ENVIRONMENTAL ASSESSMENT

ENVIRONMENTAL ASSESSMENT

APPLICATION PURSUANT TO SECTION 75W OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

SHOALHAVEN STARCHES

PROPOSED OPERATIONAL AND PROCESS IMPROVEMENTS

RELATING TO PROJECT APPROVAL MP06_0228

SHOALHAVEN STARCHES EXPANSION PROJECT

Prepared for

Shoalhaven Starches Pty Ltd

January 2012

Prepared by:

COWMAN STODDART PTY LTD

Town Planning, Agricultural & Environmental Consultants

APPLICATION PURSUANT TO SECTION 75W
OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

SHOALHAVEN STARCHES
PROPOSED OPERATIONAL AND PROCESS IMPROVEMENTS
RELATING TO PROJECT APPROVAL MP06_0228

SHOALHAVEN STARCHES EXPANSION PROJECT

Ref. 07/31

Town Planning, Agricultural & Environmental Consultants

Stephen Richardson, M.App.Sc., BTP, Grad. Dip. Env. Mgt, CPP, MPIA
Stuart Dixon, B. Urb. & Reg. Plan., CPP, MPIA

Associate: Peter Cowman, B.Sc.Agr., MAIAST
Colin Stoddart, Cert. TCP (NSW), Ass. Dip. TCP, MPIA

The Holt Centre, 31 Kinghorne Street, Nowra
PO Box 738, Nowra NSW 2541
Telephone (02) 4423 6198 (02) 4423 6199
www.cowmanstoddart.com.au
Fax (02) 4423 1569
Email – info@cowmanstoddart.com.au

COWMAN STODDART PTY LTD

CERTIFICATION OF ENVIRONMENTAL ASSESSMENT
PREPARED PURSUANT TO PART 3A OF THE *ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979*

ENVIRONMENTAL ASSESSMENT PREPARED BY

Name:	S. D. Richardson
Qualifications:	M. Appl. Sc., B.T.P., Grad. Dip. Env. Mgt, CPP, MPIA
Address:	Cowman Stoddart Pty Ltd 31 Kinghorne Street NOWRA NSW 2541

in respect of

PROJECT TO WHICH PART 3A APPLIES

Proponent Name:	Shoalhaven Starches Pty Ltd
Proponent Address:	Bolong Road, Bomaderry
Land to be developed: Address	Bolong Road, Bomaderry
Lot No., DP/MPS, Vol/Fol etc.	Various Parcels
Project Development:	Shoalhaven Starches Expansion Project (MP 06_0228)
Proposed Modification to Project:	Proposed modifications to better refine operational processes and improve energy efficiency associated with the Project Approval (MP06_0228) including modification to the fermentation and distillation processes within the plant.

Environmental Assessment — An Environmental Assessment is attached

Certification

I certify that I have prepared this environmental assessment and to the best of our knowledge

- It has been prepared in accordance with Section 75W of the *Environmental Planning and Assessment Act 1979,*
- The information contained in the Environmental Assessment is neither false nor misleading.

Signature: _____

Name: S. D. Richardson

Date: January 2012

CONTENTS

FIGURES

ANNEXURES

EXECUTIVE SUMMARY

Shoalhaven Starches is a member of the Manildra Group of companies. The Manildra Group is a wholly Australian owned business and the largest processor of wheat in Australia. It manufactures a wide range of wheat based products for food and industrial markets both locally and internationally.

The Shoalhaven Starches factory located on Bolong Road, Bomaderry produces a range of products for the food, beverage, confectionary, paper and motor transport industries including: starch, gluten, glucose and ethanol.

The use of ethanol as a fuel (or fuel additive) has many benefits including:

- it is a renewable fuel and lessens reliance on fossil fuels;
- it reduces greenhouse gas emissions and other air pollutants such as carbon monoxide and particulates;
- it reduces imports of oil and stimulates regional and local economies if produced locally.

Given the above benefits, the Federal and State Governments have introduced a range of initiatives to encourage the increased use of ethanol as a fuel additive.

Since 2007 the NSW Government has progressively increased the mandated ethanol content by volume in petrol in NSW from 2% to 6% from 1st October 2011.

In 2009 the Minister for Planning issued Project Approval for an application made by Shoalhaven Starches to increase its ethanol production capacity to meet the expected increase in demand for ethanol arising from the abovementioned ethanol mandate by upgrading the existing ethanol plant located at the Shoalhaven Starches Plant at Bomaderry. This Project Approval will enable Shoalhaven Starches to increase its ethanol production in a staged manner at its Bomaderry Plant from the current approved 126 million litres per year to 300 million litres per year subject to certain conditions.

Following the Minister's determination Shoalhaven Starches have been implementing and commissioning works in accordance with this approval. Following commissioning of components of the approved development the Company has had an opportunity to review and identify several operational efficiency and process improvements.

As a result Shoalhaven Starches have identified two areas to better refine operational processes and improve energy efficiency within the fermentation and distillation processes of the site's operations.

The modifications involving these processes will not result in any increase in the capacity of the plant or production capability. The modifications to the Fermentation process are required

for operational reasons while the Distillery modifications are required to improve energy efficiency.

The application is made pursuant to Section 75W of the Environmental Planning & Assessment Act 1979.

The preparation of this Environmental Assessment has been undertaken following consultation with relevant Government agencies, including:

- The Department of Planning and Infrastructure;
- The Office of Environment & Heritage; and
- Shoalhaven City Council.

This Environmental Assessment has been prepared to address issues detailed in requirements issued by the Director-General of the Department of Planning and Infrastructure (**Annexure 1**), and specifically the EA is supported by a Preliminary Hazard Analysis (PHA) prepared by Matrix Risk Pty Ltd. The PHA essentially reviews the proposed modification in light of the existing Preliminary Hazard Analysis that supported the Shoalhaven Starches Expansion Project.

In summary the PHA concludes:

- The offsite cumulative risk of fatalities for adjacent sensitive areas and occupancies will be less than the threshold level if risk reduction measures that are recommended are implemented.
- The level of on-site and offsite risk will be reduced substantially by upgrading the deluge system which will be activated by hydrocarbon detectors.
- For the modification, a release of ethanol vapour will not occur at pressure, hence the potential for a vapour cloud explosion (VCE) is considerably reduced.
- Any streams entering or leaving Fermenters 16 and 17 are considered to be non-hazardous.
- The potential for pool fires resulting from releases from the side stripper and rectifier within the Distillery will result in no increase in the Individual Risk of Fatality, as no additional release of flammable material will occur.
- The offsite cumulative risk of fatalities for residential areas will be less than the threshold level of risk.
- The cumulative risk of injury due to exposure to radiant heat at levels less than the threshold level of risk.

- The cumulative risk of injury due to explosion overpressure levels is less than the threshold level of risk.
- There will be no increase in the level of environmental risk.
- There will be no increase in the level of risk of damage to property and the assets.

In addition the EA is also supported by expert assessments addressing:

- Noise Impacts – the EA is supported by a Noise Impact Assessment prepared by Day Design Pty Ltd which demonstrates that the overall development incorporating the works associated with this proposed modification will still achieve the design noise limits for the site and will not cause offensive noise as defined by the Protection of the Environment Operations Act 1997.
- Air Quality Impacts and including Odours – the EA is supported by an Air Quality Impact Assessment prepared by Stephenson Environmental Management Australia (SEMA). This assessment demonstrates that as these modifications do not involve any increase in emissions to the atmosphere and are contained within close looped vessels, that the original dispersion modelling conducted to determine the environmental impact on air quality associated with the Shoalhaven Starches Expansion Project will not change. In fact, there may be a marginal decrease in impact of greenhouse gas emissions from the boilers.
- Flooding Impacts - the EA is also supported by a report addressing the flooding aspects associated with this proposed modification prepared by Webb McKeown & Associates. This report indicates that the incremental increase in flood level (for the full range of design flood events) as a result of the proposed works associated with this modification application is less than 0.01 m. A change in flood level of +/- 0.01 m in flood level is within the order of accuracy of the flood modelling process and cannot accurately be defined. This very small increase in flood level is to be expected given the magnitude of the floodplain of the lower Shoalhaven River and the relatively small extent of the proposed works.

Following an assessment of the key issues associated with this proposal, this Environmental Assessment concludes that the proposal is suitable for the site and this locality. The Environmental Assessment includes a Statement of Additional Commitments outlining additional environmental management, mitigation and monitoring measures that should be implemented to minimise potential impacts associated with the proposal.

The Minister's approval is sought for the modification application.

1.0 INTRODUCTION

Shoalhaven Starches is a member of the Manildra Group of companies. The Manildra Group is a wholly Australian owned business and the largest processor of wheat in Australia. It manufactures a wide range of wheat based products for food and industrial markets both locally and internationally.

The Shoalhaven Starches factory located on Bolong Road, Bomaderry produces a range of products for the food, beverage, confectionary, paper and motor transport industries including: starch, gluten, glucose and ethanol.

The use of ethanol as a fuel (or fuel additive) has many benefits including:

- it is a renewable fuel and lessens reliance on fossil fuels;
- it reduces greenhouse gas emissions and other air pollutants such as carbon monoxide and particulates;
- it reduces imports of oil and stimulates regional and local economies if produced locally.

Given the above benefits, the Federal and State Governments have introduced a range of initiatives to encourage the increased use of ethanol as a fuel additive.

Since 2007 the NSW Government has progressively increased the mandated ethanol content by volume in petrol in NSW from 2% to 6% from 1st October 2011.

In 2009 the Minister for Planning issued Project Approval for Shoalhaven Starches to enable the Company to increase its ethanol production capacity to meet the expected increase in demand for ethanol arising from the abovementioned ethanol mandate by upgrading the existing ethanol plant, located at the Shoalhaven Starches Plant at Bomaderry. Subject to certain conditions this Project Approval will enable Shoalhaven Starches to increase its production in a staged manner at its Bomaderry Plant from the current approved 126 million litres per year to 300 million litres per year.

Following the Minister's determination Shoalhaven Starches have been implementing and commissioning works in accordance with this approval. Following commissioning of components of the approved development the Company has had an opportunity to review and identify several operational efficiency and process improvements.

As a result Shoalhaven Starches have identified two areas to better refine operational processes and improve energy efficiency within the fermentation and distilling processes of the sites operations.

The modifications to these processes will not increase the capacity of the plant or production capability. The modifications to the Fermentation process are required for operational reasons while the Distillery modifications are required to improve energy efficiency.

The application is made pursuant to Section 75W of the Environmental Planning & Assessment Act 1979.

2.0 THE SITE AND SURROUNDING LOCALITY

The Shoalhaven Starches factory site is situated on various allotments of land located along Bolong Road, Bomaderry within the City of Shoalhaven. The factory site, which is located on the south side of Bolong Road on the northern bank of the Shoalhaven River, has an area of approximately 12.5 hectares (refer **Plate 1**).

Plate 1: Aerial view of Shoalhaven Starches factory site.

The Project Approval issued by the Minister related to the following parcels of land (**Table 1**):

Table 1
Shoalhaven Starches Property

Lot	*Deposited Plan (DP) / FP.*
Factory	
1	838753
A	334511
B	334511
B	376494
62	1078788
201	1062668
1	385145
241	1130535
Packing Plant	
16	1121337
2	538289

Table 1 (continued)

Lot	*Deposited Plan (DP) / FP.*
Wastewater Treatment Plant & Environmental Farm	
4	610696
	131008
1	842231
2	842231
3	235705
1	235705
2	235705
Part 2	854837
4	1109510
22	811233
164	4469
2	854764
210	6131
211	6131
PT 212	6131
213	6131
214	6131
248	6131
2	955009
42	751268
63	751268
PT 2	854837
3	1109510
2	1109510
1	1109510
2	833181
Overhead Bridge – Bolong Road Reserve	
2	538289
Fire Services	
241	1130535

The proposed additional two fermenters are to be located to the eastern extremity of the factory site (upon Lot 241 DP 1130535), however one of the fermenters (proposed Fermenter No. 17) will encroach slightly onto the adjoining Lot 143 DP 1069758. This adjoining land was previously the Dairy Farmers Factory complex which Shoalhaven Starches have recently acquired.

The town of Bomaderry is located 0.5 km (approx.) to the west of the factory site, and the Nowra urban area is situated 2.0 km to the south west of the site. The “Riverview Road” area

of the Nowra Township is situated approximately 600 metres immediately opposite the factory site across the Shoalhaven River.

The village of Terara is situated approximately 1.5 kilometres to the south east of the site, across the Shoalhaven River. Pig Island is situated between the factory site and the village of Terara and is currently used for dairy cattle grazing.

There are a number of industrial land uses, which have developed on the strip of land between Bolong Road and the Shoalhaven River. Industrial activities include a metal fabrication factory, the Shoalhaven Starches site, Shoalhaven Dairy Co-op (formerly Australian Co-operative Foods Ltd – now owned by the Manildra Group) and the Shoalhaven Paper Mill (Australian Papers). The industrial area is serviced by a privately owned railway spur line that runs from just north of the Nowra-Bomaderry station via the starch plant and Dairy Co-op site to the Paper Mill.

The state railway terminates at Bomaderry Railway Station with a separate, privately owned spur line to the factory site. Shoalhaven City Council sewerage treatment works is situated between the railway station and the factory.

The Company also has an Environmental Farm located over 1000 hectares on the northern side of Bolong Road. This area is cleared grazing land and contains spray irrigation lines and wet weather storage ponds (total capacity 925 Mega litres). There are at present 6 wet weather storage ponds on the farm that form part of the waste water management system for the factory. A seventh pond approved in 2002 was converted into the biological section of the new wastewater treatment plant.

The Environmental Farm covers a broad area of the northern floodplain of the Shoalhaven River, stretching from Bolong Road in the south towards Jaspers Brush in the north. Apart from its use as the Environmental Farm, this broad floodplain area is mainly used for grazing (dairy cattle). The area comprises mainly large rural properties with isolated dwellings, although there is a clustering of rural residential development along Jennings Lane (approximately 1 kilometre away) and Back Forest Road (approximately between 500 metres to 1.2 kilometres away) to the west of the Environmental Farm; and Jaspers Brush Road, approximately 1.2 kilometres to the north of the Environmental Farm.

Figure 1 is a site locality plan depicting the location of the factory site and Environmental Farm as well as the surrounding locality.

Figure 2 is a plan of the existing factory site depicting the layout of existing plant on the site as well as plant that has been previously approved as part of the Shoalhaven Starches Expansion Project (MP06_0228).

Plate 1 provides an aerial view over the factory site.

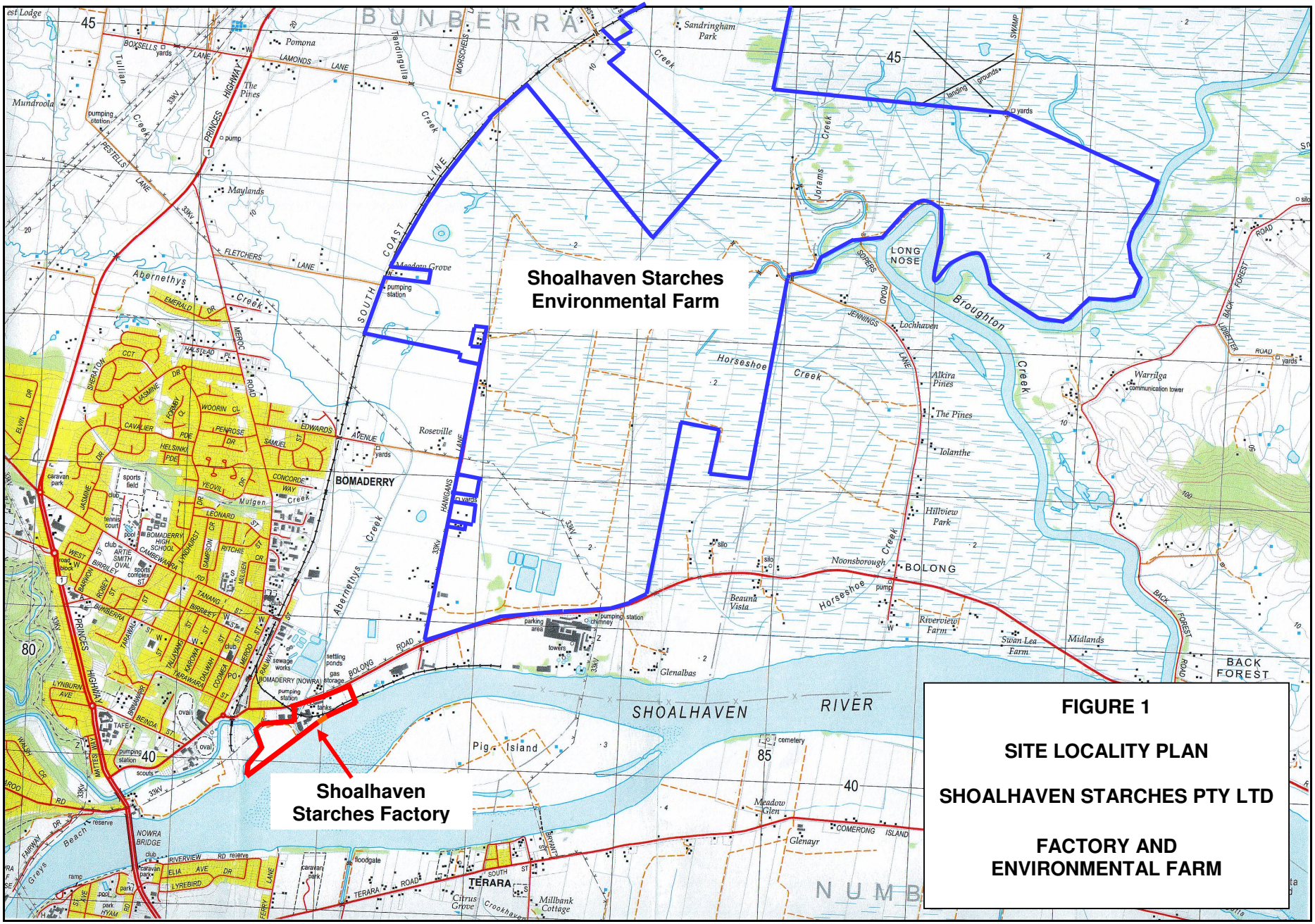


FIGURE 1

SITE LOCALITY PLAN

SHOALHAVEN STARCHES PTY LTD

FACTORY AND ENVIRONMENTAL FARM

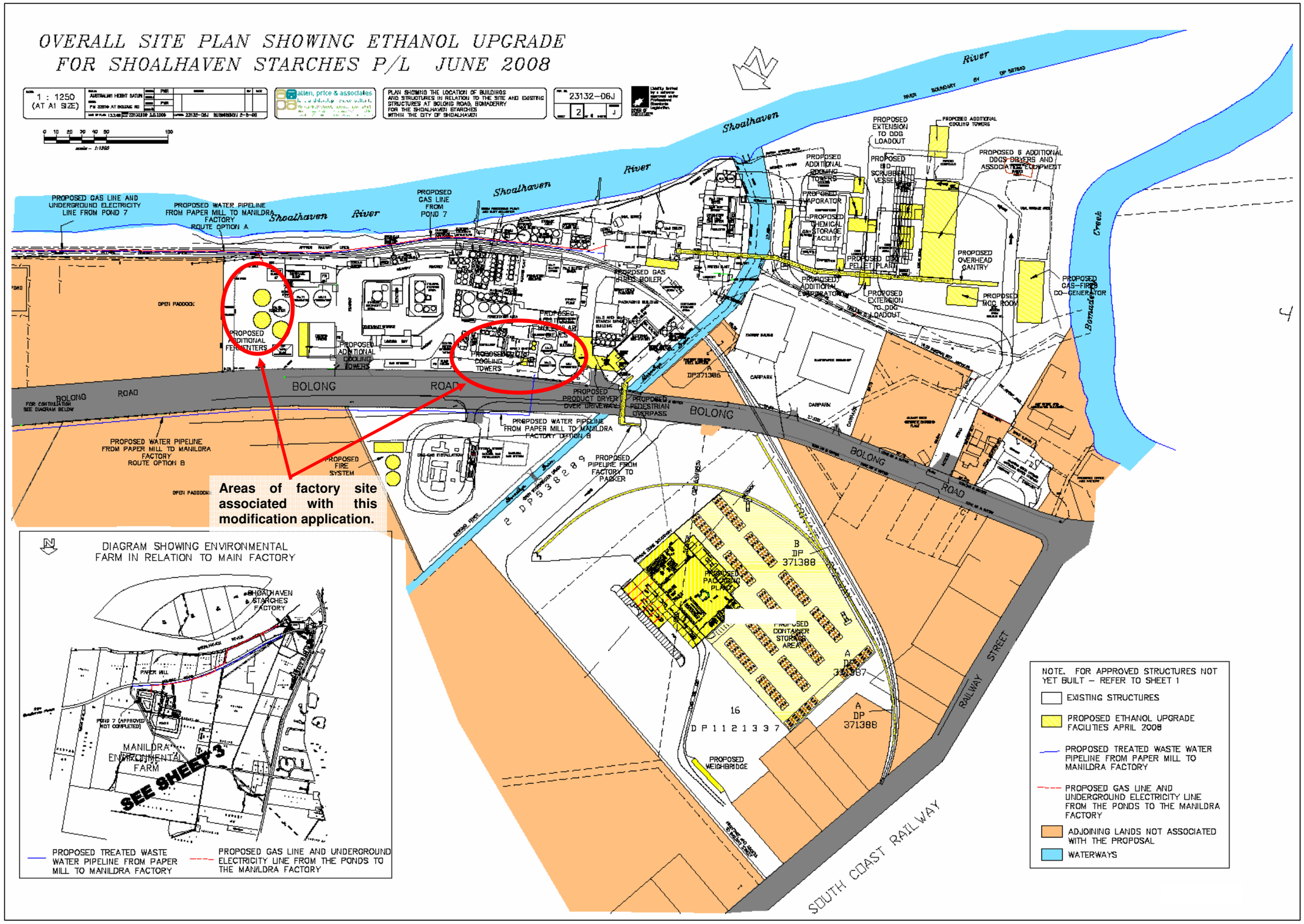


FIGURE 2: Site Plan Depicting Proposed Additions to Factory Site.

3.0 BACKGROUND

3.1 PRODUCTION PROCESSES

The production process at the Shoalhaven Starches plant has developed over a number of years. Originally the plant was primarily concerned with the production of starch and gluten from flour. However the Company has pursued a number of technological innovations particularly with respect to reducing the environmental impacts of the Company's operations. As a result Shoalhaven Starches has been moving towards a "closed" system of production. Essentially this entails the efficient use of end products to ensure wastage is reduced to a minimum.

