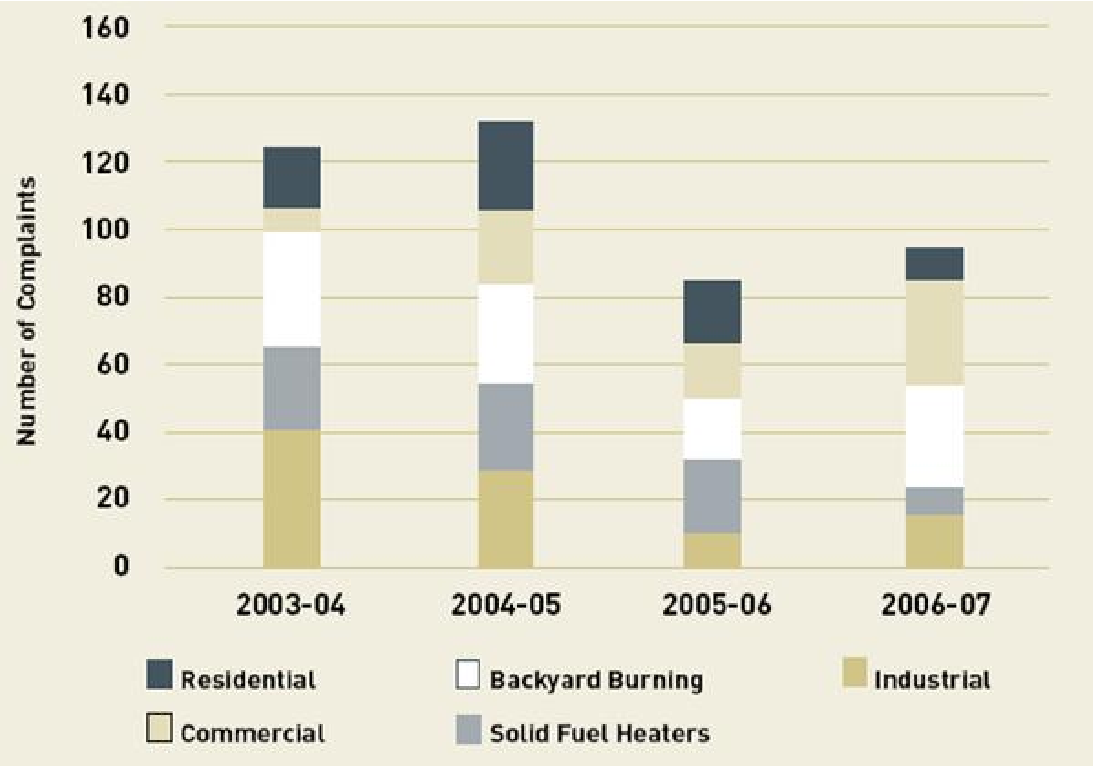
[77] NSW DECC: www.environment.nsw.gov.au, August 2008

[78] NSW DECC, Metropolitan Air Quality Study, 1998

[79] Wollongong City Council, "2006-07 State of the Environment Report", p22.

Figure 42 Air pollution complaints received by Wollongong City Council



Source: Wollongong City Council, 2006-07 State of the Environment (SoE) Report, Chapter 6 – Air (mirrir)

Existing potential sources of air pollutants

The main sources of air pollutants in the Illawarra are from motor vehicles, industry and domestic activities. These emissions result in ozone, photochemical smog and brown haze. Wollongong City Council also advises that "the growth of industrial development, the increase in motor vehicle use and the cumulative impacts of Sydney's urban sprawl on the Wollongong LGA have raised local community awareness of air quality issues"[80]. There are currently 26 premises that are licensed by the DECC in regard to their potential impact on air quality within the Wollongong LGA[81].

The National Pollution Inventory (NPI) provides information on pollutant emissions from various industrial facility sources, as well as from diffuse sources such as transportation and households. During the 2006 – 2006 period, 23 industrial facilities in the Wollongong LGA reported to the NPI. Diffuse data was collected for 41 sources. The largest volume of emissions reported in the Wollongong LGA was of carbon monoxide, followed by oxides of nitrogen, and sulphur dioxide. These pollutants and their sources are shown in **Table 25**.

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[80] Wollongong City Council, "2006-07 State of the Environment Report", p63.

[81] Wollongong City Council, "2006-07 State of the Environment Report", p65.

Table 25 **Pollutant emissions and sources in the Wollongong LGA**

Pollutant	Emissions (kg/yr) 2005 – 2006	Emissions (kg/yr) 2006 – 2007	Emissions Source (2006 – 2007)	Source Contribution to Total Emissions
CO	550,000,000	560,000,000	Basic ferrous metal manufacturing	95 %
			Motor vehicles	4 %
NOx	11,000,000	12,000,000	Basic ferrous metal manufacturing	65 %
			Motor vehicles	31 %
PM_{10}	1,500,000	1,700,000	Basic ferrous metal manufacturing	71 %
			Solid fuel burning (domestic)	15 %
			Motor vehicles	8 %
SO_2	10,000,000	11,000,000	Basic ferrous metal manufacturing	91 %
			Petroleum and coal product manufacturing	4 %
Total VOCs	6,300,000	6,300,000	Motor vehicles	38 %
			Domestic or commercial solvents / aerosols	15 %
			Architectural surface coatings	10 %
			Basic ferrous metal manufacturing	9 %
			Solid fuel burning (domestic)	8 %
n-hexane	49,000	49,000	Motor vehicles	67 %
			Domestic or commercial solvents / aerosols	15 %
			Lawn mowing	6 %
Methanol	76,000	77,000	Domestic or commercial solvents / aerosols	77 %
			Basic ferrous metal manufacturing)	17 %
			Motor vehicles	5 %

Source: National Pollutant Inventory: www.npi.gov.au, August 2008

As shown in **Table 25**, the ferrous metal manufacturing industry was the leading source of most emissions, with motor vehicles, domestic solid fuel burning, and other industrial and commercial sources also contributing to emissions.

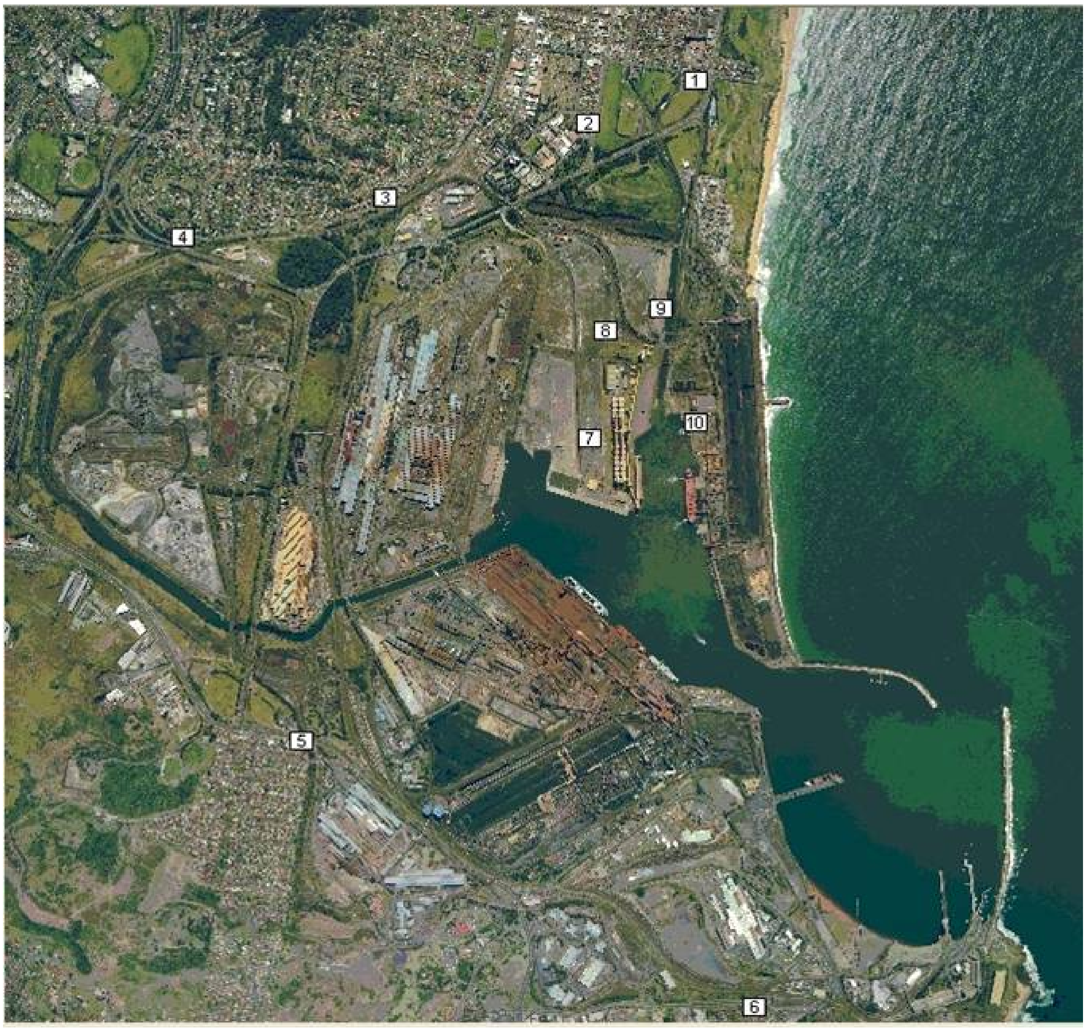
7.2.4 Methodology

As seen in **Figure 43**, the site for the proposed SPBP facility is surrounded by industrial uses including:

- BlueScope Steel (Port Kembla Steelworks, CRM Service Centre, and Illawarra Coated Products)
- Other fabricated metal product manufacturing, metal coating and finishing facilities
- BOC Gases industrial gas/chemical manufacturing facility
- Orica sulphuric acid recovery and chemical manufacturing plant
- Cement product manufacturing facilities
- Alinta Network Services gas supply
- Sydney Water Corporation's Wollongong Sewage Treatment Plant.

Residential areas lie to the north, west and south of the industrial area. The nearest residential area is that of Coniston, approximately 1.2 km north of the site.

Figure 43 Site and locality



Source: Port Kembla Port Corporation, cited in C & M Consulting Engineers report (2008)

7.2.5 Impact assessment

Point sources

The point source emissions from the proposed SPBP facility are listed below:

- hexane emissions from the soybean-oil extraction plant
- methane emissions from the biodiesel plant
- oxides of nitrogen emissions from gas-fired boilers.

Emissions properties are provided in **Table 26**.

Table 26 Emissions from proposed SPBP facility

Pollutant	Emission rate, g/s	Concentration mg/Am^3	Corrected emissions, mg/Nm^3 at 3% O_2	Regulation emissions, mg/Nm^3 at 3% O_2
Extraction plant				
Hexane	2.2	63.1	(*)	na
Biodiesel plant				
Methanol	0.002	178	(*)	na
Boilers (per boiler)				
NO_2	1.36	202(**)	350	350

Source: C & M Consulting Engineers, (2008), "Dispersion Modelling Study for National Biodiesel (Pty) Ltd Australia, Report No. 204/08"

Notes: (*): Flue gas stream is air with oxygen content of 21%. Conversion calculation not possible.

(**): The maximum allowable NO_2 emission limit of 350 mg/Nm^3 at 3% O_2, as determined by the POEO (Clean Air) Regulation 2002, was assumed to present a worst-case scenario. The value of 202 mg/Am^3 represents a conversion to actual stack temperature conditions.

na: not available

Dispersion modelling for pollutants of potential concern has been undertaken by C & M Consulting Engineers using EnviMan, a GIS-based emissions management software suite produced by Opsis in Sweden.

Estimated air pollutant concentrations at 10 receiver locations are provided in **Table 27**, **Table 28**, and **Table 29** below. These receiver locations are identified as marked on **Figure 43** previously. Locations 1 – 6 are residential areas, while locations 7 – 10 are neighbouring port users. The tables show the annual average concentration and the maximum hourly concentration of the pollutants of potential concern as identified during modelling work undertaken by C & M Consulting Engineers.