The first step in the production process is the delivery of flour and grain, by rail, from the Company's flour mills at Manildra, Gunnedah and Narrandera. The trainloads are brought into the plant via the switching yard at Bomaderry.

The Company received approval from the Minister for Planning for the erection of a flour mill on site to enable the milling of part of the Company's flour requirements to be processed directly on the site. This flour mill has now been commissioned. The remainder of the Company's flour requirement will continue to be sourced from the Company's off-site flour mills.

Flour is transferred via storage to the "wet end" of the plant where fresh water is added. The subsequent mixing and separation process produces starch and gluten.

The gluten is dried to enable it to be packaged and distributed as a high protein food additive for human consumption. This product is then taken from the site after packaging for both local and export markets. Starch is used for fermentation and distillation to produce ethanol.

The starch that is separated from the flour is either dried or remains in liquid form. The dried and liquid starch is sold to the paper and food industries. The starch is used for food, cardboard, paper and other industrial purposes. Liquid starch is used in the ethanol production process.

Starch is also used in the production of syrups on the site. The syrups plant products include glucose and brewer's syrup. These are used for foods, chocolates, confectionery, beer, soft drinks and fruit juice. The syrups plant products can also be used in the ethanol process.

The products from the starch, gluten and syrup production processes are combined to feed the fermentation and distillation stage of ethanol production. The outputs are fuel

and industrial grade ethanol. Industrial grade ethanol is used in producing pharmaceuticals, printer's ink and methylated spirits.

Ethanol production results in some liquid and solid by-products, which are processed through the stillage recovery process plant (which was approved as part of PRP No. 7 in 2005). The solids in the stillage are recovered as DDGS (Dried Distillers Grains Syrup), dried and sold as a high protein cattle feed with the remaining water used for irrigation. The waste water resulting from the ethanol production is treated in the wastewater treatment plant and is re-used in the Starch Plant and the surplus is irrigated onto Shoalhaven Starches Environmental Farm to the north of Bolong Road. This farm land is used for fodder crops, pasture and cattle grazing.

3.2 OPERATING WORKFORCE

3.2.1 Operations

The existing factory operates 24 hours per day, 7 days a week, 365 days of the year.

3.2.2 Workforce

The plant employs a total of 300 staff, covering all components of production - operators, administrative personnel and maintenance staff. Employee breakdown and hours of shifts are as follows:

A total of around 300 employees	Management, Technical & Administration	60
	Day Workers	65
	Shift Production (spread over 4 shifts)	175

Hours of Shifts

Plant:	6:00 am to 6:00 pm	- 88 employees	
	6:00 pm to 6:00 am	- 88 employees	
	Day – 7:00 am to 3:00 pm but variable		66 employees, 60 Management, Technical & Administration
Farm:	5:00 am to 5:00 pm	- 3 employees	
	5:00 pm to 5:00 am	- 3 employees	
	7:00 am to 3:00 pm	- 3 employees	

Shift work at both the factory and farm is undertaken on a continuous roster basis.

3.3 RAW MATERIALS

Raw material and energy components used in the Shoalhaven Starches processes are flour, grain for ethanol product and wheat for milling; coal, natural gas, fresh water and salt water.

Flour is delivered to the site by rail from the Company's mills at Manildra, Gunnedah and Narrandera each day of the week. The flour arrives into the plant by Company owned and hired stainless steel rail wagons. From the silos, the flour is moved into the plant by air as required. The current approved flour consumption of the plant is 20,000 tonnes per week.

Grain is delivered to the site by rail. The approved grain consumption is 6650 tonnes per week. The grain is used in the production of ethanol and DDG. The grain is "dumped" from the train into an underground hopper and conveyed by screw conveyors and bucket elevator into a silo.

3.4 HISTORY OF DEVELOPMENT ON THE SITE

The Shoalhaven Starches wheat starch and gluten plant at Nowra was originally constructed in 1970. The Manildra flour mills, at Manildra, Narrandera and Gunnedah, supply the Shoalhaven Starches factory, which currently produces wheat starch, gluten, syrups and ethanol (industrial and fuel grades). The Shoalhaven Starches operation provides direct on-site employment for 300 employees. Through the use of contractors it also indirectly creates employment for many more people in the local and regional economies.

In order to address the issue of waste water disposal, in 1984 Shoalhaven Starches installed a spray irrigation system, using farmland it owned on the northern side of Bolong Road at Bomaderry.

In June 1991, two storage ponds were built (Ponds No. 1 and 2) resulting in the cessation of waste water discharge to the Shoalhaven River.

To further reduce product wastage, Shoalhaven Starches sought to use excess starch for the production of ethanol. Ethanol production began at the Shoalhaven site in June 1992.

In 1994, the NSW Government approved the installation of a larger ethanol distillery within the existing site. The new distillery and its associated facilities enabled production of ethanol to increase from 20 million litres per annum to a production capacity of 100 million litres per year.

Subsequent to this approval Shoalhaven City Council issued development consent for:

- a protein isolate plant and DDGS Dryer; and
- a sorghum grinding plant.

Shoalhaven City Council issued development approval for the construction of a wet weather storage pond (Pond No. 6) on the 27th April 2001. At present, with the completion of Pond No. 6, Shoalhaven Starches has a combined waste water storage capacity within the existing ponds of 925 ML. A further wet weather storage pond (Pond No. 7) was approved by the Minister for Planning on the 23 December 2002 and subsequently modified by the approval by the Minister for Planning to form the anaerobic and aerobic parts of the wastewater treatment plant.

On the 1st June, 2001 the Minister for Urban Affairs & Planning, Dr Andrew Refshauge MP, declared both the Shoalhaven Starches factory and Environmental Farm as being State Significant Development for the purposes of the then Section 76A(7) of the Environmental Planning & Assessment Act.

In 2003 the Minister for Planning issued development consent (D223) for Shoalhaven Starches Pollution Reduction Program (PRP) No. 7. This approval enabled the implementation of the Company's Waste Water Management Strategy, and essentially sought to remove solids (suspended and soluble) from the Company's waste water, prior to its irrigation on the Environmental Farm.

This process, known as Stillage Recovery (to be further discussed in Section 4.1 of this report), essentially involved the introduction of additional decanters, the installation of an evaporation plant and additional dryers, to remove solids from the waste water. It is the remaining solids in the waste water that when sprayed onto the Environmental Farm, or stored in the wet weather storage ponds, which had the potential to result in the generation of odours.

The recovery of the suspended and soluble solids from the waste water could not be undertaken by the dryers in this process, without firstly providing additional coarse solids. Additional coarse solids (grain) were required to be imported to the site.

As a consequence of the additional grain, the starch contained in the grain resulted in a need to increase ethanol production to 126 million litres per year. This increase in ethanol production required the installation of additional fermenters, associated cooling towers and molecular sieves.

The increase in ethanol production also resulted in an increase in waste water, which was required to be disposed on the environmental farm. In this regard this previous proposal also included an increase in waste water disposal area on the Environmental Farm.

The plant associated with this previous approval has now been substantially installed and commissioned.

Shoalhaven Starches have subsequently received the following development approvals:

- The establishment of a flour mill on the factory site. This proposal provides for the transportation of wheat directly to the site by train for processing into industrial grade flour for the use in the production of starch and gluten at the factory site.
- An application pursuant to Section 96 of the Environmental Planning & Assessment Act seeking to modify the development approval for the PRP No. 7 project to enable a DDGS Dryer to be installed in a slightly different location in the same building as previously approved; and the installation of an additional evaporator (a redundant piece of equipment located at the Company's Altona Plant in Victoria) to provide standby capacity for the existing evaporator plant when sections of the existing plant are out of service or cleaning.
- A Section 96 modification application for a standby fermenter tank to be installed on the site, to enable the existing fermenter tanks to be taken out of service for maintenance one at a time.

A full list of all approvals that apply to the Shoalhaven Starches site are detailed within Section 2.4 of the EA prepared by our firm, in relation to the Shoalhaven Starches Expansion Project (MP 06_0228).

3.5 PROJECT APPROVAL MP 06_0228

On the 28th January 2009 the then Minister for Planning, Kristina Keneally issued Project Approval MP 06_0228 for the Shoalhaven Starches Expansion Project.

The primary objective of the Shoalhaven Starches Expansion Project is to increase the Company's ethanol production capacity to meet the expected increase in demand for ethanol primarily, arising from the NSW Government's mandate to increase ethanol content by volume in petrol in NSW from 2% to 6% from October 2011, by upgrading the existing ethanol plant.

The approval will, subject to certain conditions, enable Shoalhaven Starches to increase ethanol production in a staged manner at its Bomaderry Plant from 126 million litres per year to 300 million litres per year.

To accomplish the increase in ethanol production, the Project Approval enables Shoalhaven Starches to upgrade plant and increase throughput of raw materials, principally comprising flour and grain.

The following additions and alterations have been approved to the existing factory site as part of this Project Approval:

- the provision of an additional dryer for the starch/gluten plant;
- additional equipment and storage vessels for the ethanol plant including 3 additional fermenters, additional cooling towers and molecular sieves;
- upgrades to the Stillage Recovery Plant including 6 additional Dried Distillers Grains Syrup (DDGS) dryers; 10 decanters; chemical storage and two evaporators. The proposal includes the installation of a DDGS Pelletiser Plant within this part of the site; and,
- the establishment of a new packing plant, container loading area and a rail spur line. The establishment of this facility on the northern side of Bolong Road will require the provision of an overhead bridge structure to allow product and safe pedestrian movement across Bolong Road.

In addition, as part of the Project Approval, Shoalhaven Starches will undertake comprehensive odour reduction measures for both the existing factory site and the works associated with the Expansion Project. In 2006, the Land and Environment Court required Shoalhaven Starches to engage a suitably qualified person to conduct a comprehensive environmental audit of the factory and Environmental Farm. This environmental audit was undertaken GHD Pty Ltd. The audit report includes a number of recommendations for the implementation of works to the existing site, some of which require development approval. These works were included within this Project Approval.

The Project Approval enables a staged implementation of the expansion project. Up to 200 million litres of ethanol will be able to be produced at the Bomaderry Plant and eventually increased up to 300 million litres.

One of the odour controls originally referred to in condition 7(1) included the following:

> *"Pelletise DDG products and fit heavy curtains to openings in the DDG product storage shed and load-out tent"*

On the 30th September 2011 the Planning Assessment Commission as delegate for the Minister for Planning & Infrastructure modified the Project Approval following a modifications application made by Shoalhaven Starches pursuant to Section 75W of the Act by deleting this requirement from the mandatory odour controls for the project.

The Project Approval also enables the biological treatment of waste waters from the factory site and the re-use of over half the treated waste water within the factory processes, with the remainder irrigated onto the Company's Environmental Farm.

4.0 STATUTORY SITUATION

4.1 PART 3A OF THE EP&A ACT

The introduction of Part 3A to the Environmental Planning & Assessment Act 1979, and the introduction of *State Environmental Planning Policy (Major Development)* in 2005, brought about a change in the regime concerning the assessment of state significant development. Part 3A initially targeted the streamlining of the assessment of projects deemed to be of state significance, including critical infrastructure projects.

Following the 2011 election, the NSW Government have implemented measures seeking to change the planning legislative and policy regime applicable to projects previously subject to Part 3A.

Under these legislation changes no new applications for any of the development that was previously identified as Part 3A in the Major Development SEPP will be accepted and assessed during this interim period.

Projects currently awaiting declaration will not be declared. Generally, applications for the assessment of these projects will be able to be lodged once the new legislation has commenced, provided the category of development is one to which the new system of state significant development applies.

The NSW Parliament have subsequently passed amendments to the *Environmental Planning & Assessment Act 1979* (the EP&A Act). These amendments have created an alternative assessment system which allows the NSW Government to assess and determine projects which are of State significance.

The amended EP&A Act establishes two separate assessment frameworks for either State Significant Infrastructure (SSI) or State Significant Development (SSD). Projects that fall under these two categories will be assessed by the Department of Planning and Infrastructure (the 'Department').

To this end, the Act largely returns to the situation before Part 3A where two separate assessment pathways were in place for projects to be assessed by the State, namely

- Linear public infrastructure projects such as railways, water supply systems, pipelines and transmission lines, or other development by a State agency which has a significant environmental effect; and
- Significant development types which require consent such as mines, chemical and manufacturing plants, warehousing and distribution facilities, hospitals and associated ancillary development.

The Act also introduces a number of changes to the operation and make-up of the Planning Assessment Commission (PAC) and Joint Regional Planning Panels (Regional Panels), seeking to provide additional transparency and greater local government input.

Supporting regulations and an associated new State Environmental Planning Policy (SEPP) have been introduced and come into effect from the 1st October 2011. These supporting provisions provide additional detail with respect to the classes and thresholds for development to be considered as State Significant.

This new SEPP is called *State Environmental Planning Policy (State and Regional Development) 2011* and is known as the "State and Regional Development SEPP". This new SEPP approximately halves the number of proposals dealt with by the State when compared with the former Part 3A system.

The *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) has also been amended to update a number of procedural and administrative arrangements.

This is an interim assessment system which will be reviewed as part of the proposed overall review of the NSW planning system that the new NSW Government has also instigated.

The approved Shoalhaven Starches Expansion Project however is termed a *Transitional Part 3A Project* under the amended EP&A legislation.

These circumstances are clarified in Planning Circular PS 11-021 issued by the Department of Planning & Infrastructure on the 30th September 2011. This Circular confirms that Part 3A continues to apply to certain projects subject to transitional provisions identified in Schedule 6A of the Act.

Schedule 6A of the *EP&A Act* makes provisions for such projects. Essentially a *Transitional Part 3A Project* includes:

> *(a) an approved project (whether approved before or after the repeal of Part 3A),*
>
> *(b) a project for which environmental assessment requirements were notified or adopted before the repeal of Part 3A,*
>
> *(c) a project that is the subject of a Part 3A project application and that the regulations declare to be a transitional Part 3A project.*

As the Shoalhaven Starches Expansion Project was approved on the 28th January 2009 this project is considered a *Transitional 3A Project* for the purposes of this legislation.

Clause 3 of Schedule 6A provides for the continuation of Part 3A and Transitional Part 3A projects. Essentially it states that Part 3A continues to apply to and in respect of *Transitional Part 3A* projects. Clause 3 reads:

> ***3 Continuation of Part 3A – transitional Part 3A projects***
>
> *(1) Part 3A continues to apply to and in respect of a transitional Part 3A project.*
>
> *(2) For that purpose:*
>
> *(a) any State environmental planning policy or other instrument made under Part 3A, as in force on the repeal of that Part and as amended after that repeal, continues to apply to and in respect of a transitional Part 3A project, and*
>
> *(b) declarations, orders, directions, determinations or other decisions with respect to a transitional Part 3A project continue to have effect and may continue to be made under Part 3A (including for the purpose of the application or continued application of Part 4 or 5 or other provisions of this Act in relation to the project).*
>
> *(3) The regulations may modify provisions of Part 3A (and the instruments or decisions referred to in subclause (2)) as they apply to a transitional Part 3A project.*
>
> *(4) The declaration of development as a project under Part 3A (or as a critical infrastructure project) is revoked if the development is not, or ceases to be, a transitional Part 3A project.*
>
> *(5) A transitional Part 3A project is not State significant development or State significant infrastructure.*
>
> *(6) This clause is subject to the other provisions of this Schedule.*

Given these circumstances Part 3A will continue to apply for the proposed Shoalhaven Starches Expansion Project.

Part 3A continues to apply to the Shoalhaven Starches Expansion Project. State Environmental Planning Policy (Major Projects) continues to support Part 3A of the Act.

Section 75W of the Environmental Planning & Assessment Act makes provision for the modification of Major Projects to which Part 3A applied and continues to apply.

4.2 SECTION 75W AND MODIFICATION PROPOSALS

Section 75W of the EPA Act relates to modifications to approvals issued by the Minister for Planning and states:

75W Modification of Minister's approval

(1) In this section:

***Minister's approval** means an approval to carry out a project under this Part, and includes an approval of a concept plan.*

***modification of approval** means changing the terms of a Minister's approval, including:*

(a) revoking or varying a condition of the approval or imposing an additional condition of the approval, and

(b) changing the terms of any determination made by the Minister under Division 3 in connection with the approval.

(2) The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.

(3) The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.

(4) The Minister may modify the approval (with or without conditions) or disapprove of the modification.

(5) The proponent of a project to which section 75K applies who is dissatisfied with the determination of a request under this section with respect to the project (or with the failure of the Minister to determine the request within 40 days after it is made) may, within the time prescribed by the regulations, appeal to the Court. The Court may determine any such appeal.

(6) Subsection (5) does not apply to a request to modify:

(a) an approval granted by or as directed by the Court on appeal, or

(b) a determination made by the Minister under Division 3 in connection with the approval of a concept plan.

(7) This section does not limit the circumstances in which the Minister may modify a determination made by the Minister under Division 3 in connection with the approval of a concept plan.

This application is made pursuant to Section 75W of the EPA Act.

4.3 PROTECTION OF THE ENVIRONMENT OPERATIONS ACT

The existing Shoalhaven Starches factory site and Environmental Farm has an Environmental Protection Licence (EPL) under the Protection of the Environment Operations Act 1997 (POEO Act) (EPL No. 883). The licence imposes requirements in terms of:

- discharges to air, water and land;
- irrigation controls;
- management of irrigation;
- maintenance of irrigation reticulation;
- odour control.

If approved, the proposed modification will necessitate the terms/provisions of this licence to be also reviewed.

5.0 THE MODIFICATION PROPOSAL

5.1 MODIFICATION TO THE FERMENTATION PROCESS

The Ethanol Plant utilises feedstock and product from the starch, gluten and syrups sections of the plant to feed fermentation and distillation, which produces ethanol. In effect the ethanol production process comprises an integral component of the Company's overall production and waste water treatment process. An essential difference therefore between ethanol produced by Shoalhaven Starches and ethanol produced by other producers, is the ethanol produced at Shoalhaven Starches is a value added product from the Company's waste stream from the production of gluten and starch. The ethanol produced from waste starch does not involve the diversion of grain from other markets (such as livestock feed). Indeed a further value added product from the waste stream from the production processes at the Plant is dried DDGS which provides an alternative stock feed product.

The starch from the starch plant and grain crushed from the grain plant are mixed in the fermentation plant and the starch in this feedstock is converted to sugars, which are then fermented to produce ethanol. The fermentation process is a natural process where yeast converts the incoming sugars to ethanol. This process requires a residence time of approximately 50 hours, which necessitates the use of large holding tanks called "Fermenters", which allows time for the conversion process to take place producing a "beer" to feed the distillery.

The distillery separates the ethanol from the "beer" in the "beer" column then purifies the ethanol by passing it through rectification columns and molecular sieves which remove remaining water, not removed by the "beer" column. The ethanol is then ready for sale.

To increase production to the rates envisaged by Project Approval MP06_0228 it has been necessary to install:

- an additional 3 fermentation tanks;
- additional cooling towers;
- additional molecular sieves and associated additional cooling towers.

The three new fermentation tanks (each with a capacity of 3 ML) and associated cooling towers have been constructed to the eastern extremity of the factory site, within the vicinity of other approved fermenter tanks.

Additional molecular sieves with associated heat exchangers, pumps and cooling towers have been installed within the existing ethanol distillation plant structure, adjacent to

existing molecular sieves. Molecular sieves receive industrial grade ethanol from the storage tanks, process it to fuel grade ethanol and then pump it back to storage. The molecular sieves essentially remove water content from the industrial grade ethanol. The molecular sieves installed under the Expansion Project operate in parallel with the existing molecular sieves.

Following a review of operations since the commissioning of plant associated with the Shoalhaven Starches Expansion Project it has been ascertained that two (2) additional fermenter tanks (similar in size to the approved fermenters) are required to be installed on the site, with associated pumps, piping, valves, heat exchangers and electrical equipment. Additional compressors housed in a new compressor room will need to be provided to provide additional compressed air to the valves. Additional motor control equipment will also need to be housed within an extension to the existing electricity substation No.7.

One new fermenter tank is required to replace an existing fermenter which has been taken out of the fermentation process and is now used as a buffer tank for the stillage generated from the distillery process and which is processed further in the Dried Distillers Grain Syrup (DDGS) Plant.

Stillage comprises the suspended and soluble solids that are removed from waste water flow from the Distillery by the DDGS Plant. This process includes the use of decanters, evaporators and DDGS dryers.

The cleaning program for the evaporators and other equipment in the DDGS Plant results in disruption to and a reduction in the distillery process operations. Once this equipment is cleaned; production within the distillery process is required to be increased to meet normal operational requirements. This results in peaks and troughs in production within both the Distillery and DDGS Plants.

The allocation of an existing fermenter as a buffer tank evens out the flows and reduces the peaks. This results in better control of the Distillery and the DDGS Plants.

The buffer tank evens out the flows between the Distillery and the DDGS Plant by filling when sections of the DDGS Plant are off-line for cleaning thus allowing the Distillery to run at its normal rate. When the DDGS Plant is cleaned and the buffer tank is filled, the DDGS Plant will draw from the buffer tank at a greater rate than the flow from the Distillery thus emptying the buffer tank.

The second new fermenter is required to enable fermenters which are currently in operation in the Fermentation Plant to be taken out of service for cleaning.

The existing fermentation process was originally designed and installed as a continuous process. A continuous fermentation process is one whereby feed from the Starch Plant continually flows through each of the fermenters in turn before going to the distillery. The time the volume takes to flow through the overall fermentation process is sufficient for the conversion of the starch by yeast into alcohol.

It is difficult however to take fermenters out of service for cleaning on a continuous production system and still maintain the time required for conversion. It is very difficult to clean the fermenters when they are all part of the continuous process. Cleanliness is extremely critical to the fermentation process. If fermenters are not cleaned thoroughly remaining bacteria compete against the yeast and consume part of the carbohydrate (starch) thus reducing the yield of alcohol.

When fermenters are being cleaned on a continuous basis there is not sufficient time to enable a thorough cleaning to take place and consequently any remaining bacteria will flow through all downstream fermenters and infect the fermenters in the process.

As a consequence the fermentation system has been changed to a batch process which enables fermenters to be taken out of service individually for thorough cleaning.

A continuous fermentation process is one where the liquid starch flows through each fermenter in turn. Starch is being converted to alcohol by the yeast prior to entering the distillery whereas batch fermentation enables the conversion of starch to alcohol to occur in individual fermenters prior to transfer to the distillery. The batch process enables better cleaning of individual fermenters and eliminates the risk of infection of bacteria from one fermenter to another.

By converting to a batch process individual fermenters are taken out of service and thoroughly cleaned to ensure bacteria will not infect other fermenters in the plant because each fermenter directly feeds into the distillery rather than feed into other fermenters and resulting in “Infections”.