Table 27 Estimated concentrations of hexane

Receptor	Annual average concentration (mg/m^3)	Maximum hourly concentration (mg/m^3)	95 percentile concentration (mg/m^3)
1 (Coniston)	0.9 x 10-4	1.2 x 10-2	0.5 x 10-3
2 (Coniston)	1.1 x 10-4	3.6 x 10-2	0.4 x 10-3
3 (Coniston)	0.6 x 10-4	0.7 x 10-2	0.3 x 10-3
4 (Mt St Thomas)	0.3 x 10-4	0.4 x 10-2	0.1 x 10-3
5 (Cringila)	0.8 x 10-4	1.8 x 10-2	0.2 x 10-3
6 (Pt Kembla)	1.0 x 10-4	1.8 x 10-2	0.1 x 10-3

Receptor	Annual average concentration (mg/m^3)	Maximum hourly concentration (mg/m^3)	95 percentile concentration (mg/m^3)
7 (Site SW)	8.0 x 10-4	1.9 x 10-2	4.2 x 10-3
8 (Site N)	5.3 x 10-4	5.0 x 10-2	2.5 x 10-3
9 (Site NE)	5.4 x 10-4	3.4 x 10-2	3.3 x 10-3
10 (Site E)	45 x 10-4	3.7 x 10-2	19 x 10-3

Source: C & M Consulting Engineers, (2008), “Dispersion Modelling Study for National Biodiesel (Pty) Ltd Australia, Report No. 204/08”

Table 28 Estimated concentrations of methanol

Receptor	Annual average concentration (mg/m^3)	Maximum hourly concentration (mg/m^3)	95 percentile concentration (mg/m^3)
1 (Coniston)	2.2 x 10-7	3.1 x 10-5	0.6 x 10-6
2 (Coniston)	2.5 x 10-7	3.2 x 10-5	0.7 x 10-6
3 (Coniston)	2.3 x 10-7	2.9 x 10-5	0.4 x 10-6
4 (Mt St Thomas)	1.5 x 10-7	2.0 x 10-5	0.05 x 10-6
5 (Cringila)	2.1 x 10-7	1.8 x 10-5	0.3 x 10-6
6 (Pt Kembla)	1.4 x 10-7	1.3 x 10-5	0.01 x 10-6
7 (Site SW)	7.0 x 10-7	2.8 x 10-5	2.9 x 10-6
8 (Site N)	32 x 10-7	13 x 10-5	17.7 x 10-6
9 (Site NE)	20 x 10-7	2.6 x 10-5	6.9 x 10-6
10 (Site E)	2.8 x 10-7	4.3 x 10-5	15.7 x 10-6

Source: C & M Consulting Engineers, (2008), “Dispersion Modelling Study for National Biodiesel (Pty) Ltd Australia, Report No. 204/08”

Table 29 Estimated concentrations of nitrogen oxides (as NO_2)

Receptor	Annual average concentration (µg/m^3)	Maximum hourly concentration (µg/m^3)	95 percentile concentration (µg/m^3)
1 (Coniston)	0.14	4.2	0.85
2 (Coniston)	0.17	2.9	0.83
3 (Coniston)	0.12	18.9	0.58
4 (Mt St Thomas)	0.06	11.0	0.21
5 (Cringila)	0.09	10.1	0.29
6 (Pt Kembla)	0.05	2.5	0.17
7 (Site SW)	0.71	13.9	3.24
8 (Site N)	5.0	147	23.3
9 (Site NE)	3.0	22.7	12.8
10 (Site E)	7.4	85.2	33.1

Source: C & M Consulting Engineers, (2008), “Dispersion Modelling Study for National Biodiesel (Pty) Ltd Australia, Report No. 204/08”

As shown in the tables above, pollutant level contributions for hexane and methanol are predicted to be at minimum an order of magnitude below the criteria at each of the receptor locations. As such the potential air quality impacts from hexane and methanol are not expected to be significant.

When comparing the NO_x predictions with the existing background readings obtained from the NSW DECC, one receptor (8) was found to have a marginal potential exceedance. In reality, this potential exceedance is considered unlikely to occur and has been caused by the use of conservative input data. It should also be noted this receptor is in very close proximity to the modeled sources and no residential receptors are nearby. Further detail regarding this issue is provided in the detailed dispersion modeling report attached.

Fugitive emissions

As soybean will be stored and handled via the existing GrainCorp silos at Port Kembla, there is potential for emissions of dust from the proposed SPBP facility. However, the proposed SPBP facility will have a high level of integrated dust suppression technology to manage the risk of dust emissions, which is required from a hazard reduction and quarantine perspective, as well as the environmental drivers. These controls will be continuously improved and include:

- Extensive cleaning program to minimise the build up of combustible dusts.
- Dust collection systems at all transfer points for conveyors and silos to reduce fugitive dust emissions from the enclosed operating plant.
- All chutes and transfer points will be designed to incorporate passive flow technology where practical. This shall include soft flow entry and discharge, controlled material velocity, concentrated material bed depths and minimizing material impact and directional changes. This technology will ensure that a large proportion of the dust is kept entrained in the product, thus minimizing the dust that need to be suppressed and/or extracted.
- Small, self-contained dust extraction units will be fitted at all transfer points and direction change points. These self-contained units will extract dust from the transfer points/direction change points and re-entrain it on the belt after the transfer or direction change. In the case of multiple extraction points, the unit will be located at the furthest extraction point with ducting running to each point.
- All chutes and transfer designs will incorporate soft flow and low dust emission principles to work hand in hand with the dust extraction system.
- For soybean meal out loading from the storage shed, dust suppression units will be fitted at all transfer points and directional change points. The system will incorporate passive flow chutes and transfer design with atomizing water sprays and fully enclosed transfer points. At all transfer and directional change locations the stations will be fully sheeted around the structure to minimize any fugitive emissions.
- Weekly plant inspections to identify potential problem areas, including areas of dust leakage
- Comprehensive plant monitoring and alarm systems.

Dust

Soybean cargos can contain dust of varying nature such as coarse and/or fine sand, grain dust and other coarse materials such as sticks, leaves and branches. Unloading, conveying and handling of soybeans can lead to fugitive dust emissions entering the atmosphere. **Table 30** describes the dust control measures that will be implemented at different locations in the soybean handling system that have the potential for fugitive dust emissions. These measures will minimise the potential for possible fugitive dust emissions to enter the atmosphere.

These controls are expected to adequately mitigate dust emissions and as such dust generation from the proposed SPBP facility is not expected to cause a significant impact to the local air quality.

Odour

Methanol is described as an “odorous air pollutant” in the DECC’s guidelines. As shown in the Air Quality section and Dispersion Modelling Study, the proposed SPBP facility will emit very low levels methanol. At minimum, the methanol levels (predicted to fall between maximum hourly concentrations of 1.3×10^{-5} mg/m^3 and 13×10^{-5} mg/m^3) at nearest receivers are expected to be orders of magnitude below the DECC’s assessment criteria of 3.0 mg/m^3. As a result, no offensive odours due to methanol are expected to be experienced by sensitive receivers in the surrounding area.

Heating and processing of grains and oilseeds can produce offensive odours in some industrial applications. In the case of oilseed processing, the likelihood of offensive odours being generated varies with the type of oilseed processed and the nature of the processing operation. For example, the preparation stage in the crushing of rapeseed involves high temperatures for cooking of the seeds and hot pressing with steam. These steps can release steam and odorous compounds into the atmosphere which can be offensive. NB’s technology provider, Desmet Ballestra, offers two proven solutions to deal with the offensive odours generated in rapeseed crushing plants:

- Installation of an auxiliary piece of specialised equipment that oxidises any odorous compounds in the exhaust air streams before entry into the atmosphere.
- Re-routing of odorous exhaust air streams through the gas-fired boiler in order to incinerate any odorous compounds before entry into the atmosphere.

Desmet Ballestra has established itself as the leader in the oleochemical and oilseed processing industry and as such, has installed a large number of soybean crushers throughout Europe, the USA and the rest of the world. To date, Desmet Ballestra has not been required to install any odour-reduction technology or equipment in any of their soybean crushing facilities anywhere in the world. This is mainly due to the differences in the nature of the soybean crushing process when compared to rapeseed crushing such as:

- During soybean seed preparation, only mild conditioning is used. No hard cooking or hot pressing is used as is the case with rapeseed.
- No odorous compounds (such as sulphur-containing compounds) are released during treatment of the soybean meal.

It can be concluded that the likelihood of offensive odours being generated from the SPBP facility is extremely low, given that the same soybean processing technology has been installed world-wide without the need for any odour-treatment measures. In the unlikely event of any offensive odours being detected at sensitive receivers, proven technology (currently used in rapeseed processing plants) can be retro-fitted to treat exhaust air streams before entry into the atmosphere.

VOCs (Hexane and methanol)

The hexane consumption rate of 2.4 tonnes per day represents the manufacturer’s (Desmet Ballestra) guarantee (also known as “design value”) which states that there will be a loss of no greater than 0.6kg of hexane per tonne of soybeans processed. The loss of hexane is accounted for by four streams, namely entrained hexane in the soybean meal, entrained hexane in the soybean oil, hexane content in the stack emissions and potential fugitive emissions. The design values for the entrained hexane in the soybean meal and soybean oil as well as the hexane stack emissions are well established and can be estimated to a good degree of certainty by the technology provider. The allowance for potential fugitive hexane emissions, however, is grossly overstated due to the inability to quantify the possible contributions of:

- incorrect facility design, equipment assembly and building of the facility
- poor operation of the facility
- poor liquid storage and transfer equipment and operations
- poor maintenance of the facility.

As a result, the difference between the design value and the nominal value (i.e. the expected value during proper and efficient operation of the facility) for hexane consumption is significant.

Hexane losses entrained in the soybean meal and oil are specified with a good degree of accuracy. Desmet Ballestra design levels typically state that soybean meal and soybean oil produced in the facility will contain maximum hexane levels of 250ppm and 50ppm respectively. Entrained hexane remains in the material (soybean meal and soybean oil) through to end use. This entrained hexane cannot be recovered nor will it be emitted during storage or transport as it has been previously exposed to treatment at temperatures well above the boiling point of hexane and remained entrained.

The hexane concentration of approximately 63.1 mg/m^3 (hexane @ 35°C and 1 atm) in the stack emissions from the soybean oil extraction facility is the combination of vent emissions from both the dryer-cooling unit and post hexane scrubbing. Since the hexane path is a closed circuit, solvent used in extraction is recovered and re-used in the process. The Desmet Ballestra Hytech mineral oil absorber is employed to scrub solvent vapours from the vapour stream exiting the extraction facility. The ascending vapour stream passes through the scrubber and reduces the hexane content by 99.6%.

Methanol is a process chemical that is consumed during the transesterification reaction with soybean oil in order to produce biodiesel. Methanol is added in a stoichiometric excess during this process and any excess methanol is recovered and re-used. All vent emissions coming from the plant containing methanol are collected in a header and then condensed and recovered in a methanol holding tank. This scrubbing system reduces methanol content from collective vent emissions to below the modelled value of 150ppm.

Emission values stated for hexane and methanol are design values supplied by the technology provider. These values are significantly higher than what the emissions will be during normal operations of an efficiently designed and operated facility. NB is committed to comply with emission limits as specified by the *Protection of the Environment Operations (Clean Air) Regulation*. For example, in the case of hexane, the Regulation specifies a maximum VOC emission limit of 40 mg/Nm^3 (as n-propane equivalent) for any vapour recovery units and other non-thermal treatment plant. The design value for the hexane emission concentration of 63.1 mg/m^3, when converted to the n-propane equivalent at standard temperature and pressure (STP), is 37.1 mg/m^3. This value is below 40 mg/Nm^3 and demonstrates compliance of the hexane scrubber with the Regulation.

Fugitive emissions of hexane and methanol during storage will be minimised through efficient design and operation under current best practices that will incorporate preventative measures. On-site storage tanks for chemicals such as hexane and methanol (these chemicals have vapour pressures lower than 75kPa) will be designed in such a manner that ensures compliance with Part 5 of the *Protection of the Environment Operations (Clean Air) Regulation*. Storage tanks that have volumes in excess of 150,000 litres are classed as “large storage tanks” under the Regulation and as such will be fitted with control equipment described in the Regulation such as:

- drainage systems comprising small sumps or tundishes fitted under each water draw-off valve which are connected to a totally enclosed drain
- an appropriately designed floating roof contained with an external fixed roof
- use of inert gas (such as nitrogen) blanketing systems to act as buffer against evaporation
- installation of appropriate vapour recovery systems where possible.

Any unloading of volatile compounds will be done according to current industry best practices and in such a manner as to ensure compliance with Part 5 of the Regulation. These measures will include:

- correct and proper connection and disconnection of hoses during loading and unloading to prevent spillage and leakage
- ensuring that hatches, valves and manholes remain closed to prevent evaporation into the atmosphere

- implementation of most current industry best practices to avoid vapour losses into the atmosphere.

Finally, NB will seek to minimise any fugitive emissions of hexane and methanol during the course of normal operations through:

- placing an emphasis on efficient design during the detailed engineering design process
- ensuring proper installation of the facility by suitably qualified contractors
- efficient operation of the facility by appropriately trained employees
- efficient and regular maintenance of the facility
- identification and regular inspection of potential sources of fugitive emissions such as seals, joints, flanges, pumps, compressor seals and valves
- regular inspections for any leaks or spills in the facility. This will include a Leak Detection and Repair Program to be performed every three months and daily shift inspections for any visible leaks, spillage and mechanical conditions of plant components
- regular inspection of hexane and methanol storage areas to detect any leaks or spills
- ensuring that unloading of hexane and methanol is done by certified operators in accordance with industry best practices to avoid any leakage, spillage and evaporation
- installation of vapour detectors in different sections of the facility such as the soybean oil extraction and transesterification buildings
- monitoring of the hexane and methanol consumption at the facility to compare against predicted consumptions levels.

Distributed/off-site emissions

Other potential sources of air pollution arise from the increased transportation requirements necessary for the proposed SPBP facility. The type of transportation and frequency with which it would operate is shown in **Table 30**. The volume of movements in **Table 31** is based on maximum projected for each of the three operating scenarios discussed in the Traffic Impact Assessment.

Table 30 Transport movements

Potential Fugitive Dust Emission Point	Control/Mitigation Measure
Unloading of imported soybeans from ship at Berth 104.	An enclosed ship unloading system will be used. Soybeans will be unloaded from cargo hold of ship by a counter-clockwise rotating inlet feeder with digging vanes, fed into an enclosed vertical screw conveyor and discharged onto wharf-side conveyor. Soybeans will be enclosed from the time of entering unloader inlet up to discharge onto wharf conveyor, thereby containing any dust generated during the unloading process. The ship unloader will be fitted with suction fan-type dust collection system where dust is collected in a bag filter and returned to material flow.
Transfer of soybeans from ship unloader onto wharf-side conveyor.	Soybean conveyor transfer point will be hooded with backpressure to capture any possible fugitive dust. Dust will be collected in a bag filter and screw-fed back onto soybean conveyor.
Transfer point for soybeans from conveyor-to-conveyor leading into existing GrainCorp dust extraction system.	Soft-flow technology will be implemented to minimise possible dust generation during material flow. The head of the conveyor will be enclosed/hooded with slight backpressure to collect possible fugitive dust emissions in a bag filter. The collected dust will be screw-fed back onto soybean conveyor and into

Potential Fugitive Dust Emission Point	Control/Mitigation Measure
	storage silos.
Soybean meal transfer out of SPBP facility into soybean meal storage.	Soybean meal will be transferred using a covered conveyor to minimise possible dust generation due to exposure to wind. Soybean meal will be stored in an enclosed, clad building to ensure possible fugitive emissions of dust is minimised.
Soybean meal outloading to road and rail via overhead chute.	Generation of dust will be minimised by using minimised drop heights and controlled flow velocity of material from chute to truck/carriage. Dust suppression systems will be installed such as dust suppression hoppers (with positional feed control) or enclosing sides of truck that is being loaded with drop-down shutters and slight back pressure to collect any potential fugitive dust into bag filters. Any collected dust will be fed back into buffer chute. This will prevent fugitive dust from settling on truck tyres and bodies.

Source: Maunsell 2008, Traffic Impact Assessment

With respect to the rail and sea transportation requirements for the proposed SPBP facility, the potential for local air quality impacts is expected to be low given the low number of movements proposed.

Table 31 Daily traffic volume data

Road	Daily traffic volume (2005)	% Heavy Vehicles
Tom Thumb Road	1,200	35%
Springhill Road	40,500 *	15%
Masters Road	25,000 *	15%
Five Islands Road	36,000 *	-

Source: Maunsell 2007, Port Kembla Freight Accessibility Strategy Study

* Source: RTA Traffic Volume Data 2005

Traffic movements proposed are very low in comparison to the current movements on the wider network. The potential impact on local air quality in these circumstances is not expected to be significant. To further mitigate the potential for impacts – and the potential emission of greenhouse gases – NB will endeavour to minimise the use of road transport and where practicable, maximise the use of sea and rail.

7.2.6 Mitigation measures

The proposed SPBP facility is designed with emission control integrated into each stage. A key driver in addition to the reduction of potential harmful emissions is the desire to minimise losses of raw materials required during the extraction process. As such each stage of the process includes an element of material recovery such that losses (and emissions) can be minimised. Despite the effort to capture and reuse all raw materials such as the methanol and hexane, some losses and emissions are unavoidable. As such, they have formed the basis of this assessment and the detailed modelling undertaken by C & M Consulting Engineers.

To further safeguard the local community, it is recommended that an Air Quality Management Plan be developed as part of the ongoing environmental management of the proposed SPBP facility. Within the plan, it is recommend procedures for monitoring and inspections be developed to confirm emissions comply with manufacturers guarantees (and legislative requirements), to confirm all controls are working appropriately and to ensure potential impacts to the community are minimised.

7.2.7 Conclusion

The emissions generated by the proposed development from point sources are expected to be below the NSW DECC assessment criteria. As such the impact on the nearest sensitive receptors is not expected to be significant. It should also be noted the assessment has been based upon maximum emission information and as such the predicted concentrations are expected to overestimate contributions compared to what will actually occur. As such, this assessment is considered to be appropriately conservative.

The potential dust emissions are proposed to be controlled using a series of measures through the materials handling system. These controls are focussed on mitigating the potential for health and safety issues on-site and quarantine requirements, but equally provide a level of protection to the local Port Kembla users and local surrounding residential community. As such, it is expected the potential for impacts on local amenity will not be significant.

The proposed development is likely to generate a relatively small increase in road vehicle movements to and from the site and as such will not have a significant impact on air quality. Where practicable, this will be further mitigated by the use of rail and sea transportation.

The proposal utilises a suite of controls to reduce the potential air quality emissions and as a whole is considered unlikely to cause a significant impact to the local air quality or amenity.

7.3 Greenhouse gas emissions and energy efficiency

7.3.1 Introduction

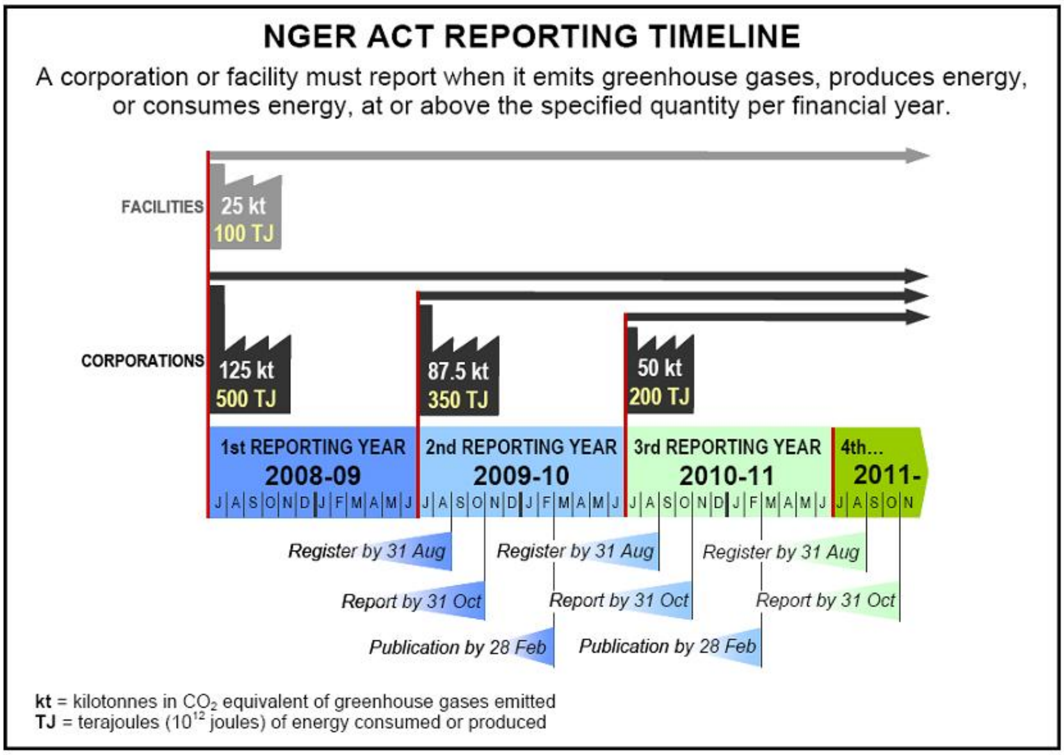
This section provides an assessment of Greenhouse Gas (GHG) emissions from the proposed SPBP facility, supply chain and delivery chain, including a quantitative assessment of the potential Scope 1, 2 and 3 greenhouse gas emissions of the project. In addition, a qualitative assessment of the potential environmental impacts of these emissions is discussed. This is followed by a detailed description of the measures that would be implemented to ensure that the project is energy efficient.

7.3.2 Relevant legislation and guidelines

Emissions reporting under the NGER Act

Under the *National Greenhouse and Energy Reporting (NGER) Act and Regulations (2008)*, organisations are required to report GHG emissions as illustrated in **Figure 44**. The estimated GHG emissions discussed above demonstrate that the proposed SPBP facility will exceed the facilities threshold of 25 kilo tonnes (kt), since predicted annual emissions are around 590 kt $CO_{2\text{-}e}$. This means that, once in operation, the operator of the proposed SPBP facility would be required to report energy consumption and GHG emissions to the Commonwealth Government on an annual basis.

Figure 44 National Greenhouse and Energy Reporting Act - reporting timeline



7.3.3 Methodology

The GHG emissions for the proposed SPBP facility were estimated using a methodology based on the NSW Department of Planning's *Draft Guidelines: Energy and Greenhouse in EIA* (2002)[82] and the Commonwealth Department of Climate Change's (DCC) '*National Greenhouse Accounts (NGA) Factors*' 2008[83].

The National Greenhouse Accounts (NGA) Factors categorise GHG emissions from an organisation into three different 'Scopes'. The definitions of these scopes are presented below:

Scope 1

Scope 1 covers direct emissions from within the boundary of an organisation, for example fuel combustion and manufacturing processes.

Scope 2

Scope 2 covers indirect emissions produced by the consumption of electricity, steam, or heat produced by another organisation. Scope 2 emissions include the emissions from the combustion of fuel to generate the electricity, steam, or heat, but not the emissions associated with the production of the fuel.

Scope 3

Scope 3 includes all other emissions that are a consequence of the proponent's activities, but which are not within the proponent's control. Scope 3 includes emissions attributable to emissions from waste disposed of in landfill; emissions from the production, extraction and distribution of fossil fuels consumed by the organisation; and emissions from the energy lost in transmission of electricity

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[82] NSW Department of Planning, *Draft Guidelines: Energy and Greenhouse in EIA*, 2002

[83] NSW DECC, *National Greenhouse Accounts (NGA) Factors*, 2008

consumed by the organisation. Emissions from the manufacture of plant and equipment, and upstream emissions from the production and delivery of feedstock are also examples of Scope 3 emissions.

In summary the three scopes are:

- Scope 1 – Direct emissions associated with activities from within the operational boundary of an organisation.
- Scope 2 – Indirect emissions due to the consumption of energy sources, such as supplied steam, heat and energy produced by a third party. Emissions arise from the combustion of fuel used to produce these energy sources by the third party.
- Scope 3 – Emissions due to third party supply chain activities that are in direct relation to the organisation. This also includes emissions associated with the end of life cycle product disposal.

The boundaries for the assessment were defined by including material GHG emissions within Scopes 1, 2 and 3. Material emissions were defined as any emission that contributes more than 0.5% to the total estimated emissions, as required by the *National Greenhouse and Energy Reporting (NGER) Act, 2007*.

The emissions sources considered were:

- fuel consumed during construction
- production of construction materials
- fuel and electricity consumed during operation
- agricultural production of the soybean feedstock
- transport of the feedstock to the proposed SPBP facility
- transport of finished products to the customer.

Total GHG emissions were predicted for the 25 year design life of the proposed SPBP facility.

Allocation of emissions

The soy biodiesel production process creates a number of co-products. This means that GHG emissions from the process must be divided, or ‘allocated’ to the various product streams. Emissions were allocated using the relative mass of each product stream in this study, since this was the most practical of all available methods. This approach was also used by the USDA and the United States Department of Energy (US DoE) to conduct a thorough life-cycle assessment of GHG emissions associated with the production of soy biodiesel[84].