Cleanliness is paramount because unwanted bacteria competes with yeast and results in the production of lactic acid. As a consequence yeast is unable to convert all of the starch to alcohol because some of the starch will have been consumed by the bacteria. The consequence of the bacterial infection consuming some of the starch reduces the amount of alcohol that is produced per tonne of starch reducing the overall plant yield.

The batch system approach has the advantage that it enables individual fermenters to be taken out of service for cleaning. To provide the necessary fermentation time and to prevent disruption to production whenever fermenters are taken out of service for

cleaning there is a need however for a fermenter to make provision for redundancy and enable continued ethanol production while Fermenters are taken out of service for cleaning.

In summary the proposed modification involves:

- An additional fermenter is required to replace an existing fermenter which is being converted to a buffer tank between the Distillery and DDGS Plants; and
- Another fermenter is required to maintain capacity when fermentation tanks are taken out of service for cleaning.

To enable construction of the fermenters, it is also proposed to construct a 20 m x 20 m slab adjacent to the site of the proposed additional fermenters.

5.2 MODIFICATION TO THE ETHANOL DISTILLERY

Energy is a significant cost within the Ethanol Distillery operations. Shoalhaven Starches have identified that there is an opportunity to undertake some modifications to the Ethanol Distillery that will result in better energy efficiency outcomes and reduce overall costs for the operations.

The distillery utilises two energy sources. Electricity for the motors on the transfer pumps; and steam which is produced by the Natural Gas and coal fired boilers on site.

All forms of energy are expensive and the energy costs on the Shoalhaven Starches site runs into the 10s of millions of dollars per year. The Ethanol Distillery is the biggest individual user of energy in the form of steam, Shoalhaven Starches have identified an opportunity to reconfigure the distillery by removing one of the older columns and associated equipment and replacing them with newer improved columns and associated equipment.

The modern columns will run at a lower steam pressure than the existing equipment.

Other forms of efficiency improvements include the replacement of the use of live steam injection by heat exchangers so that steam condensate is recovered and reused.

It is also proposed to install an evaporator unit consisting of five (5) vessels with associated condenser, heat exchangers, pumps, piping valves and electrical equipment adjacent to the existing distillery. The role of the evaporator will be to increase the solids in the feed thus reducing the amount of liquid that needs to be heated to evaporate the ethanol in the distillery. The evaporator utilises hot vapours from the existing ethanol

columns to heat incoming 'beer' from the fermenters. The vapours have a steam saving equivalent of approximately 15 t/w.

In addition, it is proposed to replace one of the high pressure distillation columns with three lower pressure columns to save steam. The design of the three replacement columns will have different types of trays inside them which will improve the separation of the ethanol from the stillage by the use of lower pressure steam than in the older designed columns.

In addition one (1) new beer column, heat exchanger H504 for the beer column, fan and platform with associated pumps, piping valves and electrical equipment will be installed within the distillery.

The new more efficient beer column evaporates ethanol from the "beer" and the heat exchanger recovers the heat.

An existing heat exchanger at ground level adjacent to the new H504 heat exchanger will be removed or modified as determined by the final new design.

The older inefficient "beer" column D10 will be removed and replaced by a new rectifier column in the same location. The new rectifier column evaporates additional ethanol from the process and further evaporation occurs in the side stripper further improving ethanol recovery and yield.

One new side stripper vessel will be located adjacent to the new rectifier column.

None of these distillery modifications will result in an increase in the capacity of the distillery but are designed to improve energy efficiency by reducing steam consumption from the boilers. As a result:

- The proposed modification will not increase emissions from the plant including odours. Indeed the project is likely to reduce overall greenhouse gas emissions from the plant.
- The proposal will not increase wastewaters that will need to be treated and disposed.
- The proposal will have no additional traffic impacts.
- The noise impacts will be minimal because the equipment is effectively static equipment with transfer pumps. However, if there is any need for noise suppression that will be incorporated in the detailed design.

Plans of the proposed modifications to both the fermentation and distillery operations are included in **Figures 3** to **8**.

6.0 CONSULTATION

During the preparation of this EA consultation has been undertaken with:

- Department of Planning;
- Shoalhaven City Council;
- Office of Environment & Heritage (OEH).

Shoalhaven Starches have consulted with staff from the Department of Planning with respect to this proposal. The Director-General of the Department of Planning has issued requirements for this EA. These requirements form **Annexure 1** to this EA.

Shoalhaven Starches staff have also liaised with representatives of OEH with respect to the project. Shoalhaven Starches have supplied a draft copy of this EA and its supporting information to the OEH for review prior to submitting this Modification Application to the Department.

Shoalhaven Starches staff have also discussed the proposed modification with staff from Shoalhaven City Council. A meeting was held with Shoalhaven City Council staff, Tim Fletcher (Director- Development Services), Robert Russell (Development Management) and Scott Wells (Traffic Manager) and Brian Hanley (Shoalhaven Starches) and the author on the 12th December 2011.

The main issues raised by Council staff at this meeting included:

- *The increase in flooding effects associated with the proposed works and impacts on development within the floodplain.*

Comment

Webb McKeown & Associates have been engaged by Shoalhaven Starches to carry out a flooding assessment with respect to this modification application. This report investigates the incremental hydraulic impact of the works associated with this modification proposal compared to the findings of their assessment carried out in May 2008 which supported the Shoalhaven Starches Expansion Project and which represents the cumulative impacts of all development by Shoalhaven Starches since approximately 1990. This report forms **Annexure 5** to this EA; and this issue is further addressed in Section 8.4 of this EA.

- *The incremental loss of landscaping along the front of the site over years and the visual impact of development along Bolong Road, a major entrance to the Shoalhaven. The need for landscaping to be provided along the frontage of the site to soften the appearance of the factory site.*

Comment

The visual impacts associated with the works that are associated with this modification proposal are addressed in Section 8.5 of this EA. This section includes a recommendation for the provision of landscape screening along the Bolong Road frontage of the subject site to soften of the visual appearance of the overall factory site.

- *The effects that the intensification of development on the site and the hazardous nature of the site.*

Comment

The DGRs for this modification application required the preparation of a Preliminary Hazard Analysis to update the existing PHA for the site to incorporate the works associated with this modification application. Shoalhaven Starches have engaged Matrix Risk Pty Ltd to prepare the PHA for this modification application. A copy of the PHA is included as **Annexure 2** and this issue is further addressed in Section 8.1 of this EA.

7.0 RISK ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS

The purpose of this section of the EA is to provide a risk assessment of the potential environmental impacts associated with the project. This section (**Table 2**) compares the potential impacts from the proposed modification against the approved project. The comparison uses the key environmental impacts assessed in the EA and summarises the relative change in environmental impacts associated with the proposed modification.

Table 2

Risk Assessment

Issue	***Relative Change in Environmental Impact***	***Additional Management or Mitigation Measures Required***	***Significance of Issue with this Modification Proposal***
Air Quality (including Odour) Assessment	One of the primary issues that was addressed in the original EA for the Shoalhaven Starches Expansion Project concerned the need for a comprehensive odour assessment and reduction as part of the project. Stephenson Environmental Management Australia (SEMA) have been engaged by Shoalhaven Starches to undertaken an Air Quality Impact Assessment with respect to this Modification Proposal. A copy of SEMA's assessment is included as **Annexure 4** to this EA. In relation to this Modification Proposal SEMA conclude that: *Since these minor modifications are not involved with increasing emissions to atmosphere and are contained within close looped vessels, it is concluded that the original dispersion modelling conducted to determine the environmental impact on air quality associated with the Shoalhaven Starches Expansion Project – MP06_0228 will not change. In fact, there may be a marginal decrease in impact of greenhouse gas emissions from the boilers.*	No additional management or mitigation measures are recommended.	This issue has not been specifically identified in the DGRs. However this issue has been addressed in the EA. Air quality impacts are further addressed in Section 8.3 of this EA.
Greenhouse Gas Emissions	The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns within the distillery will have no impact in terms of greenhouse gas emissions emitted from the site. The Air Quality Assessment undertaken by SEMA concludes in part that there may be a marginal decrease in greenhouse gas emissions from the boilers as a result of this proposed modification.	No additional management or mitigation measures proposed.	Not a key Issue.

Table 2 (continued)

Issue	*Relative Change in Environmental Impact*	*Additional Management or Mitigation Measures Required*	*Significance of Issue with this Modification Proposal*
Wastewater Treatment	The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns within the distillery will not result in any change to the amount of wastewater generated from the site nor that will require treatment. No change in environmental impacts from that originally identified in EA.	No additional management or mitigation measures proposed.	Not a key Issue.
Effluent Irrigation and Storage	The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns within the distillery will not result in any change to the amount of wastewater generated from the site and that will require to be irrigated onto the Company's Environmental Farm. No change in environmental impacts from that originally identified in EA.	No additional management or mitigation measures proposed.	Not a key Issue.
Water & Soils	The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns within the distillery will have no additional environmental impact in terms of: • Water supply • Stormwater management • Acid sulphate soils • Site contamination No change in environmental impacts from that originally identified in EA.	No additional management or mitigation measures proposed.	Not a key Issue.

Table 2 (continued)

Issue	*Relative Change in Environmental Impact*	*Additional Management or Mitigation Measures Required*	*Significance of Issue with this Modification Proposal*
Noise	Shoalhaven Starches are licensed under the POEOP Act (Environment Protection Licence No. 883) which sets noise limits for the operation of the overall factory complex. Noise goals have been designed for the site to ensure existing noise levels are not increased by additional plant. The noise goals for any new plant are 10 dBA below the EPL noise limits and range between 28 and 32 dBA depending upon the residential receptor location. The EA is supported by a Noise Impact Assessment prepared by Day Design Pty Ltd. A copy of this assessment is included in **Annexure 3** to this EA. Noise Impacts are further addressed in Section 8.2 of this EA. Day Design conclude in summary that the modification proposal will comply with the design noise goal and limits imposed on the overall Shoalhaven Starches factory complex by the EPL for the site.	No additional management or mitigation measures proposed	This issue has not been specifically identified by the DGRs. However the issue has been addressed in the EA. Noise impacts are further addressed in Section 8.2 of this EA.
Transport & Traffic	The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns within the distillery will not result in any change or increase in the amount of raw materials brought into the site; or the amount of product produced from the site. The proposal will therefore not result in any increase in either truck or train movements to the site. No change in environmental impacts from that originally identified in EA.	No additional management or mitigation measures proposed	Not a key Issue.
Hazards	The DGRs for this project have identified that a Preliminary Hazard Analysis (PHA) is required to be undertaken in relation to this proposed modification which in effect updates the existing PHA with the new processes and additional equipment.	The EA includes the following recommendations made by Matrix Risk as part of their PHA in relation to this Modification Application: • *Review and evaluate the effectiveness of the existing hydrocarbon detectors.*	This issue has been identified by DGRs as Key Issue. A PHA has been prepared for the Modification Proposal by Matrix Risk Pty Ltd and forms **Annexure 2** to this EA.

Table 2 (continued)

Issue	*Relative Change in Environmental Impact*	*Additional Management or Mitigation Measures Required*	*Significance of Issue with this Modification Proposal*
Hazards (continued)	A PHA has been prepared for the proposed modification by Matrix Risk Pty Ltd and forms **Annexure 2** to this EA. This issue is further addressed in Section 8.1 of this EA.	• *Determine whether these hydrocarbon detectors are currently installed in optimal locations for activation of an improved deluge system. Installed hydrocarbon detectors have been certified by Gastech, but do not currently initiate a deluge.* • *Modify the existing deluge system to act as a water curtain and vapour barrier. This may involve an upgrade/or improvement of the existing system.*	This issue is further addressed in Section 8.1 of this EA.
River bank stability and Riparian Management	New Fermenter 17 will be sited approximately 42 metres from the Shoalhaven River; while the substation extension will be sited approximately 26 metres from the Shoalhaven River. It should be noted however that these works are sited within established areas of the existing factory site; and separated from the river by the railway spur line. No change in environmental impacts from that originally identified in EA is envisaged.	No additional management or mitigation measures proposed	Not a key Issue
Flooding	The fermentation area was included in the original flood assessment for the site carried out by Webb McKeown & Associates. The erection of the additional fermentation tanks within this locality was considered to require an additional assessment in relation to these additional structures. Flooding impacts associated with this proposal are discussed in Section 8.4 of this EA.	No additional management or mitigation measures proposed	This is a key Issue identified by this EA (although the DGRs did not identify this issue as being significant).

Table 2 (continued)

Issue	*Relative Change in Environmental Impact*	*Additional Management or Mitigation Measures Required*	*Significance of Issue with this Modification Proposal*
Waste Management	The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns within the distillery will not alter the level of waste that is required to be managed on site. The Waste Management Assessment carried out by Stephenson Environmental Management Australia (SEMA) for the original Shoalhaven Starches Expansion Project did not identify the Distillery and Fermentation areas of the site as significant contributors to the waste generation, nor did it specify any specific requirements for this component of the Expansion Project. The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns within the distillery will not alter the way waste is managed on the site. No change in environmental impacts from that originally identified in EA.	No additional management or mitigation measures proposed	Not a key Issue
Visual Impact	The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns within the distillery are not expected to have significant impact in terms of the scenic amenity of the locality. The proposed works associated with this modification proposal will result in additional structures becoming visible; however their appearance, scale and height will be similar to existing structures located on the site. The visual impacts associated with this proposal are addressed in Section 8.5 of this EA.	The EA includes the following recommendations to mitigate the visual impact of the proposed works associated with this Modification Application: • The existing screening vegetation around the site is generally effective, particularly along the river bank.	This is a key Issue identified by this EA (although the DGRs did not identify this issue as being significant).

Table 2 (continued)

Issue	*Relative Change in Environmental Impact*	*Additional Management or Mitigation Measures Required*	*Significance of Issue with this Modification Proposal*
Visual Impact (continued)		• In order to further reduce the visual impact of the proposed and existing fermenters and works associated with the distillery the northern boundary of the subject site along Bolong Road should be landscaped with a combination of trees and shrubs. • A landscape plan should be prepared for those areas of the site associated with this Modification Application and identify suitable plantings which will grow to a suitable height to assist in screening the works associated with this application. • Where tree planting has already been established, measures should be taken to protect existing vegetation during the construction phase. • In addition to landscaping, new structures can be constructed and treated to reduce visual impact. Where appropriate and possible, buildings and structures should be constructed of similar materials as those previously used on the site. Colours and materials should be consistent with those previously used on the site.	

Table 2 (continued)

Issue	*Relative Change in Environmental Impact*	*Additional Management or Mitigation Measures Required*	*Significance of Issue with this Modification Proposal*
Flora and Fauna	The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns will all be located within the factory site which is devoid of vegetation. The original Flora and Fauna Assessment carried out by Kevin Mills & Associates for the Expansion Project did not identify any specific ecological constraints with this part of the site. The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns will not require any additional vegetation to be disturbed. No change in environmental impacts from that originally identified in EA.	No additional management or mitigation measures proposed	Not a key Issue
Heritage and Archaeological Issues	The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns are all located within the factory site which was not previously identified by the EA for the Shoalhaven Expansion Project as an area subject to either Aboriginal or European cultural heritage significance. The original Aboriginal Archaeological Assessment that supported the EA prepared by South East Archaeology did not identify any constraints with respect to this part of the site or this project. The proposed additional fermenters (and associated cooling towers and molecular sieves) and the installation of an additional evaporator and 3 low pressure columns will have no additional impact in terms of indigenous or non-indigenous heritage. No change in environmental impacts from that originally identified in EA.	No additional management or mitigation measures proposed	Not a key Issue

Following the above risk assessment of the potential environmental impacts of the proposed modification the key issues for assessment (and including that identified by the DGRs for this project) are:

- Preliminary hazard analysis;
- Noise impacts;
- Air quality (and including odour) impacts;
- Flooding;
- Visual impact.

8.0 KEY ISSUES

8.1 PRELIMINARY HAZARD ANALYSIS

This Modification Application is supported by a Preliminary Hazard Analysis prepared by Matrix Risk Pty Ltd. A copy of this PHA forms **Annexure 2** to this EA. This section of the EA is based upon the findings of this assessment.

The analysis undertaken by Matrix Risk assessed both the on-site and offsite risk of fire and explosion; impacts on the community; third party occupancies, adjacent industrial or residential sites and the environment. The analysis has considered in principle the various preventative and mitigation safeguards and controls that will be implemented in the design stage, to ensure that the level of offsite risk will be at an acceptable level to all parties concerned.

From the risk and consequence effects analysis Matrix Risk concluded:

- *The off-site cumulative risk of fatalities for adjacent sensitive areas and occupancies will be less than the threshold level of risk of 50 x 10^{-6} p.a. if risk reduction measures that are recommended are implemented.*
- *The level of on-site and off-site risk will be reduced substantially by upgrading the deluge system which will be activated by hydrocarbon detectors. The deluge system will act as a vapour barrier and will be designed to reduce the Ethanol vapour concentration to below LEL.*
- *For the modification, a release of Ethanol vapour will not occur at pressure, hence the potential for a vapour cloud explosion (VCE) is considerably reduced.*
- *Any streams entering or leaving Fermenters 16 and 17 and the contents of these evaporators will not contain Ethanol. Releases from these evaporators and associated piping systems were considered to be non-hazardous.*
- *The potential for pool fires resulting from releases from the side stripper and rectifier within the Distillery will result in no increase in the Individual Risk of Fatality, as no additional release of flammable material will occur.*
- *The offsite cumulative risk of fatalities for residential areas will be less than the threshold level of risk of 1 x 10^{-6} p.a.*
- *The cumulative risk of injury due to exposure to radiant heat at levels in excess of 4.7 kW/m^2 in each of the sensitive areas and occupancies will be less than the threshold level of risk of 50 x 10^{-6} p.a.*
- *The cumulative risk of injury due to explosion overpressure levels in excess of 7 kPa in each of the sensitive areas and occupancies is less than the threshold level of risk of 50 x 10^{-6} p.a.*
- *There will be no increase in the level of environmental risk.*
- *There will be no increase in the level of risk of damage to property and the assets.*

According to Matrix Risk the consequence effects and vulnerability analysis indicates that the risk of property and environmental damage will be acceptably low. The results of the PHA included within **Annexure 2** to this EA demonstrates that the risks associated with the proposed modification application comply with the guidelines issued by the Department of Planning & Infrastructure for tolerable fatality, injury, escalation and societal risk.

The modifications do not, according to Matrix Risk pose additional risks to the biophysical environment from potential hazardous events. The proposed modifications will have no significant impact on existing cumulative individual risk contours. In addition to this, the controls and safeguards proposed will be more effective than the existing controls and safeguards as overall preventative and mitigation risk reduction measures.

Matrix Risk qualitatively concludes that societal risk is acceptable given:

- No events analysed in the study have the potential for off-site impact and, for the ones that do, their likelihood is acceptably low; and
- The population density in the area surrounding the plant is relatively low.

The results of this PHA prepared by Matrix Risk therefore show that the risks associated with the proposed modification comply with the guidelines issued by the Department of Planning & Infrastructure for tolerable fatality, injury, irritation, escalation and societal risk.

According to Matrix Risk, the modification does not pose unacceptable levels of additional risk to the biophysical environment from potential hazardous events.

Additionally, the proposed modification will have no significant impact on any existing cumulative individual risk contours.

The proposed modifications will be reviewed during a HAZOP. A fire safety study will be performed and the existing safety management systems and emergency response plans will be revised to reflect the proposed changes.

In relation to these proposed modifications the PHA prepared by Matrix Risk makes the following recommendations:

- *Review and evaluate the effectiveness of the existing hydrocarbon detectors.*
- *Determine whether these hydrocarbon detectors are currently installed in optimal locations for activation of an improved deluge system. Installed hydrocarbon detectors have been certified by Gastech, but do not currently initiate a deluge.*

- *Modify the existing deluge system to act as a water curtain and vapour barrier. This may involve an upgrade/or improvement of the existing system.*

8.2 NOISE IMPACTS

The area surrounding Shoalhaven Starches is a mix of commercial, industrial and residential premises with vacant land, owned by the Manildra Group, to the north.

The nearest residential locations to the complex are as follows:

- Location 1 – Nobblers Lane, Terara approximately 1500 metres to the south east;
- Location 2 – Riverview Road, Nowra approximately 1000 metres to the south;
- Location 3 – Meroo Street, Bomaderry approximately 480 metres to the north west;
- Location 4 – Hannigans Lane, Bomaderry approximately 1200 metres to the north east.

This Modification Application is supported by a Noise Impact Assessment prepared by Day Design Pty Ltd. A copy of the Noise Impact Assessment prepared by Day Design forms **Annexure 3** to this EA. This section of the EA is based upon the findings of this assessment.

8.2.1 Environment Protection Licence 883

Shoalhaven Starches operates under Environment Protection Licence 883 issued by the NSW Office of Environment and Heritage.

Section L5 'Noise Limits' of this licence states:

> *"L5.1 the $L_{A10\ (15min)}$ sound pressure level contribution generated from the premises must not exceed the following levels when measured at or near the boundary of any residential premises:*
>
> *a) 38 dBA at locations in Terara on the south side of the Shoalhaven River;*
>
> *b) 38 dBA at locations in Nowra on the south side of the Shoalhaven River;*
>
> *c) 42 dBA at locations in Meroo Street, Bomaderry;*
>
> *d) 40 dBA at other locations in Bomaderry."*

These noise limits apply to the overall operation of the Shoalhaven Starches complex.

The Shoalhaven Starches complex, neighbouring properties and nearby residential locations are shown on the attached site plan in **Figure 9**.