7.3.4 Impact assessment

Construction emissions

Transport of materials and waste, site preparation, construction work, plant and people cause GHG emissions through burning fossil fuels, primarily diesel and petrol. Emissions from the construction of the proposed SPBP facility were estimated from construction data for a soy biodiesel production facility of an identical scale in South Africa. The material and fuel quantities used for the estimate are presented in **Table 32**.

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[84] A Joint Study Sponsored by: U.S. Department of Agriculture and U.S. Department of Energy, *Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus, Final Report,* May 1998

Table 32 Construction materials and fuel quantities used for estimation of GHG emissions

Emissions source	Quantity
Concrete	23300 t
Stainless Steel	3359 t
Carbon Steel	7759 t
Scraper (diesel fuel)	219 kL
Bulldozer (diesel fuel)	185 kL
Compactor (diesel fuel)	4 kL
Dump Truck (diesel fuel)	48 kL
Generator (diesel fuel)	829 kL
Transit Mixer (diesel fuel)	69 kL
Concrete Boom Pump (diesel fuel)	45 kL
Delivery Trucks (diesel fuel)	48 kL
Crane (diesel fuel)	45 kL

GHG emissions attributed to construction of the proposed SPBP facility will be generated when:

- construction materials are produced
- when materials, plant and people travel to the work site
- when site preparation and construction work are undertaken
- when waste is transported away from the work site.

Production of construction materials causes GHG emissions through the use of heat or electrical energy from burning fossil fuels, for example coal, and in some cases through chemical processes that release GHG's, for example the production of cement.

The estimation of GHG emissions from construction of the proposed SPBP facility, based on a similar sized biodiesel production facility in South Africa, is presented by source in **Table 33**.

Table 33 Estimated GHG emissions from construction based on similar facility in South Africa

Construction Component	Emissions Source	Scope 1 (tCO_2-e)	Scope 2 (tCO_2-e)	Scope 3 (tCO_2-e)	Total (tCO_2-e)
Construction Plant Fuel	Diesel	4028	-	298	4326
Transport of Materials	Diesel	1522	-	113	1635
Production of Materials	Carbon Steel	-	-	22745	22745
	Stainless Steel	-	-	13505	13505
	Concrete	-	-	3076	3076
TOTAL		**5550**	**-**	**39737**	**45287**

Source: National Biodiesel Pty Ltd and Maunsell 2008

Operational emissions

Operational emissions of GHG's will be caused by:

- consumption of natural gas (methane) for process heating
- consumption of electricity to operate production plant and ancillary buildings
- transport of the feedstock to the plant and the outgoing products to market
- agricultural production of the feedstock
- employees and contractors travelling to the plant.

Emissions from the operation of the proposed SPBP facility were estimated from data supplied by the technology provided (Desmet Ballestra) for a soy biodiesel production facility of an identical scale operated by Rainbow Nation Renewable Fuels Ltd (a subsidiary of The National Biofuels Group Pty Ltd) in South Africa, as adjusted for Australian conditions. Predicted annual emissions from the operation of the proposed SPBP facility are presented in **Table 34**.

The estimated emissions presented in **Table 34** are based on the expected operating mode at full capacity, where the majority of the soybean feedstock will be sourced primarily from the Americas and transported to the SPBP facility by sea freight. In reality the proposed SPBP facility will not produce the estimated emissions in **Table 34** until the SPBP facility has realised full production capacity, which is likely to occur over a period of five operating years. The numbers presented in **Table 34** therefore will not be realised until the proposed SPBP facility is in full operational capacity.

Table 34 Predicted annual operational emissions, main sources and normal feedstock transport case (Americas 92)

Operational component	Emissions source	Scope 1 (tCO$_2$-e/year	Scope 2 (tCO$_2$-e/year)	Scope 3 (tCO$_2$-e/year)	Total (tCO$_2$-e/year)
Agriculture					
Agriculture	Diesel fuel, fertiliser emissions			295,396	
Subtotal					**295,396**
Delivery to Plant					
Sea freight to plant	Diesel			26,979	
Rail freight to plant	Diesel			972	
Truck Freight to plant	Diesel			11,722	
Subtotal					**39,673**
Production Stage 1: Soybean Crushing & Soy Oil Extraction					
Bean preparation plant	Purchased electricity	Not applicable	24,775	4,883	
Meal treatment plant	Purchased electricity	Not applicable	5,265	1,038	
Oil extraction plant (with zero effluent section)	Purchased electricity	Not applicable	7,433	1,465	
Subtotal					**44,859**
Production Stage 2: Transesterification					
Biodiesel & glycerine production with 800BW	Purchased electricity	Not applicable	8,484	1,672	
Methanol Production	Methanol Production			4,8801	
Subtotal					**58,957**
Central Plant					
Plant boiler	Natural gas	113,905	Not applicable	35,692	
Subtotal					**149,597**
Delivery to Customer					
Road Transport	Diesel	2,048		152	
Subtotal					**2,200**
Total					**590,682**

Source: National Biodiesel Pty Ltd, Maunsell 2008 and various lifecycle analysis databases

The sensitivity of operational emissions from the proposed SPBP facility in relation to different assumptions for feedstock sources and relative means of transport are presented in **Table 35**.

Table 35 Sensitivity of operational emissions to feedstock source and transport assumptions

Feedstock Sources	Transport Modes	Operational GHG Emissions, tCO_2 e/year	% Change (relative to Australia 8%, Americas 92%)
Americas (99%), Australia (1%)	Sea	591,810	+0.2%
Americas (92%), Australia (8%)	Sea, Train, Truck	590,680	0.0%
Americas (12%), Australia (88%)	Sea, Train, Truck	5,770,056	-2.3%

Source: National Biodiesel Pty Ltd, Maunsell 2008 and various lifecycle analysis databases

The estimated emissions presented in **Table 35** demonstrate that total emissions are marginally sensitive to assumptions regarding feedstock sources and transport modes. It also demonstrates that emissions will be reduced in the long term as significant portion of the feedstock is sourced from within Australia.

Emissions from agriculture

Agricultural emissions will be caused by:

- use of diesel in land preparation, crop management and harvesting
- production of fertiliser
- emissions of Nitrous Oxide (N_2O), a greenhouse gas, when the biomass remaining in the field after the soybeans are harvested decays, and through chemical interaction between nitrogen fertiliser in the ground as well as soil and oxygen in the air.

Use of diesel is the most significant verifiable source of emissions in agricultural production, and emissions from diesel were included in the assessment. Emissions from fertiliser production and use were assessed and found to be immaterial (less than 0.5% of total emissions). Emissions from nitrogen fixation were not considered since the Intergovernmental Panel on Climate Change (IPCC) procedures for developing greenhouse inventories do not include this source due to lack of evidence regarding its significance[85].

Emissions due to deforestation and land use changes are other potential emission sources. These sources were not considered in this assessment because NB have made a corporate commitment to exclusively source soybeans that are certified to have been sustainably produced, which means that the soybean feedstock for the proposed SPBP facility will be grown on land already under established soybean cultivation (refer to **Section 8.3** for the Procurement Plan).

The allocation of GHG emissions to the various product streams by mass is presented in **Table 36**. The sensitivity of emissions allocated to biodiesel to feedstock source assumptions is presented in **Table 37**.

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[85] Intergovernmental Panel on Climate Change (IPCC), 2006, *"N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application*," in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 11.

Table 36 Allocation of GHG emissions to product streams, with feedstock sourced primarily from outside Australia (Americas (92%), Australia (8%))

Product	Plant Construction (tCO_{2-e} pa)	Agricultural Production (tCO_{2-e} pa)	Transport to Plant (tCO_{2-e} pa)	Central Plant (tCO_{2-e} pa)	Stage 1 (Crushing) (tCO_{2-e} pa)	Stage 2: Transesterification (tCO_{2-e} pa)	Delivery to Customer (tCO_{2-e} pa)	Total (tCO_{2-e} pa)	tCO_{2-e}/kL Biodiesel
Processed Hulls	11	1900	300	900	300	-	-	-	-
Impurities	19	3,100	400	1,600	500	-	-	-	-
Processed Meal	1,400	229,400	30,800	116,200	34,800	-	-	-	-
Soybean Oil	400	61,000	8,200	30,900	9,300	-	-	-	-
Pharm. Glycerine	33	5,400	700	2,700	800	5,200	-	-	-
Biodiesel	300	55,600	7,500	28,100	8,400	53,700	2,200	155,900	0.54

Source: National Biodiesel Pty Ltd, Maunsell 2008

Table 37 Sensitivity of emissions allocated to feedstock source and transport assumptions

Feedstock Source	Transport Modes	Operational GHG Emissions, tCO_{2-e} pa	tCO_{2-e}/kL Biodiesel
Americas (99%), Australia (1%)	Sea	156,100	0.54
Americas (92%), Australia (8%)	Sea, Train, Truck	155,900	0.54
Americas (12%), Australia (88%)	Sea, Train, Truck	153,400	0.53

Source: National Biodiesel Pty Ltd, Maunsell 2008

Comparison between emissions from soy biodiesel and petroleum diesel

Soybeans and other biomass play a unique role in the dynamics of carbon flow in the Earth's biosphere. Biological cycling of carbon occurs when plants (biomass such as soybean crops) convert atmospheric CO_2 to carbon-based compounds through photosynthesis. This carbon is eventually returned to the atmosphere as organisms consume the biological carbon-containing compounds and respire.

Soybean-based biodiesel and other biomass-derived fuels reduce the net atmospheric carbon in two ways:

- Biofuels participate in the relatively rapid biological cycling of carbon dioxide to the atmosphere (via engine tailpipe emissions) and from the atmosphere (via photosynthesis). Combustion of fossil fuels releases carbon that took millions of years to be removed from the atmosphere, while combustion of biomass fuels participates in a process that allows rapid recycling of carbon dioxide to fuel.
- Biodiesel displaces the use of fossil fuels where the relative price of the biodiesel and petroleum diesel maintains the total quantity of diesel fuel demanded.

Therefore, the net effect of shifting from fossil fuels to biomass-derived fuels is to reduce the amount of carbon dioxide present in the atmosphere.

The up- and downstream analysis undertaken for the proposed SPBP facility indicates that lifecycle Scope 1, 2 and 3 GHG emissions produced per unit of biodiesel delivered to the customer would be around 0.54 $tCO_{2\text{-}e}$/kL compared with emissions for petroleum diesel 2, 8 tCO_2/kL. It is noted that a recent lifecycle comparison study of soybean biodiesel and petroleum diesel undertaken by the USDA and US DoE found that "the overall life cycle emissions of CO_2 from B100 [100% soy biodiesel] are 78.45% lower than those of petroleum diesel." which implies emissions of approximately 0.6 $tCO_{2\text{-}e}$/kL.

The estimated GHG emissions over the 25 year design life of the proposed SPBP facility are summarised in **Table 38**.

Table 38 Summary of GHG emissions over the lifecycle of the proposed SPBP facility

	Construction, $tCO_{2\text{-}e}$	Operation, $tCO_{2\text{-}e}$	Total, $tCO_{2\text{-}e}$
Emissions	45,300	13,293,100	14,812,300
Emissions offset (displacement by Biodiesel)	-	-	20,880,000
Net Emissions Offset	-	-	6,067,700

The estimated lifecycle emissions presented in **Table 38** demonstrate that the proposed SPBP facility will achieve a significant GHG emissions benefit. Over time, as domestic soybean production in Australia increases and replaces a portion of imported product, the overall emissions will decline even further. Also, the potential rail link from Maldon-Dombarton to Port Kembla would provide an opportunity to further reduce emissions from transporting biodiesel to customers through a modal shift by road to rail.

7.3.5 Potential impacts

GHG's absorb and re-radiate heat from the sun. The radiation of heat from GHG's warms the Earth's surface, which means that increases in the concentration of GHG's in the upper atmosphere increase the Earth's average surface temperature. This phenomenon is known as the 'Greenhouse Effect'.

GHG emissions contribute to the climate change phenomenon. 'Climate change' refers to future climatic changes that are caused by an increase in the average temperature of the Earth. There is presently a consensus amongst prominent climate experts that climate change is occurring[86]. The IPCC has recently concluded that *"There is very high confidence that the net effect of human activity since 1750 has been one of warming"*[87], and *"Most of the observed increase in global average temperature since the mid-20th century is very likely due to the observed increase in anthropogenic GHG [gases produced by human activity that contribute to the Greenhouse Effect] concentrations"*[88].

Modelling of future climates influenced by global warming and assessment of potential impacts on infrastructure is relatively new. The information used in this assessment comes from an emerging area of research and this report is based on the most recent information available at the time of publication. Future research and modelling work by CSIRO, IPCC and others could alter the outcomes of the analysis undertaken.

Climate models prepared by CSIRO and BOM (Bureau of Meteorology) predict that the future climate on the South Coast of New South Wales, including the study area, will have:

- lower average rainfall
- more intense extreme rainfall events
- higher sea level and storm surge events
- higher average temperatures
- more frequent occurrence of extreme temperatures
- more frequent extreme fire danger days.

The direct operation and construction of the SPBP facility will result in an increase in GHG emission. However the overall plant operation and fuel consumption reduces the amount of carbon in the atmosphere relative to what would have occurred without the SPBP facility through the displacement of petroleum diesel with biofuel diesel. This assumes that the biofuel does not lead to increased demand for petroleum and biofuel products. The displacement of petroleum diesel reduces GHG emission as the only CO_2 release is associated with the operation of the plant rather than the combustion of the fuel.

The net CO_2 emission due to plant operation could be reduced using renewable energy sources and energy efficiency measures.

7.3.6 Energy efficiency measures

The Australian Government, through the Department of Resources, Energy and Tourism, has established the Energy Efficiency Opportunities Program. This program requires large energy consuming companies to undertake a rigorous and comprehensive assessment of their energy use and to identify and report cost effective energy efficiency opportunities.

Energy efficiency is accepted as one of the lower cost methods for reducing greenhouse gas emissions. The proposed SPBP facility will utilise the Energy Savings Measurement Guide (2008), published under the above program, to ensure energy efficiency opportunities are achieved in detailed design, procurement and operations through:

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[86] Intergovernmental Panel on Climate Change (IPCC) *'Climate Change 2007 Synthesis Report'*, 2007

[87] IPCC, *Climate Change 2007 Synthesis Report*, 2007

[88] IPCC, *Climate Change 2007 Synthesis Report*, 2007

- development and refining the energy baseline
- establish the energy savings from potential energy efficiency opportunities
- evaluating the full costs and benefits of each identified energy efficiency opportunity
- measure energy use and saving
- tracking the progress and performance of implemented opportunities against baselines.

One energy efficiency opportunity that will be investigated is the use of gas as the primary plant energy source. Gas-fired power for energy, heating and cooling water (tri-generation) is becoming more commercially viable since the introduction of the Carbon Pollution Reduction Scheme in 2010 increased the financial benefits of reducing GHG emissions. Gas power generation emits significantly less greenhouse gas than coal-based electricity generation. Preliminary discussions have commenced with a major gas supplier to the plant.

Energy efficiency has been identified as being of paramount importance by NB to its technology provider. The proponent will acquire and install innovative technology at a premium cost in order to incorporate a number of significant energy efficiency/savings measures which include, where possible, the following initiatives:

- the use of highly efficient plate-type heat exchangers instead of less energy efficient shell-and-tube designs
- the solvent extraction unit will use patented design technology that is currently the most energy efficient extractor design on the market. Significant flow-on energy savings will occur since
    - thicker soybean flakes can be processed, leading to less energy required during bean preparation
    - there will be 80% reduction in horsepower requirements compared to conventional designs
    - a high volume to surface ratio ensures that less miscella need to be pumped around for oil extraction
    - efficient miscella purification leads to no additional down-stream production steps being necessary
- the fatty-acid stripping unit uses steam agitation instead of mechanical agitators, which minimises heat transfer loss and reduces the condenser size.
- thermal insulation will be required to minimise temperature loss.

Plant and process technology aside, the net energy yield or balance of the soy biodiesel itself is another very important aspect to consider. It is important to know whether a net gain in energy is achieved when biofuels are produced. The energy efficiency of the entire soy biodiesel production process, from agricultural production of the soybeans to availability of the soy biodiesel at the fuel pump, was investigated and assessed by the 1998 USDA/US DoE[89] study.

The study concluded that for each unit of fossil energy consumed in the entire life-cycle of soy biodiesel, 3.2 units of energy are available through the use of the fuel. That study was recently (2008) updated by Van Gerpen, Shrestha and Pradhan from the University of Idaho (in conjunction with the USDA), leading to a revised energy yield of 3.5 units of energy for every unit of fossil energy consumed in the entire production life-cycle.[90] This result was in spite of the fact that the 2008 study was more comprehensive than the study conducted in 1998 and even included the energy needed to manufacture the farm equipment[91]. This increase in energy efficiency was mainly attributed to:

- increased soybean yields
- fertiliser application rates remaining constant

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[89] A Joint Study Sponsored by: U.S. Department of Agriculture and U.S. Department of Energy, *Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus*, *Final Report*, May 1998

[90] National Biodiesel Board press release '*Biodiesel Yields Even Higher Energy Balance',* Feb 6, 2008

[91] National Biodiesel Board press release: http://nbb.grassroots.com/08Releases/EnergyBalance/

- herbicide application rates dropping by 80%
- soybean crushing facilities requiring 55% less energy
- improved energy efficiency of transesterification process.

7.3.7 Conclusion

An assessment of GHG emissions from the proposed SPBP facility, supply chain and delivery chain, including a quantitative assessment of the potential Scope 1, 2 and 3 GHG emissions of the project, and qualitative assessment of the potential impacts of these emissions on the environment has been undertaken.

The assessment found that the emissions of GHG from the proposed development would have an insignificant incremental impact relative to the global scale of climate change. Also, displacement of petroleum diesel fuel by the biodiesel produced by the proposed SPBP facility is expected to produce a net reduction of approximately 6 million tonnes of GHG emissions over its life-time (refer to **Table 38**). Therefore, it is concluded that the net impacts of GHG emissions from the proposed SPBP facility are positive compared to reliance on petroleum based diesel.

Notwithstanding, it is recommended that an Energy Savings Action Plan be prepared in accordance with the requirements of Department of Water and Energy (DWE) and the *Guidelines for Energy Savings Action Plans* (DEUS 2005)[92]. The Energy Savings Action Plan would include details of greenhouse gas abatement measures and energy efficiency measures for the operation of the proposed SPBP facility.

7.4 Hazards and risks

7.4.1 Introduction

This section of the report provides a Preliminary Hazard Analysis (PHA) for the proposed SPBP facility. The PHA is in accordance with the guidelines published by the Department of Planning (DoP) Hazardous Industry Planning Advisory Paper (HIPAP) Numbers 4 and 6.

The main aims of this PHA study are to:

- Review the hazards and risks associated with the proposed SPBP facility and the adequacy of the proposed safeguards at a societal level.
- Evaluate the level of risk from the proposed SPBP facility to surrounding land uses and compare the risk levels with the risk criteria published by the DoP in HIPAP Number 4.
- Identify safety issues to be considered further by NB as part of design progression.

7.4.2 Scope

This PHA assesses the hazards and corresponding risks associated with the proposed SPBP facility and associated facilities such as marine unloading of methanol and soybean storage.

As this is a preliminary hazard analysis the review is restricted to major issues and the interaction of the proposed SPBP facility with adjacent land uses.

Further consideration will be given during detailed engineering design during the proposed development. Such detailed analysis is not appropriate at this time as design details are not resolved sufficiently for resolution of specific issues. Further detailed analysis would also consider events and impacts which are of less significance than those outlined in this PHA.

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[92] Department of Energy, Utilities and Sustainability, *Guidelines for Energy Savings Action Plans*, 2005

7.4.3 Methodology

Key steps in the PHA methodology include:

- Establishing the nature of the proposed SPBP facility and in particular the quantity, storage and handling of dangerous goods and combustible dusts that may give rise to major fires and explosions.
- Review of the proposed general arrangement of the proposed SPBP facility and development of possible major hazardous events, their causes and consequences.
- Review of the consequences of the identified hazardous events by considering on-site and possible off-site impacts (as per HIPAP 4), including the risk of propagation of a hazardous event to nearby processing facilities.
- Review of the likelihood, and hence risk, of the potential hazardous events with the possibility for off-site harm using appropriate qualitative and/or quantitative techniques and comparison to the criteria set in HIPAP 4.
- Comparison to the existing local land uses including consideration of cumulative risk factors.
- General consideration of proposed safeguards.

7.4.4 Hazard identification

This PHA considers hazards due to flammable liquids and combustible dusts that are present on site in sufficient quantities to cause a major fire or explosion risk. As such the hazard identification is directed at bulk quantities of materials and not minor quantities that may be found as small additives, cleaners, waste storage and like situations.

Hazardous materials

Key materials associated with the proposed SPBP facility are listed **Table 39**.

Table 39 Materials summary

Tanker Number	Material	DG Class	DG Subsidiary risk	Storage details	Distance to site boundary	Handling and movement notes
N/A	Soybeans	N/A	N/A	7 x 10,000 mt and 2 x 5,000 mt silos as part of existing GrainCorp facility	N/A – existing	Handled via conveyors and bucket elevator from wharf and into silos
TK – H1 TK – H2 TK – H3	Hexane	3 (flammable liquid)	N/A	3 x 186,000 L double skin horizontal tanks above ground	35 m	Supplied via road tankers, 336 m^3 always in circulation through the soybean processing plant
TK – C1 TK – C2	Methanol	3 (flammable liquid)	6.1 (toxic)	2 x 800 m^3 vertical tanks	12.5 m	Receival from marine tankers, circa 1250 m^3 twice/month (In cases of extreme urgency road tankers may be employed to deliver this product which is not reflected in the Traffic Impact Assessment).
TK – C10	Caustic Soda 50%	8 (corrosive)	N/A	One 25 m^3 tank	20 m	
TK – C3	Sodium Methyl ate 50%	3 (flammable liquid)	8 (corrosive)	One 300 m^3 tank	38 m	Receival from road tankers
TK – C9	Sulphuric Acid (98%)	8 (corrosive)	6.1 (toxic)	One 25 m^3 tank	30 m	
TK – C6	Hydrochloric Acid (36%)	8 (corrosive)	N/A	One 175 m^3 tank	10 m	
TK – C7	Phosphoric Acid (80%)	8 (corrosive)	N/A	One 85 m^3 tank	18 m	

Tanker Number	Material	DG Class	DG Subsidiary risk	Storage details	Distance to site boundary	Handling and movement notes
N/A	Activated Carbon	N/A	N/A	-	-	
N/A	Citric Acid	N/A	N/A	-	-	
N/A	Silica	N/A	N/A	-	-	
N/A	Bleaching Earth	N/A	N/A	-	-	
N/A	Soybean Meal	N/A	N/A	40,000mt stored in meal shed	-	
TK – Z1	Soybean Oil	N/A	N/A	One 10,800 m^3 tank		
TK – B4 TK – B5	Biodiesel (Buffer Tanks)	N/A	N/A	Two 406 m^3 tanks	11 m	
TK – P1 TK – P2 TK – P3	Soybean Oil Pre-treatment (Buffer Tanks)	N/A	N/A	Three 355 m^3 tanks	27 m	
TK – B1 TK – B2 TK – B3	Biodiesel	N/A	N/A	Three 5,600 m^3 tanks	13 m	
TK – F5	Fatty Acid (Buffer Tank)	N/A	N/A	One 140 m^3 tank		
	Glycerine	N/A	N/A			
TK – G1, G2 & G3	- Buffer storage			Three 330 m^3 tanks	30 m	
TK – E4	- Crude grade			One 260 m^2 tank		
TK – G5	- Pharma grade			Two 1,155 m^3 tanks		

Information on selected materials is shown on the following pages.

Soybeans

Soybeans are not dangerous goods, but may produce dry dust from handling due to flaking and chipping of the hulls. Depending on particle size the dust may be combustible.

As with all materials of this nature the dust particles will be a mixture of sizes, meaning that an explosion hazard can only exist where the finest dust forms or settles. Mixtures of fine dust with coarser grains and dust will reduce the dust explosion hazard.

Soybean meal is obtained after processing the soybeans and is only slightly combustible with no known dust explosion hazard.

Hexane

Hexane is a colourless, highly flammable, liquid with a petrol-like odour. It has a flash point around -23ºC and an explosive range from 1.1 to 7.1%. It is easily ignited by static electricity and other forms of ignition.

As hexane is handled above its flashpoint (i.e. at ambient temperature), any loss of containment could result in formation of a flammable vapour mixture. Hexane vapour is heavier than air and vapours may therefore concentrate in drains or hollows.

Hexane is an irritant and can be dangerous with prolonged exposure. Hexane is toxic to aquatic organisms.