DAY DESIGN	Site Plan Shoalhaven Starches, Bomaderry, NSW	4701 FIGURE 1

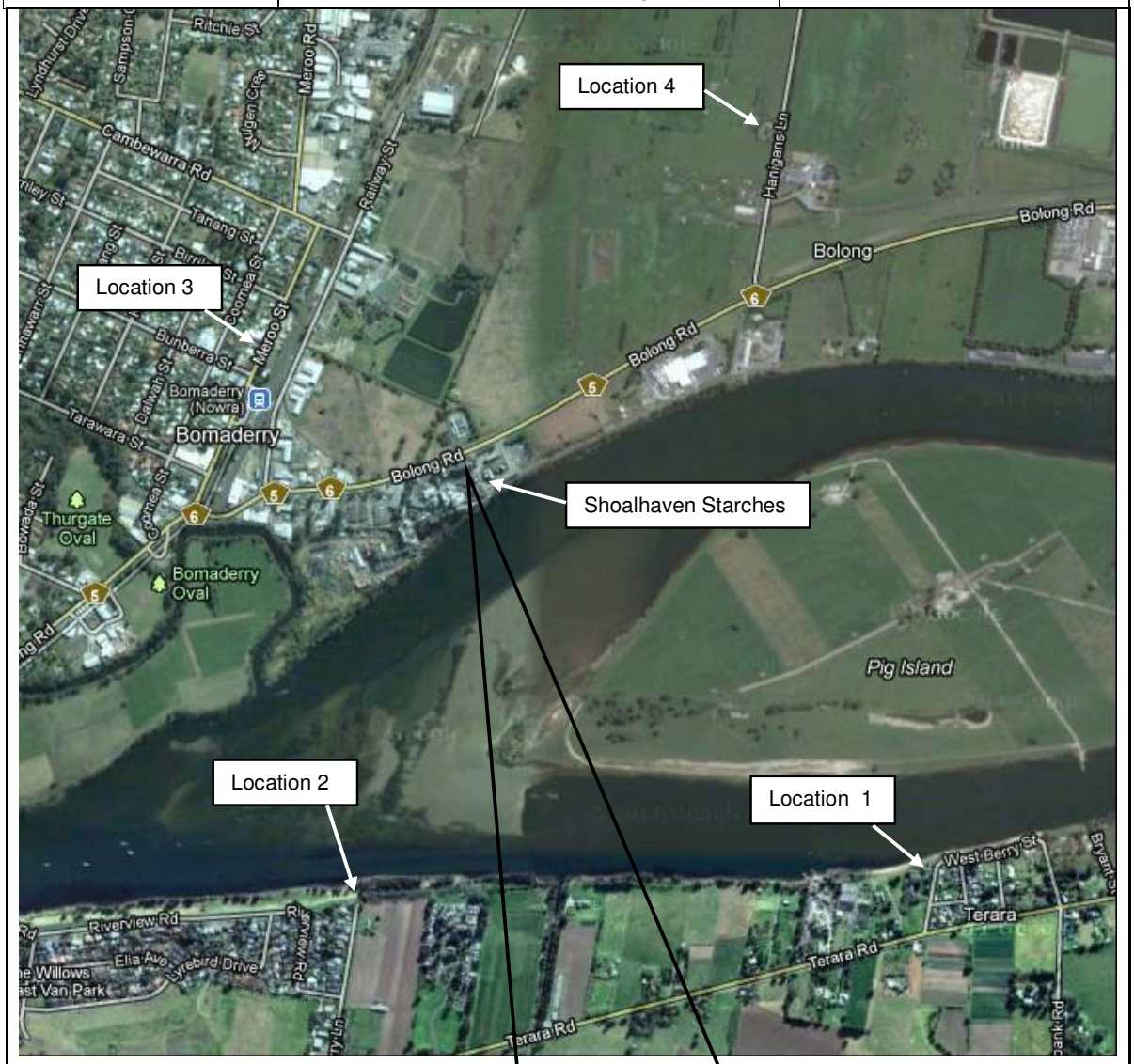


Figure 9: Nearest residential locations to Factory site.

8.2.2 Shoalhaven Starches Noise Management Plan

The Project Approval for the Shoalhaven Starches Expansion Project required the preparation of a Noise Management Plan to address and manage noise emissions from the Expansion Project.

The Shoalhaven Starches Noise Management Plan originally prepared 31 October 2009 and revised 7 September 2010 addresses, among other things, acoustic criteria relating to the Shoalhaven Starches complex and any new developments associated with the expansion project. Section 3 of the plan lists noise limits from the Environmental Protection Licence as shown in Section 4.1 above and states:

> *"Compliance testing conducted on a regular basis on behalf of the Mill* [Shoalhaven Starches complex] *has found noise emission from the premises satisfies the EPA criteria as a result of works on the Shoalhaven Starches site. In order to ensure that there is no increase in noise emission from the subject premises, with respect to the noise criteria nominated by the EPA in License Condition 6.3* [now 5.1]*, the design goal for such additional plant should be at least 10 dB below the criteria nominated by the EPA."*

8.2.3 NSW Industrial Noise Policy

The Office of Environment and Heritage (OEH) published the NSW Industrial Noise Policy (INP) in January 2000. The policy specifically aims to make provision for the assessment of noise from industrial noise sources scheduled under the Protection of the Environment Operations Act 1997.

The assessment procedure has two components; controlling intrusive noise impacts and maintaining noise level amenity.

Section 2.1 of the Industrial Noise Policy states that the L_{eq} level of noise intrusion from broad-band industrial noise sources may be up to 5 dB above the L_{90} background noise level at the receptor without being considered offensive. In this instance it is not practicable to measure background noise levels at any nearby receiver locations in the absence of noise from the Shoalhaven Starches complex.

The environment protection licence limits shown in Section 4.2 above are derived from previously measured background noise levels plus 5 dB and should be used to establish intrusiveness noise criteria as follows:

- 38 dBA ($L_{eq,\ 15\ minute}$) at locations in Terara on the south side of the Shoalhaven River;
- 38 dBA ($L_{eq,\ 15\ minute}$) at locations in Nowra on the south side of the Shoalhaven River;

- 42 dBA ($L_{eq,\ 15\ minute}$) at locations in Meroo Street, Bomaderry;
- 40 dBA ($L_{eq,\ 15\ minute}$) at other locations in Bomaderry.

These levels are derived from the lowest previously measured background noise levels during night time hours and would therefore apply at night. It is reasonable to assume that background levels may be higher in the day and evening and consequently the INP Intrusiveness Criteria could be higher also during these periods.

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. Table 2.1 of the NSW Industrial Noise Policy provides a schedule of recommended L_{eq} industrial noise levels that under normal circumstances should not be exceeded. For example in a suburban residential area, the L_{eq} noise emission level may not exceed 55 to 60 dBA in the daytime (7 am to 6 pm), 45 to 50 dBA in the evening (6 pm to 10 pm) and 40 to 45 dBA during the night (10 pm to 7 am).

In any event, the Environment Protection Licence noise limits are the more stringent and will be used for assessment. Compliance with a noise goal of 10 dB below the licence limits will ensure compliance with any Industrial Noise Policy criterion.

8.2.4 Project Specific Noise Criteria

When all the above factors are considered, Day Design Pty Ltd find that the most stringent noise criterion for the Proposed Modification is the Environment Protection Licence noise limits less 10 dB, as follows:

- *28 dBA ($L_{10,\ 15\ minute}$) at locations in Terara on the south side of the Shoalhaven River;*
- *28 dBA ($L_{10,\ 15\ minute}$) at locations in Nowra on the south side of the Shoalhaven River;*
- *32 dBA ($L_{10,\ 15\ minute}$) at locations in Meroo Street, Bomaderry;*
- *30 dBA ($L_{10,\ 15\ minute}$) at other locations in Bomaderry."*

According to Day Design these criteria apply at or near the boundary of any residential premises during the operational hours of the Proposed Modification.

8.2.5 Noise Emission Associated with Proposed Modification

Noise sources associated with the Proposed Modification include the pumps associated with the fermentation tanks, the beer column in the distillery and the evaporator. Representatives of Day Design inspected the Shoalhaven Starches site on various

occasions to measure noise levels of existing plant that is indicative to that which will be used as part of the Proposed Modification.

Details of the instrumentation used, measured sound power levels and predicted noise levels at nearby residential receptors are detailed below in Sections 8.2.5, 8.2.6 and 8.2.7 respectively.

8.2.6 Noise Survey Instrumentation

Noise level measurements and analysis were made by Day Design with instrumentation shown in **Table 3**.

Table 3

Noise Instrumentation

Description	***Model No.***	***Serial No.***
Modular Precision Sound Analyser Condenser Microphone 0.5" diameter Acoustical Calibrator Microphone Windscreen	B&K 2260 B&K 4189 B&K 4231 Acoustically transparent foam	244 3406 244 0653 243 9033
Real Time Sound level Analyser Condenser Microphone 0.5" diameter Microphone Calibrator Microphone Windscreen	CEL 593 MK 250 CAL 200 Acoustically transparent foam	035 426 3300 3646

The **B&K 2260** and **CEL 593 Sound Analysers** are real-time precision integrating sound level meters with octave and third octave filters, that sample noise at a rate of 10 samples per second. The analysers provide L_{eq}, L_1, L_{10}, L_{50} and L_{90} statistical data at 15 minute intervals (longer or shorter intervals optional) over the desired monitoring period.

According to Day Design all instrument systems had been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 0.3 dB during attended measurements. No adjustments for instrument drift during the measurement period were warranted.

8.2.7 Measured Noise Levels

Noise measurements were taken by Day Design of the existing fermentation and distillation plant at the Shoalhaven Starches Complex. Measurements were taken in terms of L_{10} sound pressure levels and have been used to calculate the L_{10} octave band,

and overall 'A' frequency weighted, sound power levels, in decibels re: 1 pW, shown in **Table 4** below.

Table 4

Existing Plant L_{10} Sound Power Levels

Description	***Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)***								
	dBA	63	125	250	500	1k	2k	4k	8k
Fermentation Tank Pump	**84**	86	81	75	75	77	76	74	80
Beer Column Pump	**90**	92	88	91	87	84	82	76	70
Evaporator Pump	**86**	89	88	82	79	82	77	75	73

8.2.8 Predicted Noise Levels

According to Day Design knowing the sound power level of a noise source (see **Table 4** above), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for distance losses, attenuation from barriers, ground absorption, etc.

The overall level of noise emission from the proposed Ethanol plant when calculated at the nearest residential locations (using computer modelling) is given in **Table 5** below.

Table 5

Predicted $L_{10,\ 15\ minute}$ Noise Levels at Residential Receptor Locations – Ethanol Plant Modification

	Nobblers Lane, Terara *(Location 1)*	***Riverview Road, Nowra*** *(Location 2)*	***Meroo Street, Bomaderry*** *(Location 3)*	***Hannigans Lane, Bomaderry*** *(Location 4)*
Predicted Noise Level $L_{10,\ 15\ minute}$ (dBA)	< 20	< 20	20	27
Acceptable Noise Level $L_{10,\ 15\ minute}$ (dBA)	**28**	**28**	**32**	**30**
Complies	Yes	Yes	Yes	Yes

The above calculations and predictions consider distance attenuation at each receptor location as well as the following:

- Barrier attenuation from existing site structures for the beer column pump at Locations 1, 2 and 3;
- Barrier attenuation from existing site structures for the evaporator pumps at locations 2 and 3 only; and

- a maximum 5 dB ground absorption attenuation at Location 4 only;

According to Day Design based upon the findings outlined in **Table 5** the level of noise emission from the proposed ethanol plant modification is well below the acceptable noise level at each receptor location without the need for noise controls.

8.2.9 Noise Impact Statement Conclusion

The Noise Impact Statement prepared by day Design concludes:

> *Measurements and computations show that the design noise goal for the modification to ethanol plant, of 10 dB below the licence noise limits, will be achieved.*
>
> *The proposed minor modifications to the ethanol plant at Shoalhaven Starches Pty Ltd, Bomaderry will not cause offensive noise as defined by the Protection of the Environment Operations Act 1997 and will comply with the requirements of the Director General and their Environment Protection Licence.*

8.3 AIR QUALITY (AND ODOUR) IMPACTS

This Modification Application is supported by a submission addressing air quality issues associated with the proposed modification prepared by Stephenson Environmental Management Australia (SEMA). A copy of SEMA's submission forms **Annexure 4** to this EA. SEMA draw the following conclusions from their review and assessment of this modification proposal:

1. *Shoalhaven Starches has identified two areas of the ethanol production process which can be modified to improve energy efficiency and better refine operational processes. These areas are Fermentation (operational processes) and Distillation (improved energy efficiency).*

2. *It is noted that these modifications will not increase capacity of the plant or production capability.*

3. ***Fermentation process:*** *It is also noted that it is proposed that two (2) additional fermentation tanks will be installed; that is, one to replace a fermenter to be converted to a buffer or surge tank and one (1) additional fermenter to facilitate the thorough cleaning of these tanks in a batch process cycle rather than continuous basis. However, the total volume processed through the fermentation process will not change from that nominated in Project – MP06-0228.*

4. ***Ethanol Distillery:*** *To reduce the amount of steam energy consumed by the Ethanol Distillery it is proposed to replace one of the older high pressure distillation columns with three (3) newer improved design low pressure columns. These newer columns will run at a lower steam pressure than the column they will replace. There are various other improved energy efficiency upgrades associated with the peripheral support equipment which is integral these proposed minor modifications.*

5. ***Boilers:*** *These distillery modifications are designed to improve energy efficiency by reducing requirements for steam created from the boilers. Therefore, this reduced steam demand will have the effect of reducing the particulate and gaseous emissions from the boilers.*

6. ***Overall:*** *The proposed minor modification to the ethanol plant will not increase production capacity or volume throughput. As presented above, it is designed to improve efficiency of both fermentation process and reduce steam consumption in the distillation process. Furthermore the fermentation tanks and distillation columns, by their very nature, are sealed, closed loop vessels which are designed to optimise the conversion efficiency in each of the process steps from commencement of fermentation to final ethanol distillation product. Therefore there will not be any additional emission discharge points associated with this minor upgrade or additional emissions through existing discharge points.*

7. ***Overview – Emissions****: The proposed minor modification will not increase production throughput and therefore, will not increase the gaseous emission of odour, oxides of nitrogen, volatile organic compounds, such as ethanol, or particulate emissions from the coal fired boilers. In fact it is likely that there will be an overall reduction in emissions from the plant; in particular, greenhouse gas emissions.*

8. ***Conclusions*** *–* ***Air Quality Assessment****: Therefore, since these minor modifications are not involved with increasing emissions to atmosphere and are contained within close looped vessels, it is concluded that the original dispersion modelling conducted to determine the environmental impact on air quality associated with the Shoalhaven Starches Expansion Project – MP 06_0228 will not change. In fact, there may be a marginal decrease in impact of greenhouse gas emissions from the boilers.*

8.4 FLOODING

This Modification Application is supported by a flood assessment prepared by Webb McKeown & Associates (WMA). A copy of WMA's report forms **Annexure 5** to this EA. This section of the EA is based upon the findings of this assessment.

WMA have undertaken numerous flood assessments associated with the development of the Shoalhaven Starches factory site and Environmental Farm including:

- *Proposed BOC Gases CO2 Plant and Dairy Farmers' Pond at Bomaderry Hydraulic Assessment of Cumulative Effects*, dated July 2000.
- *Further Development within the Manildra Starches Plant off Bolong Road, Bomaderry, Hydraulic Assessment*, dated 6th October 2000.
- *Construction of Pond No. 6*, December 2000 to March 2001
- *Construction of Pond No. 7 and Works at Plant*, dated 25th October 2002
- *Proposed Flour Mill - Manildra Starches Plant, off Bolong Road, Bomaderry, Hydraulic Assessment*, dated March 2007

- *Proposed Flour Mill and Silos - Bolong Road, Nowra: Flood Hazard & Structural Assessment*, dated April 2008
- *Proposed Ethanol Production Upgrade including Proposed Odour Reduction and Wastewater Treatment Measures for Existing and Proposed Shoalhaven Operations – Bolong Road, Nowra: Hydraulic, Economic, Social and Environmental Impacts of Flooding*, dated May 2008
- *Flood Mitigation and Management Plan*, dated June 2009

The report prepared by WMA that supports this Modification Application comprises an Addendum to their May 2008 report which concerned the Shoalhaven Starches Expansion Project. Their report held in **Annexure 5** therefore does not repeat the background, study approach and other details included in this previous assessment.

Each development on the floodplain has the potential to cause an impact upon flood levels and introduce additional flood risk. Whilst the individual impacts may be small the cumulative increases from several developments may be significant. Therefore, all proposed works need to be assessed in the context of the total cumulative impacts of all development within the immediate area.

The hydraulic assessment carried out by WMA in relation to this modification application investigates the incremental hydraulic impact of the works shown on **Figure 3** compared to the results indicated in their May 2008 report which represent the cumulative impacts of all development by Shoalhaven Starches since approximately 1990.

The hydraulic model that was used with the previous studies by WMA to assess the impacts of works on the floodplain was modified by WMA to reflect the proposed modification works (shown in red on **Figure 3**). WMA assumed that the proposed Beer Column and associated Condenser and other proposed associated works within the Distillery would have no impact on flood levels as they are to be sited within the existing plant and surrounded by other structures.

The Proposed Electricity sub station No.7, Compressor Room, Fermenter Nos.16 and 17 were considered by WMA and represented by a reduction in the flow path across the site.

WMA ran the hydraulic model for the Extreme and the 1%, 2% and 5% annual exceedance probability floods (AEP). Events smaller than the 5% AEP were not run as according to WMA there is no significant inundation of the plant in these smaller flood events.

According to WMA the results indicate that the incremental increase in flood level (for the full range of design flood events) as a result of the proposed works shown on **Figure 3** is less than 0.01 m. A change in flood level of +/- 0.01 m in flood level is within the order of accuracy of the flood modelling process and cannot accurately be defined. This very

small increase in flood level is, according to WMA, to be expected given the magnitude of the floodplain of the lower Shoalhaven River and the relatively small extent of the proposed works.

It should also be noted that the very small scale of the proposed works are such that it is not possible to precisely reflect the works in the existing hydraulic model. Thus they could only be reflected by an adjustment of the flow path from the Shoalhaven River across the Shoalhaven Starches site which likely over estimates the hydraulic effects of the proposed works.

8.5 VISUAL IMPACTS

The Scenic Character and Environment

The Shoalhaven Starches Factory Site is located on Bolong Road, one of the main gateway entrances to the Nowra / Bomaderry urban areas, and a significant tourist route along this section of the South Coast.

The factory site is situated within an area currently containing predominantly industrial land uses, although lands to the north have a rural character. These different land uses contrast with each other and result in a mixed visual character.

The rural areas, much of which comprises the Shoalhaven Starches Environmental Farm, are generally flat to gently undulating and planted with pasture grasses. These areas have a typical rural/agricultural character, common throughout the region. To the north and forming a background to the rural landscape are the timbered slopes of the Cambewarra escarpment.

The Shoalhaven City Council Heritage Study 1995 – 1998 prepared by Peter Freeman Pty Ltd in association with JRC Planning Services identified the rural landscapes north of the Shoalhaven River as the Berry-Bolong Pastoral Landscape. This Study described this area as:

> *"North of the Shoalhaven River the area is dominated by the close relationship between the Princes Highway (formalised by Berry in 1857/1858) and the railway (1893) which were instrumental in determining the location of new homesteads on Berry estate lands which resulted from drainage schemes implemented by Sir John Hay. In the foothills to the north-west, and towards Cambewarra, settlement patterns were in the main determined by the impact of Free Selection after 1861. Sub-zones include the Cambewarra-Tapitallee area, Bellawongarah and the catchment areas of Broughton Creek north of Berry. The latter are focused around communities which developed outside the Berry Estate: Cambewarra, Tapitallee, Bundewallah, Woodhill and Broughton Vale. The scale and character are dependent on the distribution of small dairy farms, with internal and external boundaries created by modified and natural vegetation (River Oaks), roads, creeks and property boundaries.*

Continuing dairy farms has contributed to the survival of the underlying late nineteenth and early twentieth century landscape patterns."

The Shoalhaven Starches factory complex is characterised by typical industrial structures with an overall bulk and scale that dominates the surrounding locality. The factory complex, despite being partially screened by vegetation along Bolong Road, the Shoalhaven River and Abernethy's Creek visually dominates the locality. The overall complex is particularly exposed to view along Bolong Road. This view reveals some of the internal structures within the site including recovery and storage tanks, car park, fermentation tanks and the Ethanol and Distillery Plants. Overall the appearance of the site is typical of a large industrial facility of this nature.

The most relevant vantage points from where the factory site is visible would include:

The Princes Highway – views of the existing factory site are possible from selected locations along the Princes Highway north of Bomaderry, travelling in both a northerly and southerly direction. Whilst the factory site is visible in the landscape, its overall visual impact is reduced by virtue of the distance between the plant; the intermittent nature of the views; a rise in topography which screens the site from view; and vegetation.

Burraga (Pig) Island – Burraga Island is situated in the middle of the Shoalhaven River to the south of the site and provides the closest vantage point to the southern boundary of the site. The island however is privately owned and not accessible to the public. Vegetation screening along the riverbank adjacent to the site also reduces the visibility of the existing buildings and structures.

Bolong Road – Bolong Road runs along the frontage of the site. Views of the plant are possible when travelling in both an easterly or westerly direction. Some attempts have been made to provide some tree planting along the boundaries to "soften" the appearance of the development. The existing building forms and structures are however clearly visible to motorists travelling along this stretch of Bolong Road.

Nowra Bridge – The Nowra Bridge crosses the Shoalhaven River and provides limited opportunities for views of the factory site. The dominant visual elements from the bridge are the river, vegetation along the riverbanks and the escarpment. The visual impact of the factory site is reduced by distance as well as the bridge structure which permits only glimpses of the site.

Bomaderry urban area – The existing plant is visible from a number of locations within the eastern outskirts of Bomaderry. Bomaderry is slightly elevated and some locations within the urban area do have extensive views of the site.

Terara – Distant views of the Plant are possible from a number of vantage points in and around the village of Terara on the southern bank of the River. The visual impact of the site however is reduced by distance, the intervening landform of Burraga (Pig) Island and the vegetated riverbanks.

Riverview Road – Views of the site are available from residential development on the southern bank of the Shoalhaven River. Vegetation along both the northern and southern banks of the river partially screens the site from view.

Cambewarra Lookout – Cambewarra lookout is a popular tourist lookout providing panoramic views over the Shoalhaven floodplain and estuary. Shoalhaven Starches, like the other significant industrial sites, is visible from the lookout.

Visual Impact of Proposal

The development application involves the installation of additional column like structures within the vicinity of the existing distillery located along the Bolong Road frontage of the site and within a central location of the factory site; as well as two additional fermentation tanks adjacent to existing fermentation tanks located at the eastern extremity of the factory site. The proposed works will all be visible when viewed from Bolong Road.

These proposed structures are generally of a similar height as the existing structures within the existing Shoalhaven Starches factory site; and importantly consistent in scale, height and appearance to existing structures within the immediate vicinity. The building forms, shapes and characteristics are also similar to those that presently exist on and within the immediate vicinity of the site, and will conform to the visual character of the site, ie. it is industrial development within an industrial setting.

The proposed fermentation tanks will be identical in shape, form and height to the existing fermentation tanks that already exist in this location. They will consist of large metal cylindrical tanks with a diameter of 16.0 metres and a height above ground level of 21 metres, with supporting gantries increasing the overall height of these works to 28.0 metres.

The proposed additional evaporator will consist of a series of additional column like structures situated within and adjacent to the existing distillery which currently consists of similar types of structures. The proposed evaporator columns will have a height ranging from 18.3 metres to 28.05 metres. Whilst the proposed new beer column and evaporator columns will be sited within and between the framework of the existing distillery, three of the proposed evaporator columns and associated equipment will be

situated upon a platform that will be situated between the distillery and Bolong Road frontage of the site.

Figure 10 provides a plan depicting the locations of vantage points (**Plates 2** to **9**) referred to in this section of the EA.

The Princes Highway

The Shoalhaven Starches factory is visible from sections of the Princes Highway between Boxsells Lane and Devitts Lane, Jaspers Brush (refer **Plate 2**) as well as its crossing of the Shoalhaven River (see Nowra Bridge). Due to the configuration of the highway and the siting of the factory, only southbound vehicles view the site. Vantage points along this section of the highway are 4.5 to 5.0 km from the site. The site becomes less exposed and is eventually obscured by a rise in topography further south of Boxsells Lane.

Given the distance from these vantage points the factory site is only barely visible. The rising topography upon which Bomaderry is sited screens the western portion of the site, as does intervening vegetation.

Given the distance of these views; the screening of the site attributed to terrain and vegetation; and the overall scale of the proposal in relation to the overall factory complex; it is considered the proposal will not adversely impact on views from these vantage points.

Plate 2: View of Shoalhaven Starches Factory from Princes Highway (within vicinity of Boxsells Lane). Factory site barely visible from this vantage point.

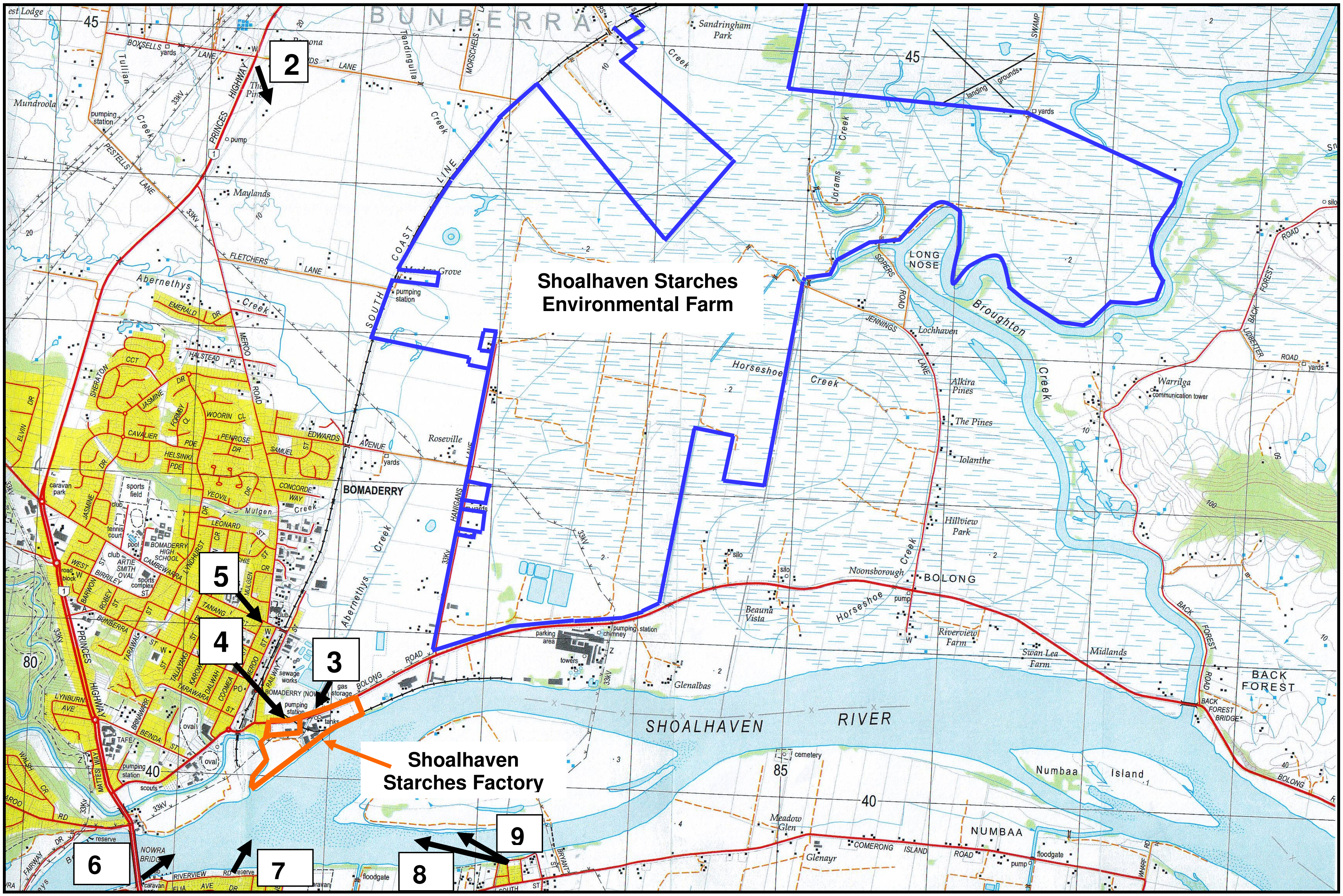


Figure 10: Vantage Points for Visual Analysis.

Bolong Road

The site is clearly visible from along Bolong Road.

The proposed additional fermenters will be clearly visible as are the existing fermenters, particular when viewing the site from along the Bolong Road frontage of the site.

The proposed plant associated with the proposed new evaporator and other vessels proposed to be erected within the distillery will also be clearly visible when viewed from Bolong Road.

These works however are all located on land within the vicinity and adjacent to structures that are similar and or the same in height, scale and appearance.

Given the nature of the existing site there is minimal scope to visually screen the site from Bolong Road. The development site will however by and large form part of the existing industrial complex and will incorporate structures that are of a similar bulk and scale and height as those which are situated within the overall complex. (Refer **Plates 3** and **4**.)

Plate 3: View of existing Fermenter tanks from Bolong Road.
The proposed additional Fermenter Tanks will be sited adjacent to these fermenter tanks.

Plate 4: View from Bolong Road of existing Ethanol Distillery Plant.

Bomaderry Urban Area

The township of Bomaderry is slightly elevated and some locations within this urban area have extensive views of the site (refer **Plate 5**). The proposed works within the distillery may be visible (as are the existing distillery columns) however the proposed additional fermenter tanks are unlikely to be visually prominent from these vantage points. As outlined the proposed works within the distillery will be similar in height to components of the existing distillery, and will be sited within proximity of other industrial activities. The proposed works in this part of the plant will be largely indistinguishable with existing plant. In this way the vistas from these vantage points will not be significantly altered.

Nowra Bridge

The view from Nowra Bridge to the east is mainly dominated by the river, riparian vegetation and the floodplain (refer **Plate 6)**. The site is largely obscured by riverside vegetation. The proposed fermenter tanks are situated further to the east of the factory site which is not visually prominent from this location. The proposed works within the distillery plant will be largely shielded from this vantage point by existing plant within the factory. These structures will be sited within the overall “silhouette” of the existing factory complex, and will not intrude into the existing skyline created by the existing factory.

Plate 5: View of Shoalhaven Starches factory site from corner of Meroo Road and Cambewarra Road, Bomaderry.

Plate 6: View of Shoalhaven Starches factory site from Nowra Bridge over the Shoalhaven River.

Riverview Road

The factory site is also visible from residences along located along Riverview Road directly south of the site (refer **Plate 7**). This view is from a distance of about 750 metres. Riverside vegetation along both the northern and southern banks of the river screens much of the site from view. However components of the factory are clearly visible. Existing industrial buildings are situated between the proposed works within the distillery and the river which will screen these structures from this vantage point. In this way it is unlikely that these proposed works will be visible from this vantage point. One of the proposed new Fermenter tanks could potentially be visible when viewed from the location, however riverside vegetation already obscures the views of existing Fermenter tanks when viewed from this location (refer **Plate 7**).

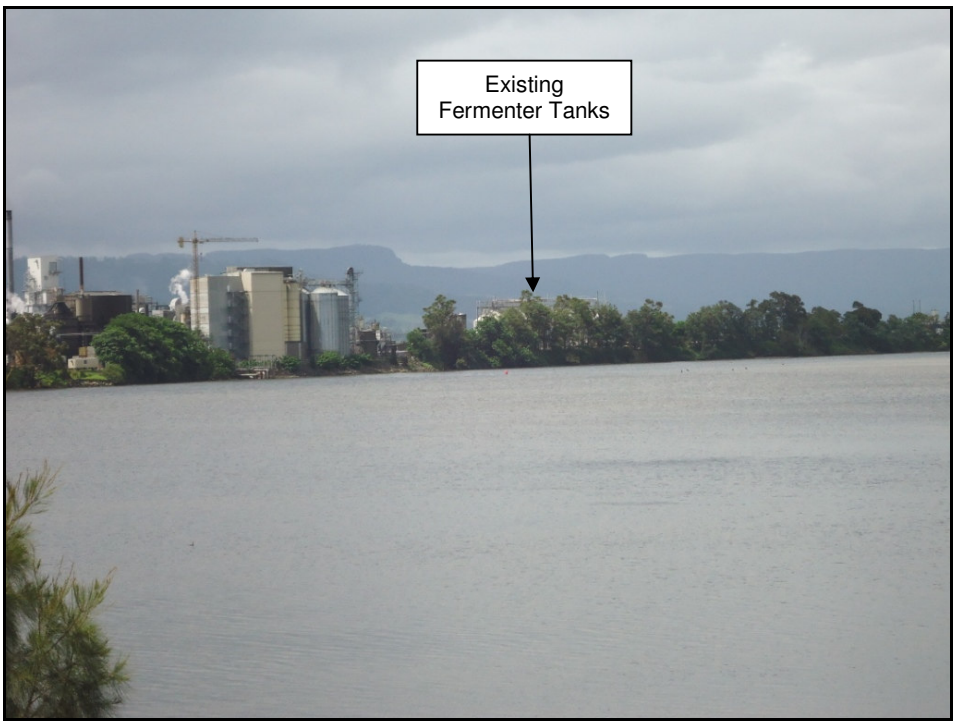


Plate 7: View of existing Shoalhaven Starches Factory Site and including Fermenter Tanks when viewed from Riverview Road area

Terara

The village of Terara is approximately 1.5 kilometres from the factory. The proposed works associated with the distillery will not be visible from this vantage point, mainly due to vegetation along the riverbank and the existing industrial development associated with the overall factory complex which screens the proposed works from view (refer **Plate 8**).

One of the proposed new fermenter tanks could potentially be visible when viewed from the location, however riverside vegetation already obscures the views of existing fermenter tanks when viewed from this location (refer **Plate 9**)**.**

Plate 8: View of Shoalhaven Starches Factory Site from the Terara Village.

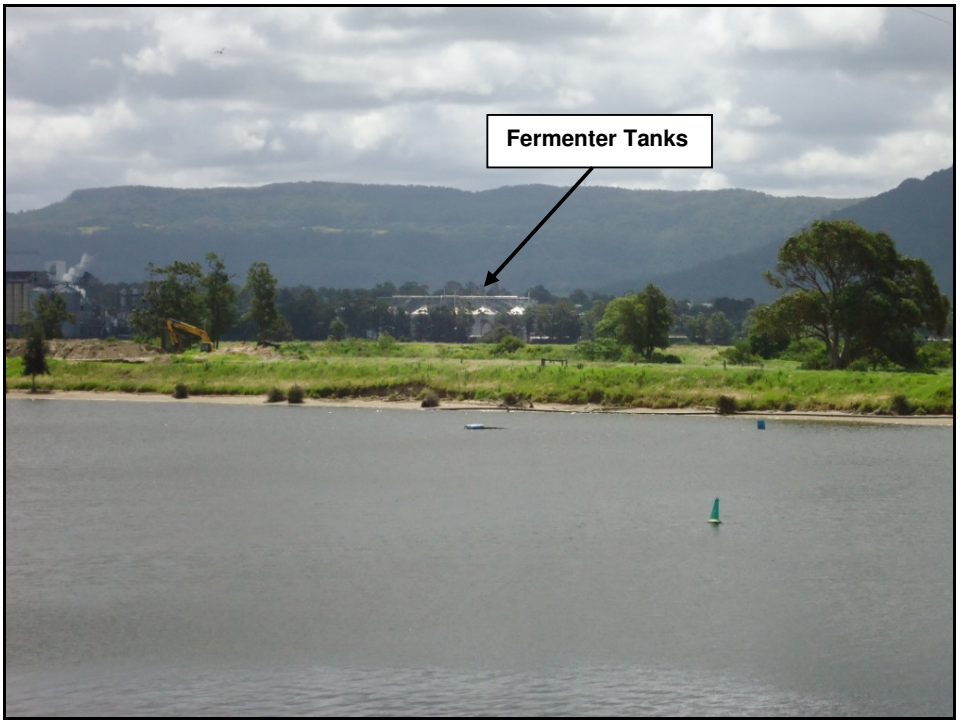


Plate 9: View of existing Fermenter Tanks when viewed from Village of Terara.

Cambewarra Lookout

Cambewarra Lookout is situated about 7 km to the northwest of the site. Views from the lookout are from an elevation over 620 m ASL, and encompass the Shoalhaven River floodplain and the coast including Jervis Bay. Whilst the factory site is visible from this vantage point, due to scale of the view, it would be extremely difficult to make out the works associated with the project from this vantage point.

Overall it is considered that the proposed works will not create a significant adverse visual impact due, principally, to the existing industrial development. There are however measures which can be implemented to assist in screening and further minimising any visual impact. Consideration for instance should be given to providing additional tree screening along the Bolong Road frontage of the site to assist in visually screening existing and proposed works from view. New structures can also be constructed and treated to reduce visual impact. Where appropriate and possible, buildings and structures should be constructed of similar materials to match the existing structures. Colours should blend with existing structures on the site to ensure visual harmony. Consideration should be given to incorporating a cladding colour to match the existing structures on the site.

9.0 STATEMENT OF ADDITIONAL COMMITMENTS

Section 8.0 of the EA for the Shoalhaven Starches Expansion Project prepared by our firm provides a Statement of Commitments agreed to by Shoalhaven Starches Pty Ltd outlining environmental management, mitigation and monitoring measures to be implemented to minimise potential impacts associated with the Shoalhaven Expansion Project and having regard to the findings of the EA.

The only additional commitments arising from this modification proposal include the following:

9.1 PRELIMINARY HAZARD ANALYSIS

Table 6 outlines recommended additional management procedures and design considerations that Shoalhaven Starches commits to implementing and incorporating into practices that would prevent and / or minimise risk scenarios from occurring.

Table 6

Preliminary Hazard Analysis

Preliminary Hazard Analysis
Shoalhaven Starches commits to implementing the following recommendations made by Matrix Risk as part of their PHA in relation to this Modification Application: • Review and evaluate the effectiveness of the existing hydrocarbon detectors. • Determine whether these hydrocarbon detectors are currently installed in optimal locations for activation of an improved deluge system. Installed hydrocarbon detectors have been certified by Gastech, but do not currently initiate a deluge. • Modify the existing deluge system to act as a water curtain and vapour barrier. This may involve an upgrade/or improvement of the existing system.

9.2 VISUAL IMPACT

As outlined in Section 8.5 of this EA it is our view that the proposed works will not create a significant adverse visual impact due principally to the location of the proposed works within the vicinity of existing structures of a similar height, bulk and scale as those works which are proposed. Shoalhaven Starches however commit to the following additional measures as outlined in **Table 7** to assist in screening and further minimising visual impacts arising from the proposed works.

Table 7

Visual Impact Mitigation Measures

Visual Impact Mitigation Measures
Shoalhaven Starches commits to implementing the following recommendations to mitigate the visual impact of the proposed works associated with this Modification Application: • The existing screening vegetation around the site is generally effective, particularly along the river bank. • In order to further reduce the visual impact of the proposed and existing fermenters and works associated with the distillery the northern boundary of the subject site landscaping with a combination of trees and shrubs should be undertaken along Bolong Road. • A Landscape Plan should be prepared for those areas of the site associated with this Modification Application and identify suitable plantings which will grow to a suitable height to assist in screening the works associated with this application. • Where tree planting has already been established, measures should be taken to protect existing vegetation during the construction phase. • In addition to landscaping, new structures can be constructed and treated to reduce visual impact. Where appropriate and possible, buildings and structures should be constructed of similar materials as those previously used on the site. Colours and materials should be consistent with those previously used on the site.

10.0 CONCLUSION

In 2009 the Minister for Planning issued Project Approval for an application made by Shoalhaven Starches to increase its ethanol production capacity at its existing ethanol plant located at the Shoalhaven Starches Plant at Bomaderry. This Project Approval enables Shoalhaven Starches to increase its ethanol production in a staged manner at its Bomaderry Plant from the current approved 126 million litres per year to 300 million litres per year.

Following the Minister's determination Shoalhaven Starches have been implementing and commissioning works in accordance with this approval. Following commissioning of components of the approved development the Company has had an opportunity to review and identify several operational efficiency and process improvements.

As a result Shoalhaven Starches have identified two areas to better refine operational processes and improve energy efficiency within the Fermentation and Distillation operations of the factory

The proposed modifications will not result in any increases in the capacity of the plant or volume throughput. The modifications to the Fermentation process are required for operational reasons while the Distillery modifications are required to improve energy efficiency

The preparation of this Environmental Assessment pursuant to Section 75W of the Environmental Planning & Assessment Act has been undertaken following consultation with relevant Government agencies, including:

- The Department of Planning;
- The OEH; and
- Shoalhaven City Council.

This Environmental Assessment has been prepared to address requirements issued by Director-General of the Department of Planning. Specifically the DGRs require the preparation of a Preliminary Hazard Analysis to update the existing PHA with the new processes and additional equipment. This EA is supported by a PHA prepared by Matrix Risk

The PHA includes recommendations to minimise risk associated with this Modification Application and Shoalhaven Starches commits to implementing these recommendations.

The EA is supported by a Noise Impact assessment prepared by Day Design Pty Ltd. This assessment confirms that the modification proposal will ensure that the Shoalhaven Starches factory site complies with the design noise goals and limits set under its EPL; and will not cause offensive noise.

The EA is also supported by an Air Quality Impact Assessment prepared by Stephenson Environmental Management Australia. This assessment confirms that since these modifications do not involve any increase in emissions and are contained within close looped vessels, that the original dispersion modelling conducted to determine the environmental impact on air quality associated with the Shoalhaven Starches Expansion Project will not change. In fact, there may be a marginal decrease in impact of greenhouse gas emissions from the boilers.

The EA is also supported by a report prepared by Webb McKeown & Associates addressing the flooding aspects associated with this proposed modification. This assessment indicates that the incremental increase in flood level (for the full range of design flood events) as a result of the proposed works associated with this modification application is less than 0.01 m. This very small increase in flood level is to be expected given the magnitude of the floodplain of the lower Shoalhaven River and the relatively small extent of the proposed works.

Under the terms of the DGR's for this proposed modification the conclusion of the EA is required to justify the project on economic, social and environmental grounds taking into consideration whether the project is consistent with the objects of the EPA Act 1979. The objects of the EPA Act are detailed within Section 5 of the Act and include:

(a) to encourage:

(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,

(ii) the promotion and co-ordination of the orderly and economic use and development of land,

(iii) the protection, provision and co-ordination of communication and utility services,

(iv) the provision of land for public purposes,

(v) the provision and co-ordination of community services and facilities, and

(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and

(vii) ecologically sustainable development, and

(viii) the provision and maintenance of affordable housing, and

(b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and

(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

Following an assessment of the key issues associated with this proposal, this E A concludes that the proposal is suitable for the site and this locality and consistent with the above objects of the EPA Act.

- The works associated with this Modification Application seek to better refine operational processes and improve energy efficiency within the site's operations.
- The proposed modifications will not result in an increase in the capacity of the plant or volume throughput.
- The works will not result in increases in wastewater treatment and disposal.
- The proposed modification will not result in any increase in air quality impacts including odours within the locality.
- The overall development incorporating the works associated with this proposed modification will still achieve the design noise limits for the site and will not cause offensive noise as defined by the Protection of the Environment Operations Act 1997.
- The proposal will also not alter the vehicle generation of the site, or by association result in any adverse impacts on the local traffic network. The proposal will not result in any adverse social impacts to the local community.
- The incremental increase in flood level (for the full range of design flood events) as a result of the proposed works associated with this modification application is less than 0.01m. This very small increase in flood level is to be expected given the magnitude of the floodplain of the lower Shoalhaven River and the relatively small extent of the proposed works.
- The proposed works will not create a significant adverse visual impact given the structures associated with this modification proposal are to be sited within the vicinity of similar structures of a similar height, bulk, scale and appearance and will be in keeping with the character of development on the site. There are however measures which can be implemented to assist in screening and further minimising any visual impact.
- The proposed modification will not result in any significant adverse environmental impacts within the locality.
- Relevant government agencies have been consulted with respect to the proposal.

The Environmental Assessment includes a Statement of Additional Commitments that should be read in conjunction with the Statement of Commitments detailed in the original EA prepared by our firm. This Statement of Additional Commitments outlines environmental management, mitigation and monitoring measures that should be implemented to minimise potential impacts associated with this proposal. In this regard Shoalhaven Starches commit to:

- Implementing the following recommendations made by Matrix Risk as part of their PHA that supports this Modification Application:
    - Review and evaluate the effectiveness of the existing hydrocarbon detectors.
    - Determine whether these hydrocarbon detectors are currently installed in optimal locations for activation of an improved deluge system. Installed hydrocarbon detectors have been certified by Gastech, but do not currently initiate a deluge.
    - Modify the existing deluge system to act as a water curtain and vapour barrier. This may involve an upgrade/or improvement of the existing system.
- Implementing the following recommendations to mitigate the visual impact of the proposed works associated with this Modification Application:
    - In order to further reduce the visual impact of the proposed and existing fermenters and works associated with the distillery the northern boundary of the subject site along Bolong Road should be landscaped with a combination of trees and shrubs.
    - A Landscape Plan should be prepared for those areas of the site associated with this Modification Application which identifies suitable plantings which will grow to a suitable height to assist in screening the works associated with this application.
    - Where tree planting has already been established, measures should be taken to protect existing vegetation during the construction phase.
    - In addition to landscaping, new structures can be constructed and treated to reduce visual impact. Where appropriate and possible, buildings and structures should be constructed of similar materials as those previously used on the site. Colours and materials should be consistent with those previously used on the site.

The Minister's approval of this proposed modification to Project Approval MP 06_0228 is sought for the proposal.

ANNEXURE 1

Director-General Requirements (DGRs)
for the preparation of this EA

ANNEXURE 1

NSW GOVERNMENT | Planning & Infrastructure

Contact: David Mooney
Phone: (02) 9228 2040
Fax: (02) 9228 6399
Email: david.mooney@planning.nsw.gov.au

Our ref: 10/06422

Brian Hanley
Manager, Energy & Sustainability
Manildra Group
PO Box 123
NOWRA NSW 2541

Dear Mr Hanley,

Director General's Requirements - Section 75W Modification Application - Shoalhaven Starches Expansion Project - MP06_0228 Fermentation tanks and distillation columns MOD 2

I refer to your request to modify the Minister's approval (MP 06_0228) at the Shoalhaven Starches Bomaderry Factory, under Section 75W of the *Environmental Planning & Assessment Act 1979* (EP&A Act).