Methanol

Methanol is a flammable liquid with a flash point of around 12ºC and forms flammable vapours in air at normal temperatures. Methanol vapour is flammable in the range of 5.5 to 37% in air and a saturated air-methanol mixture is flammable over a wide temperature range. Methanol vapour is heavier than air and vapours may therefore concentrate in drains or hollows.

A methanol flame is practically invisible in daylight which complicates fire fighting. The methanol flame does not produce soot, although formaldehyde and carbon monoxide forms during combustion when insufficient oxygen is available for complete combustion. Water is unsuitable as an extinguishing agent for fires involving large amounts of methanol because it is miscible with the compound (mixtures containing small amounts of methanol also burn). Protein-based alcohol resistant foams are used for fire fighting.

Whilst explosions involving methanol vapours can and have occurred, these have been in processing equipment or confined spaces, for example the vapour space in tanks.

Methanol is also toxic. It is a scheduled poison and is toxic through inhalation, ingestion and dermal absorption. Methanol is also mildly toxic to aquatic life.

Caustic Soda

Caustic soda, typically as a solution in water, is an odourless and colourless liquid. Caustic soda is highly corrosive and reactive. Caustic soda can be irritating to the skin, eyes and gastrointestinal tract and requires the use of appropriate Personal Protective Equipment (PPE) when handled.

Although caustic it is only slightly toxic to aquatic organisms, a large discharge can change the pH of the aquatic system which may be toxic to aquatic organisms.

Sodium Methylate

Sodium methylate used in the biodiesel plant will be a 30% solution, i.e. 30% sodium methoxide and 70% methanol. Therefore, this material will exhibit similar properties to methanol (as detailed above). It is a clear liquid which is partly miscible in water.

Sodium methylate is toxic to personnel if swallowed, if in contact with skin or if inhaled.

Sodium methylate boils at approximately 92ºC and has a flash point of 32ºC. The explosive limits are 5.5 to 44 vol%.

When in contact with various metals, e.g. aluminium, magnesium and zinc, hydrogen can be evolved (i.e. a flammable gas).

Sulphuric Acid

Sulphuric acid is an odourless, colourless to brown liquid. It reacts violently with water and is highly corrosive to some metals.

Sulphuric acid can cause severe burns and is toxic.

Hydrochloric Acid

Hydrochloric acid is normally supplied as a 33wt% solution. It is a clear to slightly yellow fuming solution with a pungent odour.

Hydrochloric acid reacts violently with alkalis and sodium hypochlorite (the latter reaction evolves chlorine gas). It is highly corrosive to most metals with evolution of hydrogen gas (i.e. a highly flammable gas).

Exposure to hydrochloric acid can lead to severe burns and irritation. Prolonged exposure can lead to dermatitic effects.

Hydrogen chloride gas can be released to the atmosphere by evaporation from spills of concentrated hydrochloric acid. It is toxic and acts as a respiratory irritant. It has a readily noticeable odour at low concentrations (around 0.3 ppm) that do not constitute an acute hazard.

If involved in a fire, toxic fumes can be evolved.

Phosphoric Acid

Pure 75-85% aqueous solutions (the most common form of this chemical) are clear, colourless, odourless, non-volatile, rather viscous, syrupy liquids, but still pourable. Because it is a concentrated acid, an 85% solution can be corrosive, although nontoxic when diluted.

Activated Carbon

Activated carbon is usually derived from charcoal. It is a form of carbon that has been processed to make it extremely porous in order to have a very large surface area available for adsorption or chemical reactions.

Activated carbon can form explosive dusts, but the very high ignition energy and other properties make the risk of explosion very low.

Citric Acid

Citric acid is a weak organic acid. Citric acid is a colourless to white crystalline powder that is soluble in water.

Bleaching Earth

Bleaching earth is adsorbent clay that will remove colouring from oils.

Biodiesel

Biodiesel is a generic name for fuels produced by the transesterification of vegetable oils and animal fats. This process produces a fuel with similar properties to diesel obtained from crude oil fractionation.

The flash point for biodiesel is above 100ºC (typically 160ºC) and its boiling point is typically above 205ºC. Products of combustion, if ignited, are carbon dioxide, carbon monoxide and water.

Biodiesel will contain no hazardous materials such as benzene (which is present in petroleum based diesel).

It is insoluble in water and is a stable material.

Glycerine

Glycerine is also known as 1, 2, 3 - Propanetriol which is a stable material under normal operating procedures. It is not classified as dangerous and is biodegradable. It has a melting point of approximately 18ºC. Above 22ºC, it is soluble in water.

Glycerine has a high boiling point and flash point which make it difficult to ignite. If it does ignite, toxic products of combustion can result, e.g. acrolein.

7.4.5 Safety management

Design and operations of the plant will comply with numerous Australian Standards and recognised management practices as part of an overall Safety Management Plan (SMP) for the site design and operations.

Applicable standards cover all aspects of the safety management requirements including items such as:

- Handling of Combustible dusts (AS/NZS 4745)
- Handling and storage of flammable and combustible liquids (AS/NZS 1940)
- Tank design (API 650 / AS 1692 / AS 1170)
- Classification of Hazardous Areas (AS/NZS 60079-10)
- Application of HAZOPs (AS IEC 61882)
- Variety of other standards.

These standards provide requirements for both prevention and mitigation measures such as the following.

Prevention control measures

- Facility’s design and layout (at both ‘macro’ and ‘micro’ levels)
- Separation of dangerous goods from occupied areas and other chemicals
- Spill containment
- Equipment inspection and maintenance procedures
- Operating procedures, e.g. manual tank transfers, and training
- Commissioning checks on the adequacy of the control system
- Control of ignition sources, e.g. no smoking on site and hot work permit system

- Site speed limit (reduces risk of impact events)
- Physical barriers, e.g. bunding and bollards
- Security measures including fencing, CCTV, intruder beams, security patrols, operator / driver vigilance
- Process control systems and alarms
- Procedures for operating in some adverse weather conditions
- Operator training.

Mitigation control measures

- Site emergency response plan
- Fire protection systems, e.g. hydrants, foam, monitors, tank spray systems and fire extinguishers, as currently available on the site
- Spill response procedures
- Emergency shutdown systems.

Desmet Ballestra, the technology supplier, is experienced in the design and operation of this type of facility and will ensure relevant safety matters are considered as part of the proposed SPBP facility design and operation.

Upon receival the soybean will be stored and handled via the existing GrainCorp silos at Port Kembla. The existing silo facilities incorporate a number of design and operational features to manage the risk of dust explosions. These include:

- extensive cleaning program to minimise the build-up of combustible dusts
- dust collection systems at all transfer points for conveyors and silos
- use of equipment that is certified for safe use in dust hazard conditions
- staff that are trained in dust hazards and compliance requirements
- weekly plant inspections to identify potential problem areas
- comprehensive plant monitoring and alarm systems.

In this context the PHA presents risk to people and property in the presence of controls that would be reasonably expected.

Only the likelihood of individual events is considered, as preventative control measures are generally applicable at the site to prevent the risk of propagation.

7.4.6 Hazardous incidents review

In keeping with the nature of a PHA only major scenarios are considered. Minor events would be reviewed as part of more detailed design development reviews. Key examples used in this PHA to provide worst case event conditions and are outlined in the sections below. It should be recognised that such worst case events are most unlikely given the design and operational nature of the proposed SPBP facility, including incident management controls.

The focus is for events that are both credible and have potential for off-site effects. Events that are not considered probable include items such as aircraft crash and earthquake. Events such as the Buncefield (UK) tank farm fire are also not credible for this site due to the smaller volume of flammable liquids held on site and the limited delivery volumes of fuel via tankers.

7.4.6.1 Flammable liquids

Flammable liquids at the site are stored in tanks at two main locations. The hexane tanks are located near the Extraction building on Allotment 5 and the chemical tank farm is located near the Biodiesel Processing building on Allotment 3. A considerable amount of flammable liquid is used, and circulates within the equipment inside the Extraction and Biodiesel Processing buildings.

For the purpose of the PHA major events can be broadly categorical as:

- **External to buildings**

  Events such as tank farm fires will provide worst case heat and explosion pressure scenarios to nearby land uses (refer to **Figure 45**).
- **Internal to buildings**

  Events internal to buildings will be shielded to nearby facilities by the building walls. The ability to cut off fuel supply (shutdown the plant) will assist greatly in managing event escalation. Events inside buildings may lead to greater injury or loss of life to personnel associated with plant operations. In this regard, events inside buildings will have less effect on nearby facilities they are not reviewed further in this PHA.

Whilst it is possible to have fires associated with losses of containment from the wharf lines and tanker loading/unloading, the larger fires for these lines can only occur when product transfer is taking place. During this time, the point of transfer and general facilities will be manned. Should a loss of containment occur, the transfer will be stopped irrespective of ignition occurring. This will mitigate the size of the fire and hence the potential impact damage. As a result of this emergency response for standard transfer lines and the various combinations of releases that are possible, no modelling is performed for release of bulk liquids to other than bunded areas.

Table 40 Event summary

Event No.	Event Type	Description/Causes	Consequences/Notes	Control Measures
1.	Fire from spills – General	Spills from hexane, methanol or sodium methylate may cause fires. Spills of biodiesel, glycerine, vegetable oils may burn but not likely to cause fires due to very high flash points. Causes include: failures of pipes, tanks & equipment; operational error (human factors); or failure of control systems.	Spills are contained in plant and bunded areas. Fires will depend on spill size. Toxic products will be evolved from fires due to burning of liquid noted and nearby plant.	Plant Design e.g. • Piping & tanks • Control systems etc. Inspection, maintenance & operating procedures. Classification of hazardous areas & control of ignition sources. Fire protection systems & emergency response.
1a.	Chemical bund fire – Methanol spill	Worst case event on site due to large surface area. Possible if tank is overfilled.	See heat flux modelling in **Section 7.4.8** and **Figure 45**.	Tank overfill protection and level monitoring. Limit on product volume delivered via ship.
1b.	Internal to plant	As for 1.	Smaller fires in plant.	As for 1, plus shutdown plant to cut off fuel supply. Fire detection.
1c.	Port and road tanker unload points	As for 1.	Smaller fires than other scenarios.	As for 1, plus manned operations to shutdown transfers.
2.	Tank fires (including ship at berth)	Hexane, methanol or sodium methylate may cause tank fires. Causes include hot items or sparks near tanks, static electricity, and lightning.	Consider only one tank in a group would be on fire due to separation from other tanks. See heat flux modelling in **Section 7.4.8** for each storage area. Includes fire in the ship or tanker delivering the liquid.	Plant Design e.g. • Piping & tanks • Control systems etc. Inspection, maintenance & operating procedures. Classification of hazardous areas & control of ignition sources. Fire protection systems & emergency response. Limitation of flow rates to reduce static electricity. Lightning protection & grounding. Port fire fighting to be updated to meet AS 3846 as part of the development.

Event No.	Event Type	Description/Causes	Consequences/Notes	Control Measures
3.	Dried sodium methylate explosion	Spills of sodium methyl ate if left to dry can result in explosion. Reacts violently with water.	Local explosion with damage to plant localised to spill area.	Spill response procedures. Avoid leaks and spills via equipment design & inspection.
4.	Biodiesel Bund Fire	Overfill of tank leading to liquid in bund.	Biodiesel is a combustible liquid (non-flammable) and incidents are not likely to cause fire.	Plant Design e.g. • Piping & tanks • Control systems etc. Inspection, maintenance & operating procedures. Fire protection systems & emergency response.

7.4.6.2 Combustible dusts event summary

Combustible dusts do not generate large fires in the manner of a flammable liquid. This is due to dusts only burning intensely when in suspension in air. Once the volume in suspension is consumed in an initial explosion the fire rapidly reduces. However, the explosion pressure and shockwave may be high.

Dust explosions are also characterised by a tendency to initiate multiple explosions. Dust can be raised into the air by preceding explosions and then be ignited as a secondary explosion, which can be more violent than the preceding event.

Providing general buildings are kept clean of dust the explosions can be limited internally to process equipment. Under such conditions the resultant pressure wave external to the plant will be minimal and not result in damage to buildings beyond the immediate vicinity of the explosion.

Soybeans are stored in existing GrainCorp silos. The proposed SPBP facility adds equipment for this storage i.e. conveyors and elevators and therefore potentially provides additional equipment which could lead to a dust explosion. However the consequences of an explosion do not materially change from the existing land use as can be seen in **Table 41**.