I have attached a copy of the Director-General's requirements for the environmental assessment of the proposed modification.

These requirements will be published on the Department's website along with other relevant information that becomes available during the assessment of the proposed modification. Please ensure any documents that you submit are in a suitable format for the web.

You should contact the Department at least 2 weeks before you propose to submit the environmental assessment for the project so that we may determine:

- the applicable fees;
- the consultation requirements; and
- the number of copies of the environmental assessment required.

Please feel welcome to telephone or email David Mooney on the details above if you have any questions.

Yours sincerely

DKitto 1/9/11

David Kitto
Director
Mining and Industry
As delegate for the Director-General

Director-General's Requirements

Section 75W of the *Environmental Planning and Assessment Act 1979*

Application number	MP06_0228 MOD 2 Fermentation tanks and distillation columns
Proposed modification	To install two additional ethanol fermentation tanks to facilitate batch instead of continuous fermentation; and to replace one older high steam-pressure distillation column with three new low steam-pressure distillation columns to improve energy efficiency.
Site	160 Bolong Road, Bomaderry
Proponent	Shoalhaven Starches Pty Ltd
Date of Issue	August 2011
Date of Expiry	August 2013
General Requirements	The Environmental Assessment of the proposed modification must include: • an executive summary • a detailed description of the following within the site and any associated areas: – historical operations/activities – existing and approved operations/facilities, including any statutory approvals that apply to these operations and facilities; – a description of the proposed modifications in relation to any existing environmental management plans that may need to be updated; • a detailed description of the project, including: – need for the modification – proposed modifications or upgrades to activities or infrastructure – alternatives considered – various components and stages of the proposal – likely interactions between existing and proposed operations; and – plans of any proposed building works – flow-diagrams that show how the modifications work. • a detailed assessment of the following, and any other significant issues identified in the Environmental Risk Assessment (see 'Key Issues'): – a description of the existing environment, using baseline data; – a detailed description of the process and equipment modifications involved (to determine whether any additional impacts are likely (e.g. noise, odour, wastewater and traffic); – an assessment of the potential impacts of the project, including any cumulative impacts, taking into consideration any relevant guidelines, policies, plans and statutory provisions – a description of the measures that would be implemented to avoid, minimise, mitigate, rehabilitate/remediate, monitor and/or offset the potential impacts of the project, including detailed contingency plans for managing any significant risks to the environment. • a statement of commitments, outlining all the proposed environmental management and monitoring measures • a conclusion justifying the project on economic, social and environmental grounds, taking into consideration whether the project is consistent with the objects of the *Environmental Planning & Assessment Act 1979*; and • a signed statement from the author of the Environmental Assessment, certifying that the information contained within the document is neither false nor misleading.

Key Issues	• **Preliminary Hazard Analysis** – update the existing Preliminary Hazard Analysis with the new processes and additional equipment.
References	While not exhaustive, the following attachment contains a list of the guidelines, policies, and plans that may be relevant to the environmental assessment of the project.
Consultation	During the preparation of the Environmental Assessment, you should consult with the relevant local, State or Commonwealth government authorities, service providers, community groups or affected landowners. The consultation process and the issues raised must be described in the Environmental Assessment. In particular, you should consult with: • Shoalhaven City Council; and • Department of Environment, Climate Change and Water. The consultation process and the issues raised must be described in the Environmental Assessment.

Guidelines, Policies and Plans

Aspect	Policy /Methodology
Hazard and Risk	
	AS/NZS 4360:2004 Risk Management
	HB 203:2006 Environmental Risk Management – Principals and Process
	State Environmental Planning Policy No 33– Hazardous and Offensive Development (SEPP 33)
	Applying SEPP 33 – Hazardous and Offensive Development Guidelines
	Planning Advisory Paper No. 6 – Hazard Analysis, 2011, Department of Planning
	Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning, 2011, Department of Planning
Air Quality	
	Protection of the Environment Operations (Clean Air) Regulation 2002
	Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW (DEC)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC)
Odour	
	Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW (DEC)
	Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW (DEC)
Noise	
	NSW Industrial Noise Policy (DECC)
	Environmental Criteria for Road Traffic Noise (NSW EPA)
	Environmental Noise Control Manual (DECC)
Soil and Waters	
Soil	Acid Sulfate Soil Manual (ASSMAC)
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC & NHMRC)
	National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Managing Land Contamination - Planning Guidelines SEPP 55 – Remediation of Land (DUAP and EPA)
	Contaminated Sites: Sampling Design Guidelines (NSW EPA)
	Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (NSW EPA)
Surface Water	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems - Effluent Management (ARMCANZ/ANZECC)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems - Use of Reclaimed Water (ARMCANZ/ANZECC)
	National Water Quality Management Strategy - Guidelines For Water Recycling: Managing Health And Environmental Risks (Phase1) (EPHC, NRMMC & AHMC)
	National Water Quality Management Strategy - Guidelines For Water

	Recycling: Managing Health And Environmental Risks (Phase1) (EPHC, NRMMC & AHMC)
	Managing Urban Stormwater: Council Handbook. Draft (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control. Draft (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC)
	Floodplain Risk Management Guideline: Practical Consideration of Climate Change (DECC)
Groundwater	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	NSW State Groundwater Policy Framework Document (DLWC)
	NSW State Groundwater Quality Protection Policy (DLWC)
	NSW State Groundwater Quantity Management Policy (DLWC) Draft
	The NSW State Groundwater Dependent Ecosystem Policy (DLWC)
	Guidelines for the Assessment and Management of Groundwater Contamination (DECC) Draft
Greenhouse Gas	
	National Greenhouse Accounts (NGA) Factors
	Guidelines for Energy Savings Action Plans (DEUS)
Transport	
	Guide to Traffic Generating Development (RTA)
	Road Design Guide (RTA)
Waste	
	Waste Avoidance and Resource Recovery Strategy (Resource NSW)
	Waste Classification Guidelines (DECC)
Flora and Fauna	
	Draft Guidelines for Threatened Species Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979* (DEC)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Visual	
	Control of Obtrusive Effects of Outdoor Lighting (Standards Australia, AS4282)
Heritage	
Aboriginal	Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC)
Non-Indigenous	NSW Heritage Manual (NSW Heritage Office & DUAP)

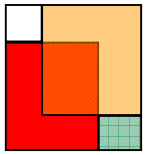
ANNEXURE 2

ANNEXURE 2

Preliminary Hazard Analysis

prepared by

Matrix Risk Pty Ltd



MATRIX RISK PTY LTD

SHOALHAVEN STARCHES ETHANOL PLANT MODIFICATIONS PRELIMINARY HAZARD ANALYSIS

19 December 2011

Submitted to: Brian Hanley

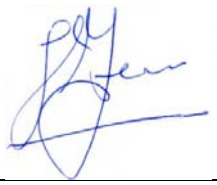
J22.1108.MAN.d01.2 *19 December 2011*

MATRIX RISK Pty Ltd
Suite 1
2 Dean St
KEW
Vic 3124

ACN *089 067 890*
ABN *11 089 067 890*
Telephone: +61 3 98168566
Facsimile: +61 3 98168566
E-mail: matrix@matrixrisk.com.au
Web: www.matrixrisk.com.au

DOCUMENT ISSUE & DISTRIBUTION

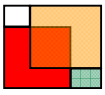
Job Number	J22.1108.MAN.d01.2
Document Title	Shoalhaven Starches Ethanol Plant Modifications Preliminary Hazard Analysis

Revision No.	**Date Issued**	**Checked**	**Authorised**
1	19 December 2011	DB	JCG 

Client Details
Brian Hanley Shoalhaven Starches Pty Ltd Manildra Group Bolong Rd Bomaderry

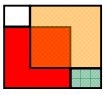
REVISION REGISTER			
Page	**Revision**	**Date**	**Comments**
	0	28 November 2011	Draft PHA for review.
	1	17 December 2011	Manildra review comments included.
	2	19 December 2011	Manildra review comments included.

TABLE OF CONTENTS



LIST OF TABLES

LIST OF FIGURES



1. EXECUTIVE SUMMARY

The analysis has assessed both the onsite and offsite risks of fires and explosions. Impacts on the community, third party occupancies, adjacent industrial or residential sites and the environment have been considered. The analysis has considered in principle the various preventative and mitigative safeguards and controls that will be implemented in the design stage, to ensure that the level of offsite risk will be at an acceptable level to all parties concerned.

1.1 FINDINGS AND CONCLUSIONS

From the risk and consequence effects analysis, the following was concluded:

- The offsite cumulative risk of fatalities for adjacent sensitive areas and occupancies will be less than the threshold level of risk of 50 x 10^{-6} p.a. if risk reduction measures that are recommended are implemented.
- The level of on-site and offsite risk will be reduced substantially by upgrading the deluge system which will be activated by hydrocarbon detectors. The deluge system will act as a vapour barrier and will be designed to reduce the Ethanol vapour concentration to below LEL.
- For the modification, a release of Ethanol vapour will not occur at pressure, hence the potential for a vapour cloud explosion (VCE) is considerably reduced.
- Any streams entering or leaving Fermenters 16 and 17 are considered to be non-hazardous.
- The potential for pool fires resulting from releases from the side stripper and rectifier within the Distillery will result in no increase in the Individual Risk of Fatality, as no additional release of flammable material will occur.
- The offsite cumulative risk of fatalities for residential areas will be less than the threshold level of risk of 1 x 10^{-6} p.a.
- The cumulative risk of injury due to exposure to radiant heat at levels in excess of 4.7 kW/m^2 in each of the sensitive areas and occupancies will be less than the threshold level of risk of 50 x 10^{-6} p.a.
- The cumulative risk of injury due to explosion overpressure levels in excess of 7 kPa in each of the sensitive areas and occupancies is less than the threshold level of risk of 50 x 10^{-6} p.a.
- There will be no increase in the level of environmental risk.
- There will be no increase in the level of risk of damage to property and the assets.

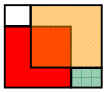
The consequence effects and vulnerability analysis indicates that the risk of property and environmental damage will be acceptably low. The results of this PHA show that the risks associated with the proposed modification comply with the DoP guidelines for tolerable fatality, injury, escalation and societal risk.

The modifications do not pose additional risks to the biophysical environment from potential hazardous events. The proposed modifications will have no significant impact on existing cumulative individual risk contours. In addition to this, the controls and safeguards proposed will be more effective than the existing controls and safeguards as overall preventative and mitigation risk reduction measures.

Societal risk is qualitatively concluded to be acceptable given:

- No events analysed in the study have the potential for off-site impact and, for the ones that do, their likelihood is acceptably low; and
- The population density in the area surrounding the plant is relatively low.

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



Also, the modification does not pose unacceptable levels of additional risk to the biophysical environment from potential hazardous events.

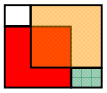
Additionally, the proposed modification will have no significant impact on any existing cumulative individual risk contours.

It is assumed that the proposed modifications will be reviewed during a HAZOP. A fire safety study will be performed and the existing safety management systems and emergency response plans will be revised to reflect the proposed changes.

1.2 RECOMMENDATIONS

The following recommendations are made as part of this PHA:

- Review and evaluate the effectiveness of the existing hydrocarbon detectors.
- Determine whether these hydrocarbon detectors are currently installed in optimal locations for activation of an improved deluge system. Installed hydrocarbon detectors have been certified by Gastech, but do not currently initiate a deluge.
- Modify the existing deluge system to act as a water curtain and vapour barrier. This may involve an upgrade/or improvement of the existing system.



2. INTRODUCTION

The Ethanol plant utilises waste from the Starch, Gluten and Syrup's sections of the plant to feed the Fermentation and Distillation Plants, which produce Ethanol.

Starch and grain are mixed in the Fermentation Plant where the Starch is converted to sugars, which are fermented to produce Ethanol. In the fermentation process yeast converts the incoming sugars to Ethanol. This process requires a large residence time in large volume Fermenter Tanks, which allow sufficient time for the process to take place producing "beer" to feed the Distillery.

The Distillery separates the Ethanol from the "beer" in the Beer Column. The Ethanol is then purified in the Rectification Columns and Molecular Sieves where the remaining water, not removed by the Beer Column, is removed.

Shoalhaven Starches have identified two areas where operations can be improved and energy efficiency increased substantially. Essentially this may be achieved by means of modifications in the Fermentation and Distillation Plants.

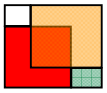
The modifications proposed will involve installation of:

- Quadruple effect evaporators, to concentrate the syrup feed stream to the Fermenter Tanks. Heat will be provided by a hot vapour stream from the Beer Columns.
- Evaporator Effects 1 and 2 in the zoned area adjacent to the Distillery on the west side. The area is congested and will require the removal of a concrete wall and a set of access stairs to provide sufficient space for plant and equipment to be installed.
- Evaporator Effects 2, 3 and 4 in an unzoned Ethanol free area, adjacent to the Distillery on the North side. The area is currently unoccupied.
- A side-stripper and rectifier in the Distillery area.
- Two Fermenter Tanks adjacent to the existing Fermenter Tanks.

Manildra have requested a modification to the Minister's approval (MP 06_0228) at the Shoalhaven Starches Bomaderry Factory under Section 75W of the Environmental Planning and Assessment Act 1975 (EP&A Act). The NSW Director General requirements regarding the installation of the plant and equipment are to prepare a Preliminary Hazard Analysis which will update the existing PHA with the new processes and additional equipment.

This PHA has been prepared to comply with the requirements of the Director General and in accordance with the guidelines published by the NSW Department of Planning (DoP) Hazardous Industry Planning Advisory Papers No. 4 and 6 [1 & 2] (HIPAP).

The analysis has assessed both the onsite and offsite risks of fires and explosions. Impacts on the community, third party occupancies, adjacent industrial or residential sites and the environment have been considered. The analysis has considered the various preventative and mitigative safeguards and controls that are normally implemented to ensure that the level of offsite risk will be at an acceptable level to all parties concerned.



2.1 AIMS AND OBJECTIVES

The objectives of the PHA were to:

- Identify all hazards associated with the proposed modification, with the potential for on-site and off-site impacts;
- Assess and quantify risks to people from the proposed plant in surrounding occupancies and land uses;
- Determine whether these risks were less than the threshold levels of risk set in the NSW DoP in Hazardous Industry Planning Advisory Paper HIPAP[1] No 4;
- Provide an opinion regarding the level of environmental or property damage risk;
- Assess whether proposed safeguards and controls will effectively prevent and mitigate the potential hazardous events; and
- Where necessary, submit recommendations to Manildra to ensure that modified plant and equipment will be operated and maintained at acceptable levels of safety and that effective safety management systems will be implemented when the modified plant and equipment become operational.

2.2 SCOPE

This PHA addresses the credible, potential hazardous events and corresponding risks associated with the modifications proposed with the potential for off-site impacts.

The impacts of the following modifications were analysed. The installation of:

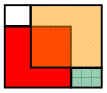
- Evaporator Effects 1 and 2 adjacent to the Distillery on the West side.
- Evaporator Effects 2, 3 and 4 in an unzoned and unoccupied Ethanol free area, adjacent to the Distillery on the North side.
- Additional Fermenter Tanks to provide a back-up when Fermentation Tanks are taken out of service for cleaning.
- The impact of replacing one of the high pressure distillation columns within the Distillery with three low pressure columns was analysed.
- The impact of removal of the concrete wall and access stairs separating the Distillery from the adjacent process area to provide more space for plant and equipment to be installed was analysed.
- The risk associated with the rest of the Ethanol plant or any other process units in the vicinity was not included in the analysis.

2.3 METHODOLOGY & APPROACH - SUMMARY

In accordance with the approach recommended by the DoP in HIPAP[2] 6, the underlying methodology of the PHA was a risk-based approach, that is, the risk of a particular potentially hazardous event is assessed as the outcome of its consequences and likelihood.

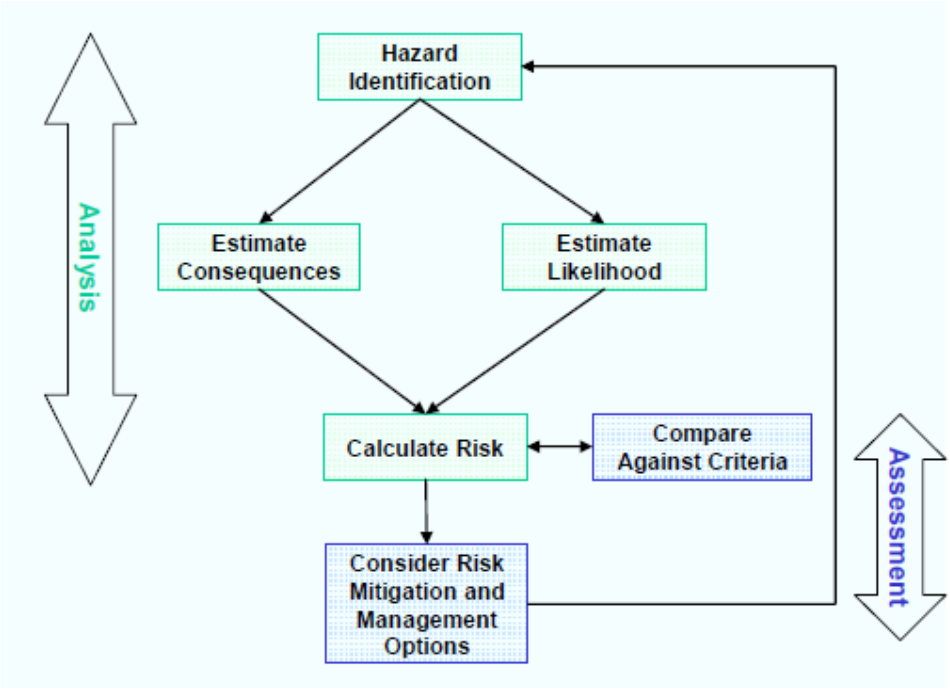
The main elements of the PHA[2] conducted were:

- The nature and scale of all hazards associated with the additional evaporators, Fermenter Tanks and columns and associated equipment to be installed on site were identified;
- Representative fire and, explosion release scenarios involving Ethanol were selected;
- The consequence effects of these incidents were determined;
- The vulnerabilities of people, property and the biophysical environment to these 'effects' were analysed;



- The likelihood of such events occurring were determined and the effectiveness of existing and proposed safeguards, controls and "layers of protection" as risk reduction measures evaluated;
- The resulting risk levels at the plant and off-site were determined;
- Risk levels were compared to established risk level criteria; and
- Opportunities for risk reduction were identified.

The PHA process followed is shown in the following schematic.



The detailed approach and methodology is given in Section 10.1.

3. SITE, FACILITY AND PROJECT DESCRIPTION

3.1 SHOALHAVEN STARCHES

Shoalhaven Starches is a member of the Manildra Group and operates the Shoalhaven Starches plant near Nowra. The plant was constructed in 1970, and produces Starch, Gluten, Glucose, Brewer's Syrup, Gem Sweet, Ethanol and Dimethyl Ether.

The irrigation area, known as the Environmental Farm comprises cleared grazing land, spray irrigation lines and 6 wet weather storage ponds with a total capacity of 925 megalitres.

3.2 DESCRIPTION OF PLANT AND AREA

3.2.1 LOCATION AND LAYOUT

The location of the site is shown in Figure 3.4-1; Page 15.

The plant is located within the industrial and farming area of Bomaderry, in the district of Nowra which is located approximately 160 km south of Sydney. The plant is located 2 km north east of Nowra on a flat alluvial plain on the northern banks of the Shoalhaven River. The plant is located on the south side of Bolong Road, the main road from the Princess Highway to Shoalhaven Heads, located approximately 3 km north of the city of Nowra. The plant covers an area of 12.5 hectares.

3.2.2 ADJACENT TOWNSHIPS, PROPERTIES AND LAND

The site is surrounded by a mix of agricultural and industrial properties with the township of Bomaderry located to the west with the nearest residence located 200 meters to the north-west. Bomaderry is located approx 0.5 km to the west of the site.

The immediate surrounding environment can be described as follows:

- North: The property boundary faces the sealed Bolong Road. The company owns approximately 1000 hectares of cattle grazing land beyond Bolong Road.
- South: The property faces onto the left bank of the Shoalhaven River.
- East: The property boundary faces onto vacant land, with the Australian Paper plant located a few hundred meters beyond.
- West: The property boundary faces a steel distribution facility.

Open grassland to the north of Bolong Road is owned by the company and is irrigated by treated wastewater from the plant.

The village of Terara is located on the southern bank of the Shoalhaven River, separated from the site by Pig Island, which is used for dairy cattle grazing.

3.2.3 NEIGHBOURING INDUSTRIES

There are small workshops, industries and storage facilities adjacent to the plant and located between Bolong Road and the Shoalhaven River.

Land to the east is zoned industrial. The only significant off-site hazard in the area, shown on Figure 3.2-1, is the Jemena Natural Gas Facility (ACTEW AGL).