Table 41 Combustible dusts event summary

Event No.	Event Type	Description/Causes	Consequences/Notes	Control Measures
1.	Main silo explosion due to soybean dust	Worst case event due to ignition source in silo.	Destruction to the top of silos. Shockwave across site. Explosions due to current materials in the existing silos are more likely and will have higher consequences (i.e. rate of combustion, ignition sensitivity etc. are higher).	Plant design to minimise dust generation. Dust extraction systems. Heat detection & plant controls (e.g. belt drift monitoring). Classification of hazardous areas and control of ignition sources.
2.	Dust explosion within process equipment	Primary explosion inside plant due to heat, sparks etc.	Damage to plant and initiation of secondary explosions.	Plant design to minimise dust generation. Dust extraction systems. Water sprays. Heat detection & plant controls (e.g. belt drift monitoring). Explosion venting to avoid overpressures. Classification of hazardous areas and control of ignition sources.
3.	Dust explosion within buildings	Secondary explosions could be initiated by an explosion within other plant if dust is in the general plant area.	Building overpressure leading to dislodgement of wall sheets and plant damage.	Dust collectors and dust suppression at all transfer points and other areas of dust creation. Housekeeping to keep dust to minimum in buildings. Grated flooring and other measures to avoid dust accumulation. Fire protection and alarms.

7.4.6.3 General risk events

As with any facility of this nature there will be a number of other event types. Illustrations of these sorts of events are provided in **Table 42** below. As these events have limited and generally localised consequences they are not developed further in this PHA. Events of this category would not generally impact on nearby land uses.

Table 42 General risk events

Event No.	Event Type	Description/Causes	Consequences/Notes	Control Measures
1.	Process disruption	Overpressure, leaks, plant failures etc. Human error.	Exposure to chemicals, spills, noise, odour and other items.	Plant design and automated control systems. Details to be resolved through 'HAZOPS' during design phase.
2.	Vehicle accidents	Road details, human error. Inadequate training.	Spills, injuries, environmental.	Speed limits, training, road layout, barriers etc.
3.	Security sabotage	Intruders, employees.	Product release, plant damage etc.	Fencing, CCTV, guards, access controls & process alarms.
4.	Fire water run-off	Fire fighting.	Environmental damage from run-off.	Bunding and waste water containment systems. Run-off water treatment.
5.	Chemical or liquid spill	Plant failure or human error.	Environmental, operator injury.	Plant design for containment bunding. Operating & process controls. Spill response measures. PPE & safety showers etc.
6.	Toxic reactions	Plant failure or human error.	Environmental, operator injury. Plant damage.	PPE & safety showers, etc. and separation of incompatible materials.
7.	Shipping accident	Impact to wharf, spills and other events.	Injury, damage to wharf, environmental.	Existing shipping procedures. Spill response measures.

Other processing risks will be managed by safe plant design, for example, spontaneous combustion can be an issue with the storage of oil rich seed cake and spent bleaching earth. Processing at the plant will be designed to avoid this hazard by de-oiling and steam stripping so that the oil content is managed below critical levels.

7.4.7 Risk analysis

Typical risk analysis methodologies attempt to take account of all credible hazardous situations that may arise from the operation of processing plants etc. For quantitative risk analysis (QRA), this is done by first taking a probabilistic approach to failures. Specific incidents that are identified are then added and the combined data used to generate composite risk contours which can be used for both the public and plant personnel.

Once data on possible incidents is assembled, risk analysis requires consequence to be considered in the form:

Risk = Likelihood x Consequence

For QRA, the consequences of an incident are calculated using standard correlations and probit-type methods which assess the effect of fire radiation, explosion overpressure and toxicity to an individual, depending on the type of hazard.

In this PHA, however, the approach adopted to assess the risk of the identified hazardous events is a scenario-based risk assessment. The reasons for this approach are:

1) The distance to residential and other sensitive land users is large and hence it is unlikely that any significant consequential impacts due to radiant heat from fires or overpressure from explosions (the main events of interest for the proposed development) will have any significant contribution to off-site risk; and
2) The distance between the on-site tanks and other equipment to the neighbouring industrial facilities is generous; hence, the consequential impacts due to radiant heat from fires or overpressure from explosions may not have any significant contribution to off-site industrial risk.

Therefore, appropriate analysis of credible scenarios is performed in this PHA. Initially, the consequences of the potential events with off-site impact are assessed. For the events which do not contribute to off-site risk (as determined by the risk criteria in HIPAP No. 4, no further risk analysis is warranted. When the consequence of an event does contribute to off-site impacts, the likelihood and hence risk is then analysed as required.

The scenario-based risk assessment approach analyses major possible hazardous events individually as illustrations of issues at the site to enable assessment to HIPAP 4.

7.4.7.1 Risk criteria

The risk criteria applying to developments in NSW are summarised in **Table 43** below (HIPAP 4).

Table 43 Risk criteria, new plants

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

Description	**Risk Criteria**
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 x 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 x 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 x 10^{-6} per year
Propagation due to Fire and Explosion – exceed radiant heat levels of 23 kW/m^2 or explosion overpressures of 14 kPa in adjacent industrial facilities	50 x 10^{-6} per year

As discussed above, the consequences of potentially hazardous events are initially analysed to determine if any events have the potential to exceed the above-listed criteria and hence be worthy of further analysis.

The values of interest for radiant heat (DoP, HIPAP No. 4) are shown in **Table 44**.

Table 44 Radiant heat impact

Heat Flux (kW/m^2)	**Effect**
1.2	Received from the sun at noon in summer
2.1	Minimum to cause pain after 1 minute
4.7	Will cause pain in 15-30 seconds and second degree burns after 30 seconds. Glass breaks
12.6	30% chance of fatality for continuous exposure. High chance of injury. Wood can be ignited by a naked flame after long exposure
23	100% chance of fatality for continuous exposure to people and 10% chance of fatality for instantaneous exposure. Spontaneous ignition of wood after long exposure. Unprotected steel will reach thermal stress temperatures to cause failure
35	25% chance of fatality if people are exposed instantaneously. Storage tanks fail
60	100% chance of fatality for instantaneous exposure

For assessment of the effects of radiant heat, it is generally assumed that if a person is subjected to 4.7 kW/m^2 of radiant heat and they can take cover within approximately 20 seconds, then no serious injury, and hence no fatality, is expected. However, exposure to a radiant heat level of 12.6 kW/m^2 can result in fatality for some people for limited exposure durations. Therefore, for the larger events, appropriate emergency response actions are required to minimise the potential for harm to people. This should include moving people away from such releases to a safe distance.

For information, further data on tolerable radiant heat levels is shown in **Table 45**. This provides an indication of the potential for escalation, or impact, of an incident on site.

Table 45 Layout considerations – tolerable radiant heat levels

Plant Item	Tolerable Radiant Heat Level, kW/m^2
Drenched Storage Tanks	38
Special Buildings (Protected)	25
Cable Insulation Degrades	18-20
Normal Buildings	14
Vegetation	12
Plastic Melts	12
Escape Routes	6
Glass Breakage	4
Personnel in Emergencies	3
Plastic Cables	2
Stationary Personnel	1.5

The effects of overpressure are relevant to flammable liquid fires e.g. due to tank explosion and combustible dust explosions. Overpressure effects are summarised in **Table 46**.

Table 46 Effects of explosion overpressure

Overpressure, kPa	Physical Effect
3.5	90% glass breakage. No fatality, very low probability of injury
7	Damage to internal partitions and joinery. 10% probability of injury, no fatality
14	Houses uninhabitable and badly cracked
21	Reinforced structures distort, storage tanks fail 20% chance of fatality to person in building
35	Houses uninhabitable, rail wagons & plant items overturned. Threshold of eardrum damage, 50% chance of fatality for a person in a building, 15% in the open
70	Complete demolition of houses. Threshold of lung damage, 100% chance of fatality for a person in a building or in the open

7.4.8 Event modelling

Example events from **Section 7.4.6.1** have been modelled and the results are presented in the attached drawings and tabulated below.

- R101 Heat Flux Contours – 45,000 m^3 methanol tanker
- R102 Heat Flux Contours – Hexane Storage Tanks
- R103 Heat Flux Contours – Methanol Storage Tanks
- R104 Heat Flux Contours – Chemical Tanks Bund Pool

Figure 45 Heat flux contour map

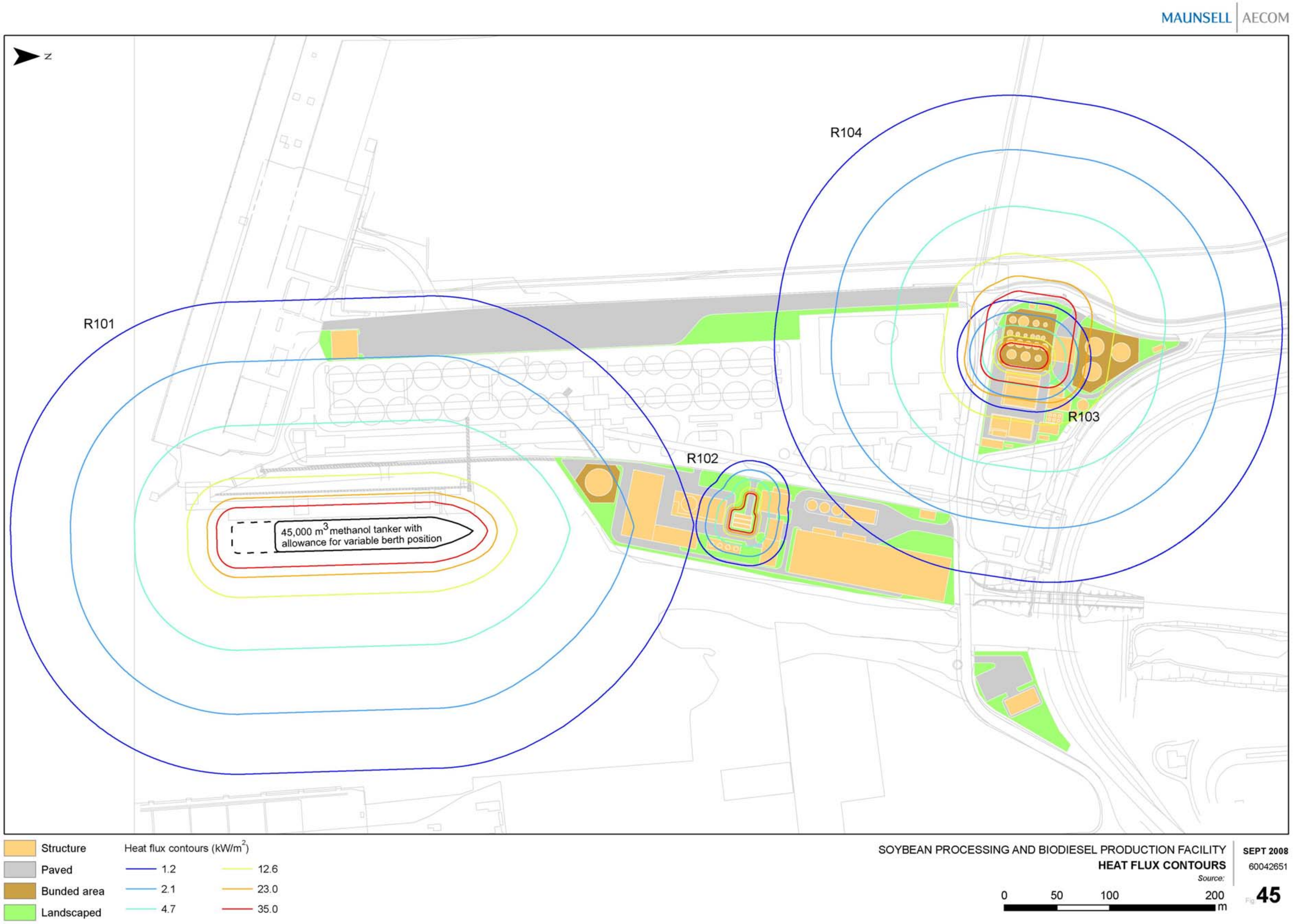

Table 47 Expected heat flux hypothetical targets

Radiant Heat	Receiver Distance for Specified Fire Source (m)					
(kW/m^2)	Single Methanol Tank		Single Hexane Tank	Bund Pool North/South	Bund Pool East/West	Tanker in Dock
1.2	47.00		34.60	217	202	210.0
2.1	35.20		25.75	162.5	150.5	153.0
4.7	23.09		16.50	105	97	92.3
12.6	13.21		8.785	57	52.5	42.05
23	8.86		5.38	34.5	31.5	23.09
35	6.264		3.474	19	17	14.2
Notes:	1.	All tanks and structures are assumed to maintain structural integrity with 800° C surface temperature.				
	2.	All tanks and structures are assumed to exhibit ‘black body’ emissivity due to surface scorching (worst case).				
	3.	All distances are calculated as normal to emitting surface.				
	4.	No allowance is made for topographical features.				
	5.	Bund fire is assumed to burn at 1200 degree C, producing a heat plume emitting surface to a height of 75 m. Ref NIST publication NISTIR 6546 “Thermal Radiation From Large Pool Fires”.				
	6.	Tanker fire is assumed to be length of holds, approximately 6/7 of ship length.				