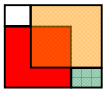
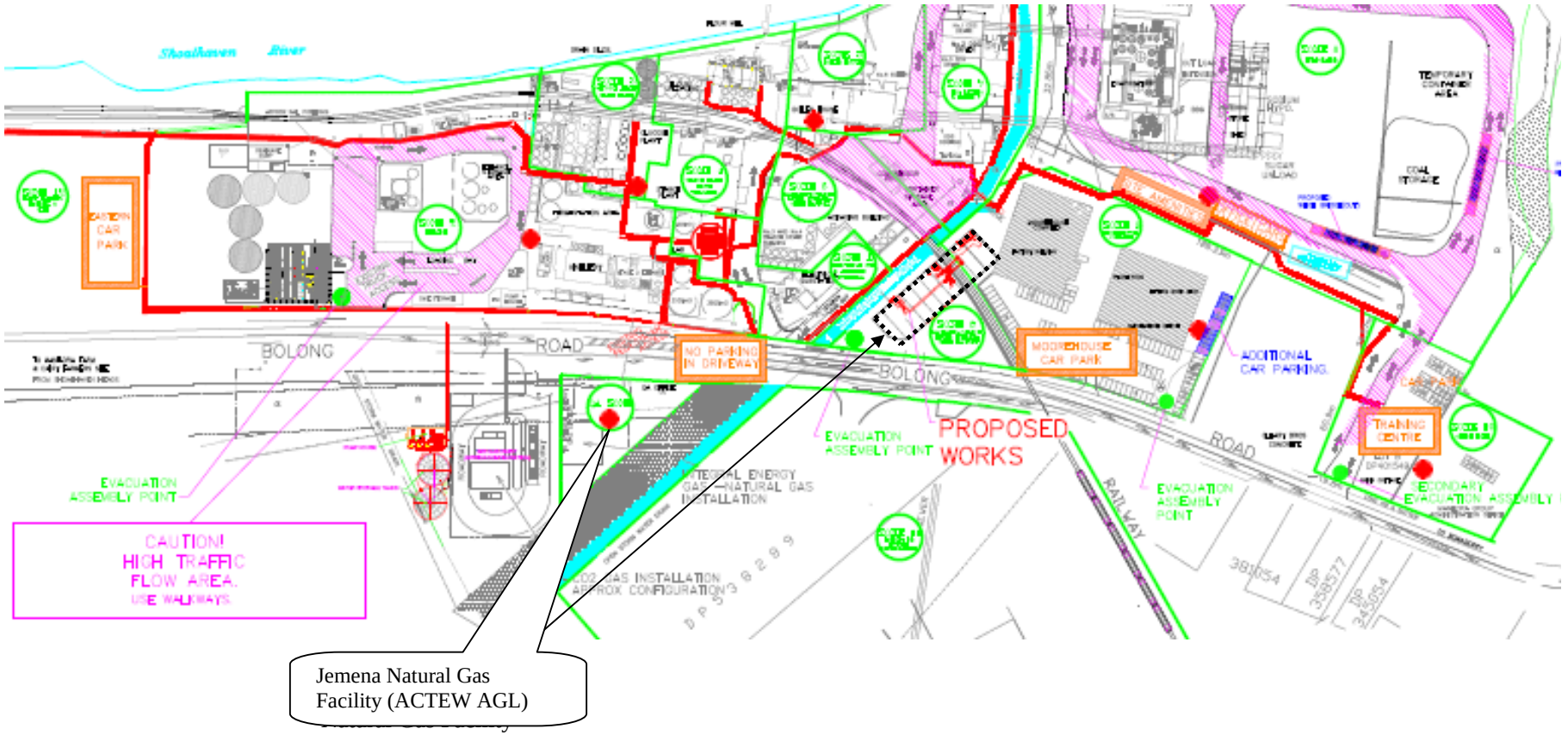


Figure 3.2-1: Offsite Hazards



3.2.4 SENSITIVE AREAS

There are no sensitive areas such as hospitals, child care facility, schools or residential areas located close to the site.

3.3 OFF-SITE POPULATION DENSITY

The plant operates on a 24 hour, seven days a week, basis.

There is no residential or sensitive population close to the site that can be affected by a fire, flash fire or explosion on the site. The closest residential area is over 350 m away to the west beyond the railway line.

As indicated, the residential population of Bomaderry is centred in the north and west of the suburb. The main residential community is located within an area bounded by Bolong Road (to the south); Princes Highway to the west/north); and Meroo Road to the east.

3.4 PROJECT DESCRIPTION

3.4.1 FERMENTATION PLANT MODIFICATIONS

A recent review of operations has identified a requirement of install additional Fermenter Tanks on site for the following reasons.

3.4.1.1 ADDITIONAL FERMENTER TANKS

Two new Fermenter Tanks are required to enable Fermenter Tanks to be taken out of service for cleaning and to act as a buffer to steady the flow to the Distillery.

Currently process disruptions occur during cleaning of the Fermenter Tanks. This results in peaks and troughs in production within both the Distillery and DDGS Plants. The allocation of an existing Fermenter Tank as a buffer tank will even out the flows and will reduce the peaks which occur. This will result in improved operational efficiency due to improved control of the process.

3.4.1.2 BACK-UP FERMENTER TANK

A second back-up Fermenter Tank is required that will enable operating Fermenter Tanks to be replaced by a back-up tank while a tank is removed from service for cleaning. This arrangement will prevent bacterial infection during the cleaning process.

3.4.2 DISTILLERY MODIFICATIONS

The installation of quadruple effect evaporators adjacent to the existing Distillery will provide a significant reduction in energy usage. The Evaporators will cause an increase the solids in the feed thus reducing the amount of liquid that needs to be heated up to vapourise Ethanol in the Distillery.

The Distillery is the largest steam consumer on site. Modifications to the Ethanol Distillery have been proposed that will result in increased energy efficiency with a reduction in overall operational costs. Energy consumption can be reduced by replacing one of the older columns and associated equipment with newer energy efficient columns and associated equipment. These columns will operate at lower steam pressure.

Further energy savings are proposed by installing heat exchangers to replace live steam injection within the process. This will allow recovery and re-use of condensate.

3.4.2.1 MULTIPLE EFFECT EVAPORATORS

The multiple effect evaporators will concentrate the syrup feed stream to the Fermenter Tanks by using a hot vapour stream from the Beer Columns. Evaporator Effects 1 and 2 will be installed in the zoned area adjacent to the Distillery on the west side. The area is congested and will require the removal of a concrete wall and a set of access stairs to provide sufficient space for plant and equipment to be installed

Evaporator Effects 2, 3 and 4 will be installed in an unzoned Ethanol free area adjacent to the Distillery on the north side. The area is currently unoccupied.

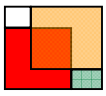
The plant and equipment will be designed and installed in accordance with the requirements of the appropriate Standards and Codes of Practice.

Evaporator dimensions are:

- Evaporator Effects 1 and 2: Diameter 3 m; height 22 m.
- Evaporator Effects 2, 3 and 4: Diameter 4 m; height 22 m.

3.4.3 SIDE STRIPPER AND RECTIFIER

One of the high pressure distillation columns will be replaced with three low pressure columns to save steam. The replacement columns will have different internal tray designs to improve column efficiency – i.e. the separation of the Ethanol from stillage and water will be improved by the use of lower pressure steam.



Proposed mmodifications are indicated in:

- Figure 3.4-1: Photograph - Location of Modifications.
- Figure 3.4-2: Location of Modifications.
- Figure 3.4-3: Modifications Plan.
- Figure 3.4-4: Fermenter Tanks.
- Figure 3.4-5: Photograph – Location of Proposed Fermenter Tanks.
- Figure 3.4-6: Elevations.

.

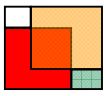


Figure 3.4-1: Photograph - Location of Modifications

Figure 3.4-2: Location of Modifications on Site Plan

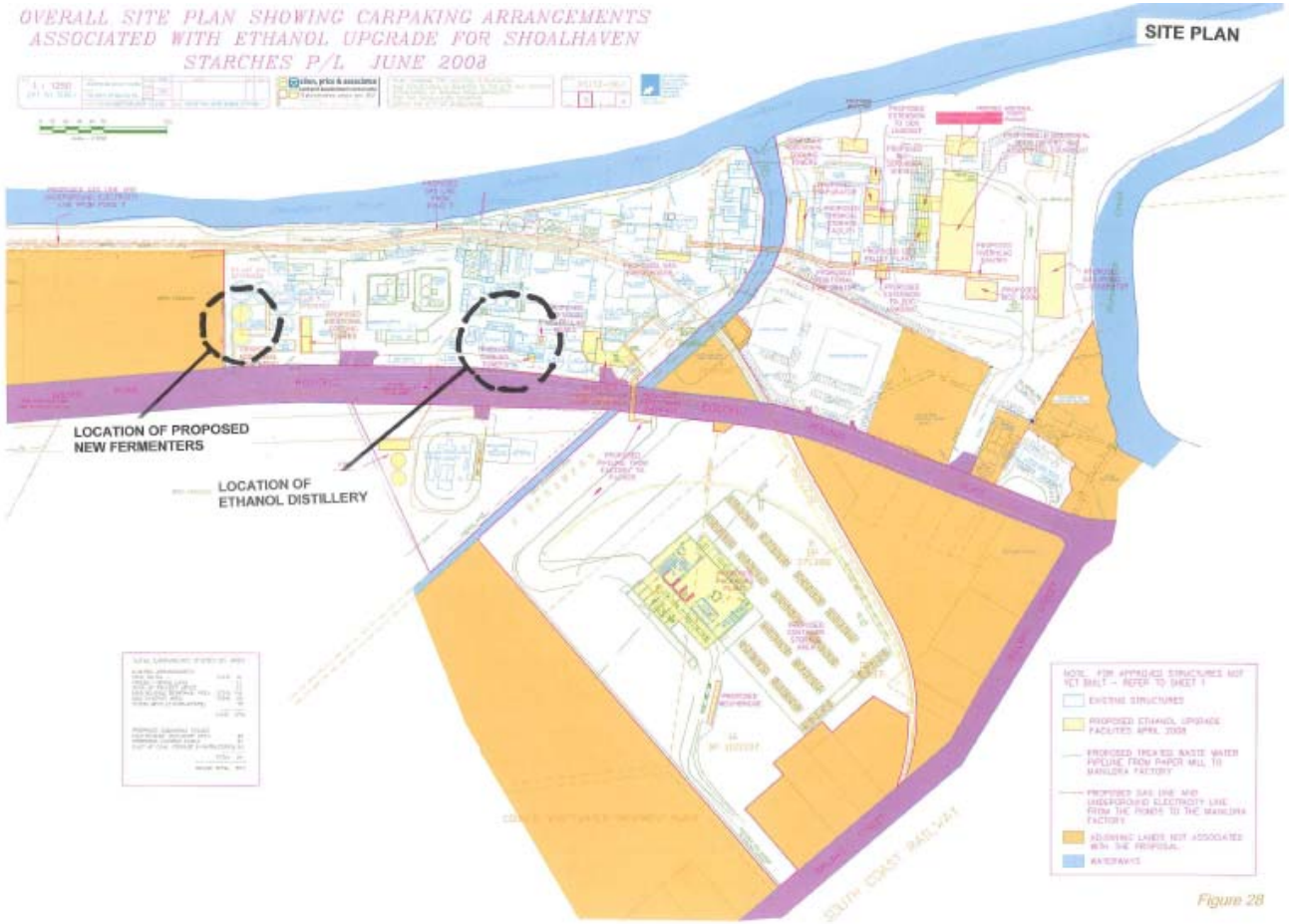


Figure 3.4-3: Modifications Plan View

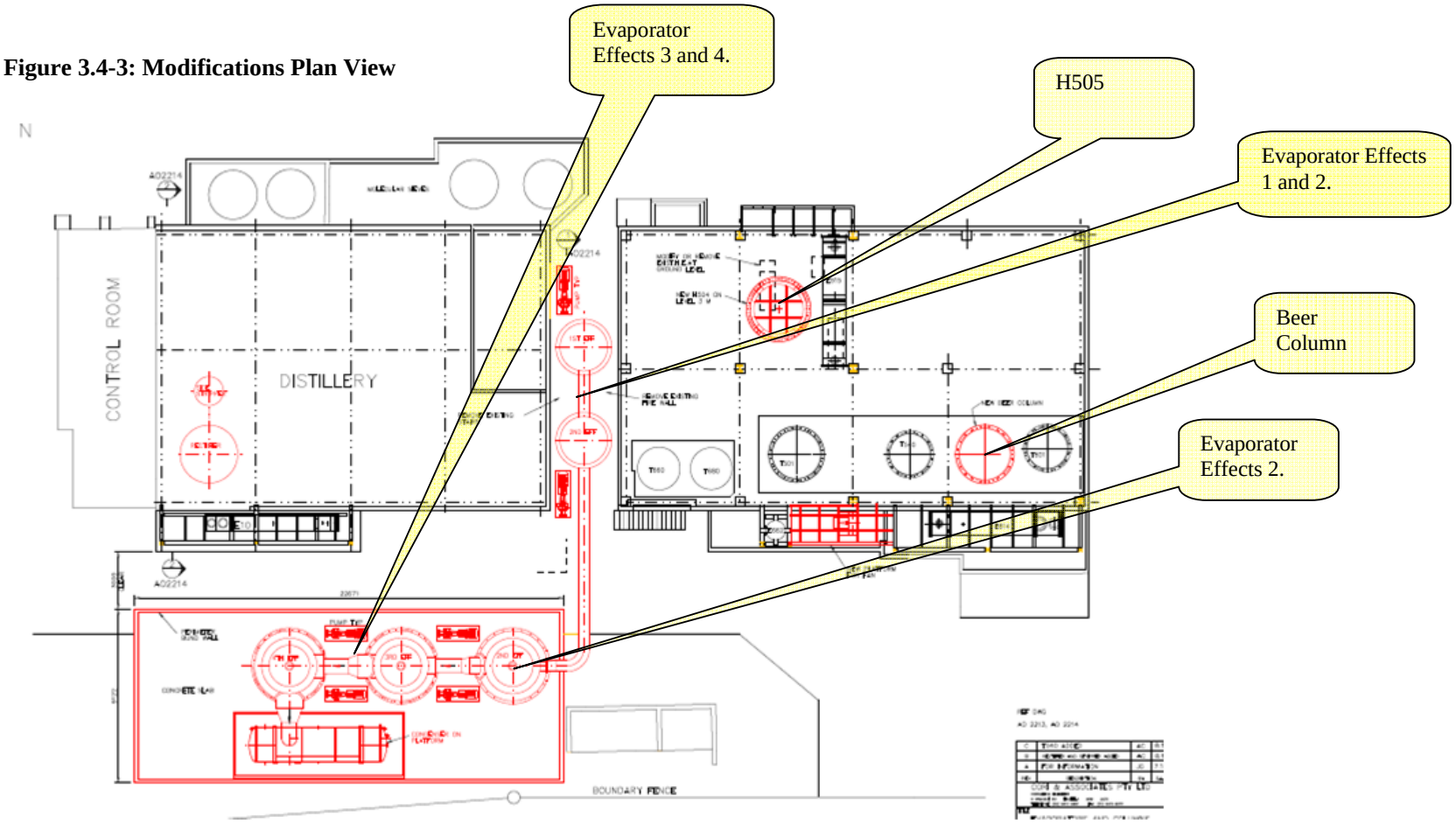


Figure 3.4-4: Fermenter Tanks – Plan View

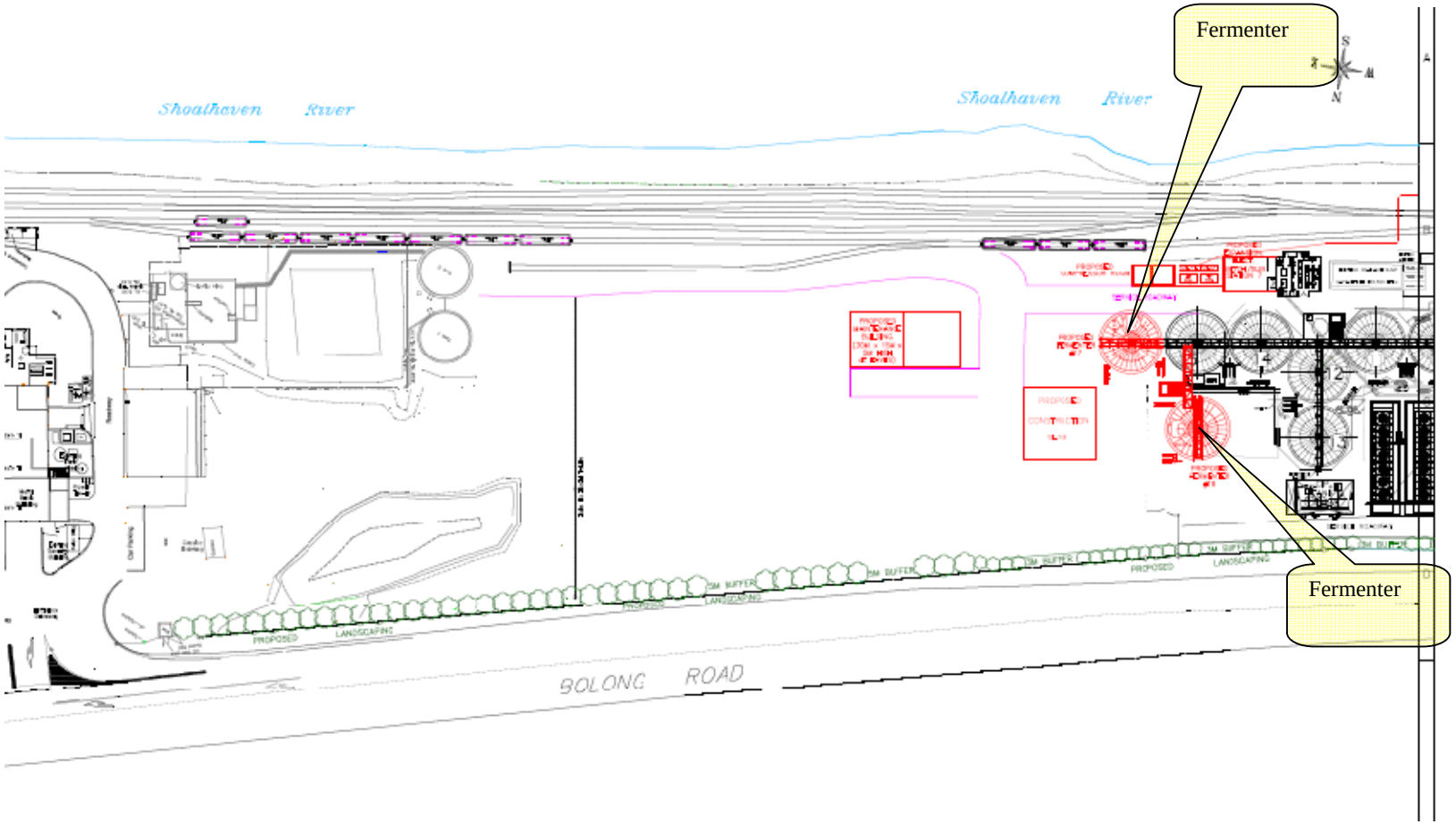
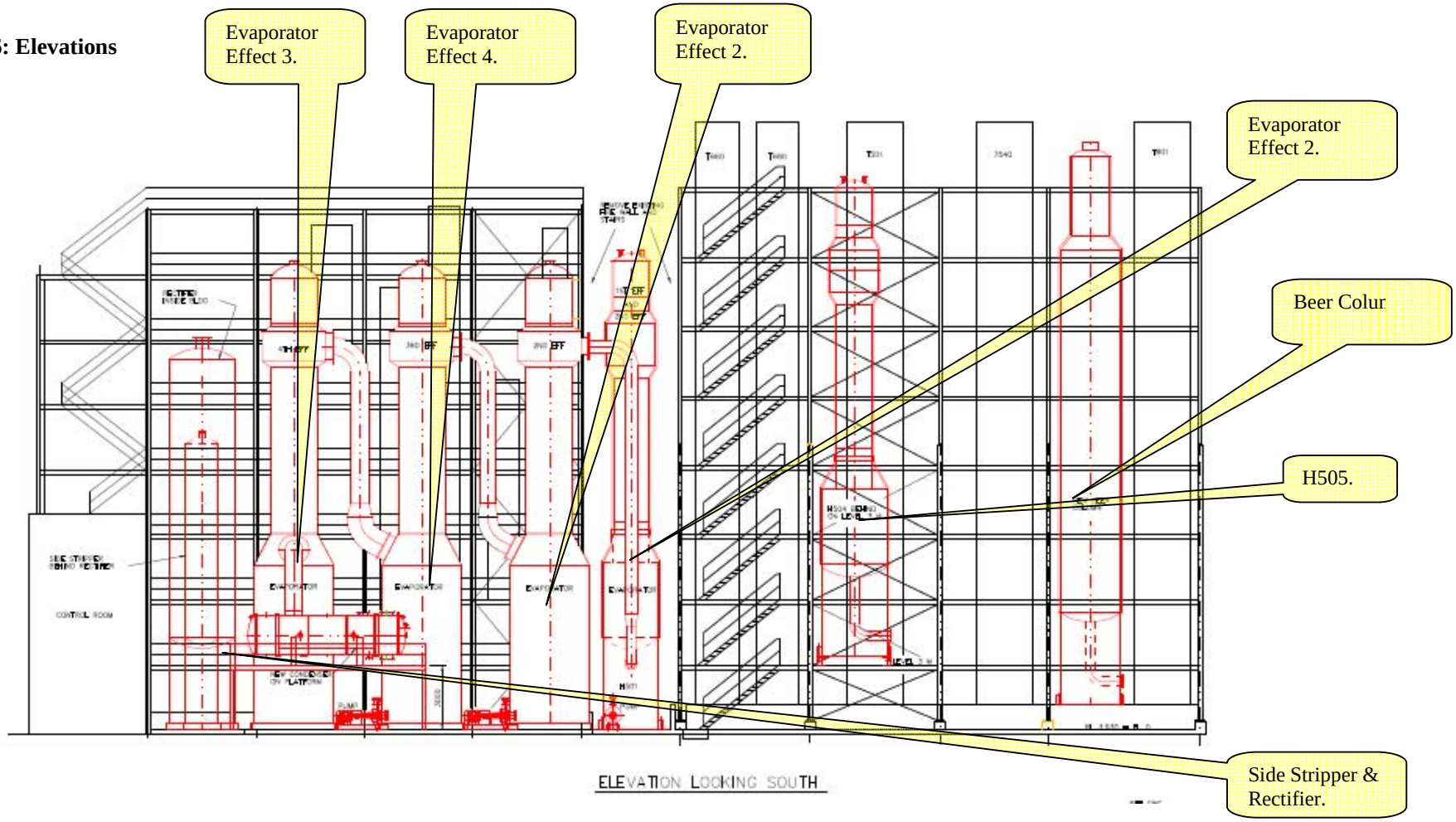


Figure 3.4-5: Photograph – Location of Proposed Fermenter Tanks

Figure 3.4-6: Elevations



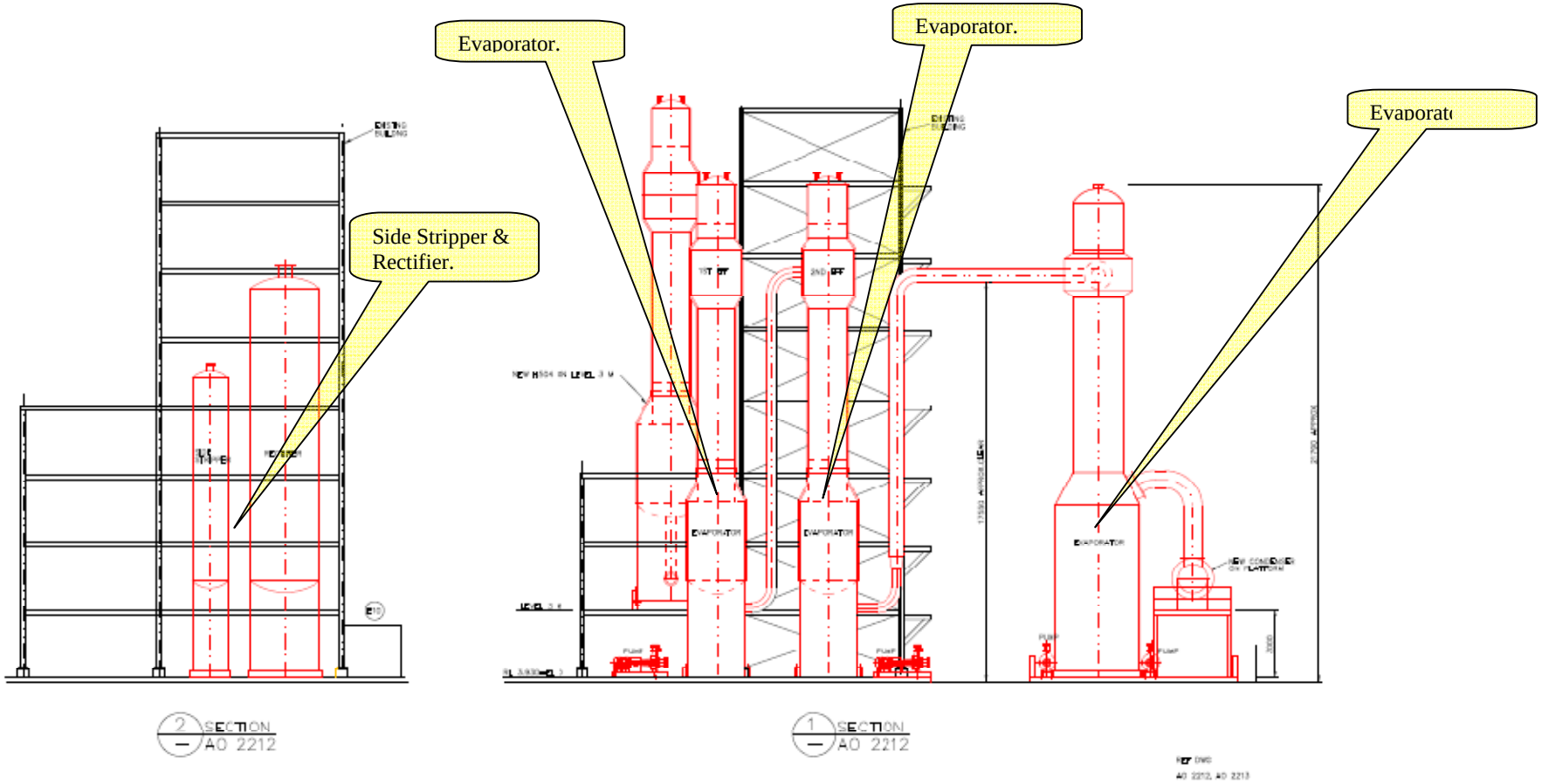

Evaporator.
Evaporator.
Evaporat
Side Stripper &
Rectifier.
2 SECTION
AO 2212
1 SECTION
AO 2212

Figure 3.4-7: Elevations - Photograph

3.5 PROCESS AND PLANT DESCRIPTION

3.5.1 OVERALL ETHANOL PLANT PROCESS/PROCESS CONTROL

Processes carried out on the site consist of extracting starch, gluten and syrups from milled flour received at the site by bulk rail transport.