For the purpose of this study bund pool fires have been based on a fire covering the entire chemical tanks bund area. However, as noted in **Section 7.4.9**, the bund area for flammable liquids will be less than this in the final design. Receiver distances, and hence risk levels for final design, will therefore be less than that shown in this PHA.

For other conditions associated with considered events at the site typical outcomes are summarised below.

Products of combustion

There is a potential risk to those attending a fire emergency (and possibly off-site) of effects from toxic products of combustion, e.g. carbon oxides and smoke, as well as vaporised product (i.e. not combusted).

Impact from toxic products of combustion will only be significant, generally, in close proximity to the fire.

As the fire burns, a buoyant plume is formed and the combustion products rise and are dispersed as per the prevailing wind/weather conditions. Modelling suggests the plume will rise to the order of 100 m and then disperse in the down wind direction. Momentum effects continue to cause the plume to rise whilst it is dispersing.

Therefore, unless a temperature inversion exists where reverse atmospheric currents can occur (i.e. air slumps to the ground as opposed to air eddies that rise), minimal effect at ground level is expected.

Explosion pressures

Explosions have the potential to cause harm through overpressures and possibly missiles. As mentioned in **Section 7.4.6.2**, significant explosions due to combustible dusts are not expected.

For tanks built to API 650 where a frangible roof is installed, explosion pressures due to tank incidents are minimised. This 'weak' roof seam is designed to fail at low pressures to restrict the pressure build-up and hence overpressure and missile generation.

Distances to 7 kPa overpressures are estimated in the order of 50 m from any event.

In this study, a likelihood of an internal tank explosion is conservatively taken to be 6.6 x 10^{-6} per year.

Overpressures from the potential internal tank explosions for three tanks (methanol and sodium methyl ate) have the potential to cause propagation at neighbouring facilities (i.e. above 14 kPa). However, the combined likelihood for three tanks is approximated to be less than 20 x 10^{-6} per year. This is below the criterion for industrial areas of 50 x 10^{-6} per year and is therefore broadly considered acceptable. As the combined likelihood for internal tank explosions is also below 50 pmpy, the risk of fatality due to overpressures at neighbouring industrial facilities is also acceptable.

7.4.9 On-site risks

For on-site risks the events modelled represent only a small number of possible events that could lead to fatality. Further analysis will be needed as part of detailed design analysis once design information becomes available.

Fully defined quantitative assessments for on-site risks will require a significant amount of plant design data which is not available for the planning approvals stage i.e. this PHA. However, the following broad statements can be made with respect to the proposed SPBP facility and based on the key fire scenarios reviewed.

- Typical tank failure rates may be considered as 3 x 10^{-6}. With an ignition of probability of 0.3 and allowing for 3 tanks, the total risk for the main chemical tank bund fire remains as 3 x $10^{-6.}$ As this is below the 50pmpy criteria the risk from tank and bund fires is acceptable.
- Smaller leaks and incidents will have much higher probabilities of occurring. However the resultant event will also be order of magnitudes smaller. The nett probability for fatality will be less than 50pmpy.
- Persons on site would be evacuated or escape before a fully developed fire scenario occurred. The risk of fatality can be reduced from the simple event probability consideration.
- The design basis for the proposed SPBP facility is comparable with other facilities and fuel storage areas which are accepted in Australia.

These factors indicate that the proposed SPBP facility will meet the 50 x 10^{-6} pmpy critical for industrial land use from HIPAP No. 4.

Propagation of incidents due to radiant heat from a potential fire to metallic structures can occur if the impacted area is subjected to 23 kW/m^2 or higher without any emergency response action, e.g. the application of cooling water. Damage to nearby metallic structures is predicted to occur for most of the scenarios considered:

Whilst the event likelihoods are acceptably low, control measures such as plant isolation and fire fighting are employed at the site to either prevent or mitigate the risk of propagation.

Products stored in bunded areas

Spillages of products from the tanks and adjacent piping are contained in the bunds. The bunded areas are sized to contain the entire contents of the single tank so that a total loss of contents does not spill over the bund, plus an allowance for rainwater, fire water, hosing down etc.

It is noted that the chemical tanks bund does not include intermediate bunding to separate reactive liquids e.g. hydrochloric acid and caustic soda. The final design of the tank storage area will require re-alignment and provision of intermediate bund for separation of liquids that have incompatible interactions. Realignment of the bunds will also result in smaller areas with respect to flammable liquid fires.

Bund water will be analysed prior to determining further treatment options, e.g. trade waste, treatment in the existing dissolved flotation plant or to be recovered into existing waste storage tanks for subsequent removal by licensed waste contractors.

Tank failure rates

Tank failure rates are presented in a number of reference documents and span a range of frequencies.

These reports present failures from a number of causes which include earthquake and overfilling. Not all causes may be applicable to this facility.

It is important to identify that the references present data from older studies, generally in the 1980-1990 period. The tanks in this installation would be constructed and operated to more recent standards than those applicable to the studies referenced. In particular, failure rates for tank overfill or similar events will be reduced as more technologically advanced systems are now commonplace in industry.

The hazard analysis is also based on catastrophic failure rates and discounts lesser failures due to the lesser consequence factors resulting.

For these reasons a failure rate of 6.6 x10^{-6} is taken as a conservative value for this report. This value compares with a mean for the references noted and is similar to the value in reference 5 for all causes.

For the National Biofuels PHA any value in the 10^{-6} range could be selected as the resultant risk level only becomes significant for much higher failure rates.

Table 48 Failure Rate – Frequency Values

Ref	Source of Data	Frequency Value
1.	Department of Environment and Planning, *A Risk Assessment Study for the Botany/Randwick Industrial Complex and Port Botany, NSW Government, Sydney,* 1985	Storage tank failure frequency of 6 x 10^{-4}/year
2.	Cremer and Warner, *Risk Analysis of Six Potentially Hazardous Industrial Objects in the Rijnmond Area, a Pilot Study, A Report to the Rijnmond Public Authority, D Reidel Publishing Company,* 1981	Failure rates for specified failure modes of atmospheric storage tanks: 1 x 10^{-4}/yr for leak 6 x 10^{-6}/yr for catastrophic failure
3.	Bureau Veritas, *Preliminary Risk Analysis of Petrochemical Industries Company Limited's Proposed Integrated Petrochemical Complex (Kwinana),* December 1987	Adopted the following failure modes of atmospheric storage tanks: 1 x 10^{-4}/yr for storage 6 x $10^{-6/}$yr for severe leaks
4.	Batstone, R.J. Tomi, D.T., *Hazard Analysis in Planning Industrial Developments, Loss Prevention,* 13, 7, 1980	3 x 10^{-5}/yr for catastrophic failure
5.	Rijnmond Public Authority, *A Risk Analysis of Six Potentially Hazardous Industrial Objects in the Rijnmond Area – A Pilot Study,* COVO, D. Reidel Publishing Co., Dordrecht, 1982	6 x 10^{-6}/yr for catastrophic failure
6.	Taylor, J.R., *Risk Analysis for Process Plant, Pipelines and Transport,* London: Spon, 1994	1 x 10^{-5}/yr for catastrophic failure
7.	Prokop J, *The Ashland Tank Collapse, Hydrocarbon Processing,* 67(5), 105, May 1988	2 x 10^{-7}/yr for catastrophic failure

Ref	Source of Data	Frequency Value
8.	Christensen, R.A. and Eilbert, R.F., *Aboveground Storage Tank Survey,* EL RN-623, Entropy Limited, Lincolm, MA, 1989	9.2 x 10^{-6}/yr for catastrophic failure for all tanks

Drainage systems and site grades

These have been designed so that in the event of fire, fire water run off containing any materials is held on site, away from plant equipment and buildings. All open areas are paved.

Small spills will be contained using the existing spill response kits which include absorbent material.

Other spills can occur as a result of road tanker operations, failures of the pipes in the pipeline corridor and at the Bulk Liquids Berth.

Gaseous emissions

Combustion of the stored products, caused by ignition following a spillage or leak, will release products of combustion (e.g. carbon dioxide, carbon monoxide, soot, vaporised product [unburnt] and water vapour). As shown in **Table 47**, for typical wind / weather conditions, the products of combustion from a fire will rise due to momentum and buoyancy to the order of 75 m. Local impact can be expected for very still conditions only (in which case, emergency response is required for evacuation). The products of combustion are unlikely to include any materials which present a long-term risk to the biosphere.

The plant has a number of vents included in the design and emissions can also be expected. The release rates from these items are small. The impact from these releases are analysed in the Environmental Assessment in **Section 7.2**.

7.4.10 Off site risks

Quantitative risk assessments are not carried out for off-site risks as event consequences generally do not exceed minimum threshold values to cause damage or injury.

For residential areas:

- heat flux radiation does not exceed 1.2 kW/m^2
- explosion pressures do not exceed 3.5 kPa
- toxic concentrations, including the results of combustion will not exceed a sensitivity level of 10 in a million per year.

Given the large distance to the nearest residential area and the estimated radiant heat levels from the potential fire events, there is no risk of injury or fatality in residential areas. Correspondingly, the risk criteria for fatality and injury in residential areas are therefore satisfied.

For adjoining industrial land uses the risk levels are generally less than the on-site risks. The worst case scenario shows adjoining land use may be subject to radiant heat up to 23 kW/m^2 in open areas and up to 12.6 kW/m^2 on nearby buildings. Theoretically these radiant heat levels can lead to fatality. However it is more probable that should a bund fire occur, people within the area (rare event) will be either evacuated or escape before a fully developed bund fire occurs. Therefore, it is unlikely that fatality at these industrial neighbouring areas will result from these events.

The likelihood of these types of fire events has been estimated at approximately 3 x 10^{-6}/year and is therefore below the 50pmpy criteria from HIPAP No. 4.

7.4.11 Conclusion

The risks associated with the proposed SPBP facility and their associated operations have been assessed and compared against the Department of Planning risk criteria.

In summary:

- Fires
    - No risk of injury or fatality at residential areas or other sensitive land uses as the separation distance is large, i.e. 1 km or larger
    - Fire events have the potential to cause fatality in neighbouring industrial areas, however, their likelihood is acceptably low and there exists a high probability of escape
    - Fire events have the potential to cause propagation on-site and at neighbouring industrial facilities; however, the combined likelihood is less than the acceptable criterion of 50 pmpy.
- Explosions
    - No risk of injury or fatality at residential areas or other sensitive land uses as the separation distance is large, i.e. 1 km or larger
    - Internal tank explosion events have the potential to cause fatality or propagation damage on-site and in neighbouring industrial areas; however, the combined likelihood (approximately 20 pmpy) is less than the acceptable criterion of 50 pmpy
    - Dusts explosions are possible but worst case events are restricted to existing plant (GrainCorp silos). Minimal increase in risk results from the proposed operations. Dusts explosion pressures will not impact on residential areas.
- Societal risk is qualitatively concluded to be acceptable given:
    - Few events analysed in the study have the potential for off-site impact and, for the ones that do, their likelihood is acceptably low
    - The risk of off-site individual fatality is low and acceptable
    - The population density in the area is low.

Therefore, the results of this PHA show that the risks associated with the proposed changes comply with the Department of Planning guidelines for tolerable fatality, injury, irritation and societal risk.

The primary reason for the low risk levels from proposed changes is that significant consequential impacts from potential hazardous events (mainly radiant heat from fires) do not extend far from the relevant processing areas.

It is assumed that the proposed changes will be reviewed via a HAZOP as part of detailed design development. An updated fire safety study will also be performed and that safety management systems and emergency response plans will be developed for the proposed Facility.

A specific recommendation is made from this PHA to review bunding arrangements at the chemical tank bund to separate reactive liquids.

7.5 Traffic and transport

7.5.1 Introduction

The proposed SPBP facility is located in the Inner Harbour of Port Kembla, NSW. Port Kembla is located in the Wollongong Local Government Area and is approximately 80km south of Sydney's CBD and 3km south of Wollongong. The site in its regional context identifying key road links is shown in **Figure 46**.