All the starch and the waste products from the starch production operations are used as feedstock for fermentation in the Fermentation Plant.

The fermentation process consists of converting the carbohydrate in the starch slurry from the Starch Plant into Ethanol. Enzymes (Alpha Amylase and Amylopectine) are added to aqueous slurry and its pH adjusted by the addition of aqueous Ammonia. Slurry is heated to 90^{o}C to break down the starch into Dextrins. Upon cooling down to 60^{o}C a second enzyme (Glucamylase) converts Dextrins to single Glucose. Finally yeast is added to convert Glucose to Ethanol at a temperature of 35^{o}C with the evolution of Carbon Dioxide which is vented to atmosphere. The process results in a liquid fermentation product containing 4-5% Ethanol in water.

The distillation plant takes this fermentation product as feedstock and separates out Ethanol to a purity of 96-100% Ethanol. The final purification of Ethanol is achieved by using molecular sieves.

In addition to a comprehensive process control of the distillation plant, a differential flow analysis of the lines carrying Ethanol outside the distillation plant is included in the PLC. This consists of flow measurement at each end of the lines between the distillation plant and storage and between storage and a load-out facility.

3.5.2 PROCESS MODIFICATIONS

A hot vapour stream from the Beer Columns will supply heat to the quadruple effect evaporators. The process is shown in the P&IDs - Figure 3.5-1 and Figure 3.5-2.

The hot Ethanol vapour stream considered has the following composition:

- Ethanol vapour - 50% v/v.
- Air – 50% v/v.

Process conditions are:

- 22000 kg/hr
- 15 kPa(g)
- 95 deg. C.

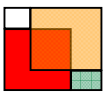


Figure 3.5-1: Evaporator Effects 1/2

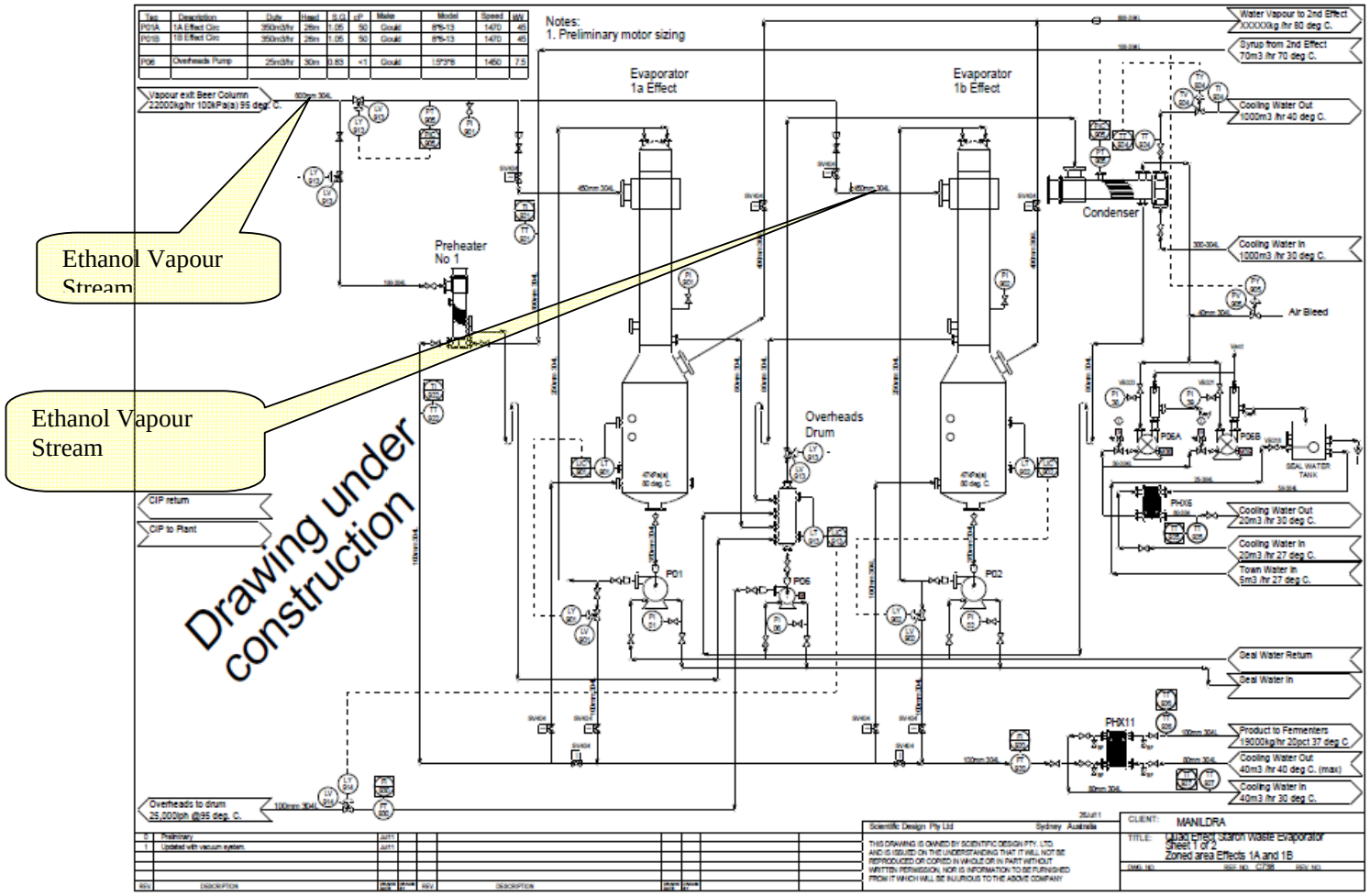
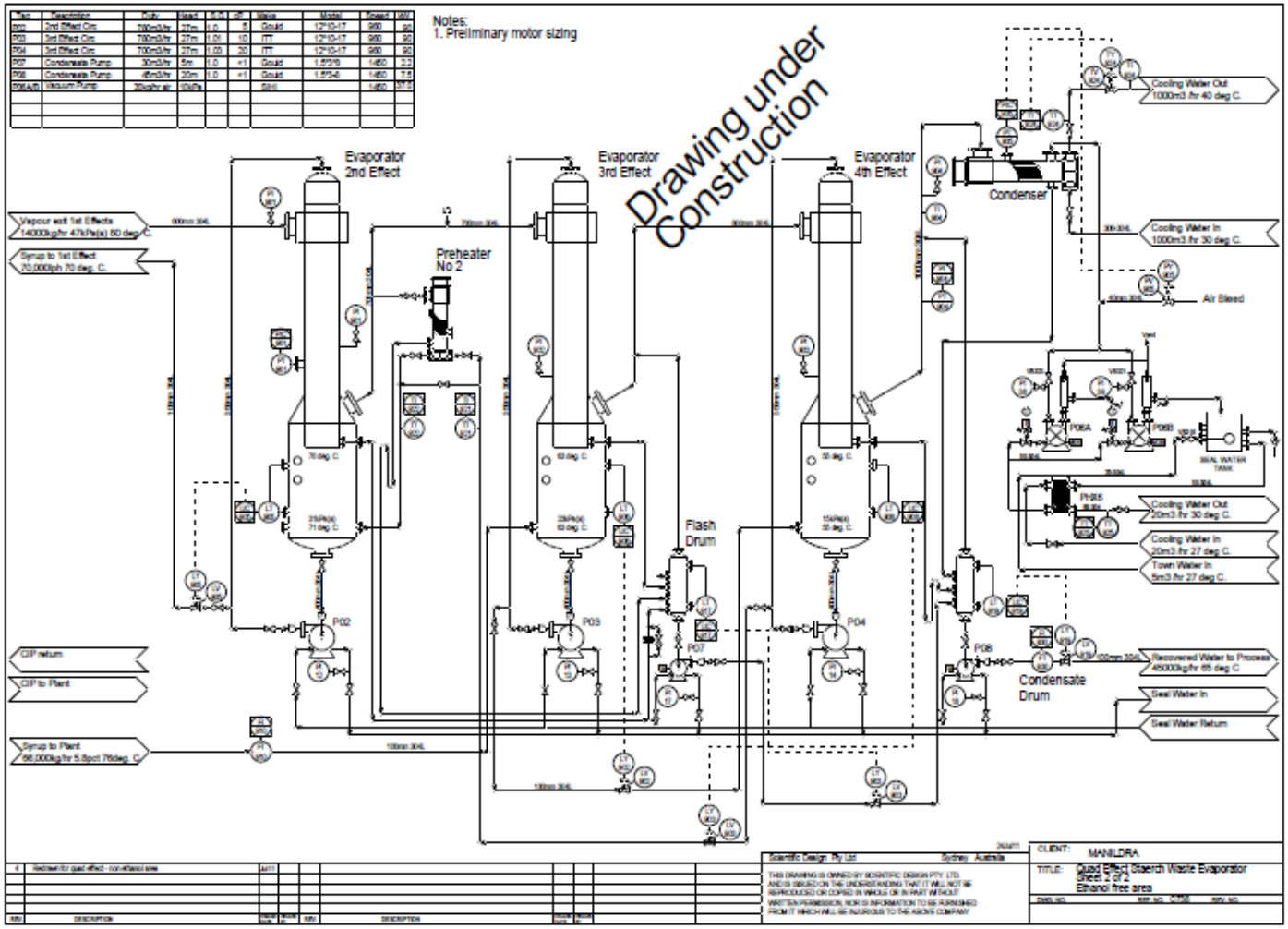


Figure 3.5-2: Evaporator Effects 2/3/4



3.6 SAFEGUARDS, CONTROLS AND LAYER'S OF PROTECTION

3.6.1 SAFETY MANAGEMENT SYSTEM

The design, operation and maintenance of the plant and existing and proposed safeguards and controls as effective risk reduction measures will depend on the effective implementation of the following safety management system/s.

3.6.1.1 Emergency Plan

Shoalhaven Starches has a Site Emergency Plan that is regularly audited and reviewed by the DoP. The plan is regularly updated and revised. These will be updated on completion of modifications. Safety training programmes include training in emergency drills, evacuations etc.

3.6.1.2 Operating Procedures

Shoalhaven Starches has a set of safe operating procedures for each plant and operating area developed in consultation with the personnel involved. These procedures define the tasks, responsibilities, safety requirements and accountability. Procedures cover normal conditions, start up, commissioning and requirements for maintenance work, including the work permit system. Procedures further cover the requirements for changing and updating the procedures and for ensuring that the information is communicated effectively. These will be updated on completion of modifications.

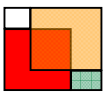
3.6.1.3 Induction and Training

All new employees and contractors are given a formal induction and provided with training when first starting at the site.

Plant operators are provided with on-the-job training and must satisfy the supervisor of their capabilities before being given independent charge. The time frame of the training is flexible and depends on the needs of the individual. Detailed records are kept of all training given to each employee. The company has introduced a programme of skills based training, including an assessment of any competence gained. Additional external training is provided in addition to the internal programmes. Each individual training record sheet is reviewed every 12 months to determine any further training requirements. The company also provides in-house training using external specialists. The induction and training programme will be revised to address the changes to the system.

3.6.1.4 Safety Training

Fire crew training is conducted on a weekly basis and covers all aspects of first response fire fighting techniques which include training on usage of fire hydrants, hosereels, foam monitors, fire extinguishers, SCBA, rescue training and confined space training. Training is conducted on tactics and strategies to be employed for onsite fire scenarios that may occur. Employees are drilled annually in evacuation and the emergency plan procedures. Operators are given a 12 monthly refresher course in the Safe Work Permit System and gas testing procedures. Safety training programmes will be revised to address changes in training requirements due to the modifications to the plant.



3.6.1.5 Safe Work Permit System

All work done in the plant is subject to a work permit for which procedures have been defined. All operators have been trained in how to implement this system. Operators are provided with further training in the permit to work system. This includes work site checks, gas test methods etc. Permits cover electrical isolation, hot work, confined space entry, working at height, equipment isolation and wash out. The system will be used for any work carried out in the areas to be modified.

3.6.1.6 Plant Modification Control

Formal management of change procedures will address the modifications to be implemented, including any changes to these modifications.

3.6.1.7 Site Security

The Shoalhaven Site is manned 24 hours a day, providing a good measure of security. In addition, the company has arranged security patrols on contract for a period from 5 pm to 6 am. Stage 1 perimeter fencing and secure gate access is underway with a completion date of February 2012. Visitors to the site need to be inducted or accompanied.

3.6.1.8 Inspection, Maintenance and Testing

Shoalhaven Starches has in place a formal program of periodic inspection and testing of:

- Fire protection systems;
- Pressure vessels; and
- Critical instruments, alarms and interlocks.

3.6.1.9 Regular Safety Monitoring and Auditing

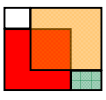
The site Occupational Health and Safety Committee conducts monthly inspections of the plant. The company's Safety Officer conducts periodic audits of the effectiveness of the corrective actions recommended by the OHS Committee. All audits are based on the company Quality Management Systems.

3.6.2 FIRE PROTECTION SYSTEM

The Ethanol Plant together with the proposed modifications is protected by a comprehensive fire fighting system. The fire protection system comprises the following:

- 4 Diesel Fire Pumps;
- 1 Diesel Cooling Water Pump (could be employed for additional back-up);
- 1 Electric Cooling Water Pump (could be employed for additional back-up);
- 2 Electric Jacking Pumps which maintains the ringmain pressure; and
- A fire fighting water reserve storage tank, capable of a 90-minute supply of water at maximum demand.

All pumps are tested on a weekly basis – in accordance with AS 1851. During tests, water is supplied to a different deluge system on each occasion.



An automatic deluge system, fed from the ringmain, covers the Ethanol plant and structural steel. Hydrants and monitors are installed in strategic locations with sufficient range to provide additional protection. Hose reels and suitable fire extinguishers have been installed to provide "first aid" protection.

Pumps start automatically when there is a loss of mains pressure or pressure in pneumatic control lines, or an emergency push button or break glass push button is activated.

Communication links with the Fire Brigade include a direct transponder link and a land line independent of Telstra. The Control Room has rapid dial-up for emergency services. There is a control panel in the Central Control Room with repeat panels located in the distillation plant control room, the Starch Plant and the Boiler House.

A two-way radio system is kept in the control room for the use of fire crews.

Crew response time is 1 to 3 minutes with a Nowra Fire Brigade response time of between 10 - 15 minutes.

Site fire fighting teams include 8 to 10 operators on site per shift.

3.6.3 FIRE & EXPLOSION PREVENTION AND MITIGATION MEASURES

The following fire and explosion prevention and mitigation measures are provided:

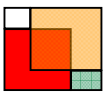
- The area has been bunded for the purposes of spill control (escalation prevention).
- Hydrocarbon/flame detectors are located in critical areas (fire & explosion prevention).
- The hazardous area classification for the area is appropriate (ignition prevention).
- An emergency shutdown system (ESD) that shuts down pumps and isolates inventory.

3.6.4 DRAINAGE AND SPILL CONTROL

The plant areas to be modified are bunded and drainage is to a wastewater treatment tank. The concentration of Ethanol in spills from this area will be automatically analysed. Spills drain to a recovery tank when Ethanol concentration exceeds 5%. This water is reprocessed in the distillation plant. Waste water with less than 5% Ethanol is directed to a holding tank where it is treated and then pumped to the company's irrigation farm.

Storm water from the site roads and other hard stand areas is drained to a First Flush Pond. Any collected water is analysed to check the Ethanol content and then directed to either the recovery tank or the irrigation farm. Wet weather storage ponds provide back-up storage for irrigation. Any analyser failure activates an alarm in the control room.

There is no direct path for any spills or surface water from the site to the Shoalhaven River.



4. HAZARD IDENTIFICATION

4.1 HAZARDOUS MATERIALS

The modified plant and equipment will process the following materials:

- Flammable Ethanol liquid.
- Flammable Ethanol/air mixtures.

A summary of the material hazards is given below.

4.1.1 ETHANOL LIQUID/VAPOUR HAZARDS

The Ethanol Dangerous Goods Classification is given in the following table.

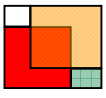
Table 4.1-1: Ethanol Dangerous Goods Classification

Substance	UN Number	Dangerous Goods Classification	Flammable/Combustible Liquid	HAZCHEM Code	Packing Group
Ethanol	UN 1170	Class 3	Flammable liquid	2[S]E	II

Toxicity, flammability and explosion hazards were identified by examination of the physical and chemical properties of Ethanol in Table 4.1-2 below.

Table 4.1-2: Ethanol Properties

Properties	
Chemical Structure	C_2H_6O
Molecular Weight	46.07
Form and Colour	Colourless liquid
Solubility in water	Soluble
Boiling Point: ^oC	78.3
Melting Point: ^oC	-112
Flash Point: ^oC	12.7
Autoignition temp ^oC in air	370
Heat Capacity: kJ/kg ^oK	2.71
Vapour density relative to air	1.6
Liquid density kg/m^3	790
Vapour pressure @ 20 ^oC kPa	5.7
Lower explosive limit in air % v/v	3.4
Upper explosive limit in air % v/v	19.0
Heat of Vapourisation kJ/kg	0.84
Gross Combustible Value Liquid MJ/kg	29.69
Nett Combustible Value Liquid MJ/kg	26.88



Physiological responses due to Ethanol exposure are summarised in the following table[3].

Table 4.1-3: Ethanol Toxicity

Concentration	Level of Impairment
1400 ppm:	No effect after 20 minutes; headache and slight numbness after 40 minutes.
5000 ppm:	Transient coughing and irritation of eyes and nose.
9000 ppm:	Eye and nose irritation, headache, drowsiness and fatigue after 60 minutes.
15000 ppm:	Continuous eye irritation and coughing.

In terms of toxic properties, the dangers of exposure to Ethanol are low – as indicated in Table 4.1-3 above.

The major hazard associated with Ethanol is its flammability, not its toxicity. As indicated, the lower flammability limit of Ethanol is 3.4% (34000 ppm). Ignition of an Ethanol vapour stream with a concentration of Ethanol vapour within the flammable range, can lead to a jet fire, flash fire or vapour cloud explosion.

Ethanol produces an almost smokeless fire. The flash point of pure Ethanol is 12.7 ^{o}C. An 85% Ethanol/water solution has a flash point of 20 ^{o}C and a 24% solution has a flash point of 36.1 ^{o}C.

Large amounts of water will be required to provide a sufficiently dilute solution of Ethanol in water for extinguishment.

Products of combustion will include Carbon Monoxide and Carbon Dioxide.

4.1.2 HAZARD IDENTIFICATION – PROCESS PLANT P&ID

Operating hazards were identified by review of P&ID - Figure 3.5-1 and Figure 3.5-2. Hazards identified were:

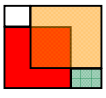
- Condensing flammable Ethanol vapour.
- Flammable Ethanol vapour within process piping and vessels.
- The pumping of flammable Ethanol in solution.

The following potential loss of containment events (hazards) were identified:

- Loss of containment of flammable Ethanol vapour/air mixtures from fittings, nozzle, flanges and process vessels.
- Release of condensed flammable Ethanol liquid from fittings, nozzles, flanges, pumps and process vessels.

4.1.3 HAZARD IDENTIFICATION - IGNITION SOURCES

It was assumed that ignition sources may be present.



4.2 CAUSE – CONSEQUENCE ANALYSIS

A "cause-consequence" analysis was conducted. The results are given in Table 4.2-1. The most likely potential releases/loss of containment areas are identified in the following table.

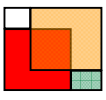


Table 4.2-1: Hazard Identification – Word Diagram

	Facility/Event	Cause	Consequences	Prevention/Detection/Protection to be Provided or Existing
1.0	**Preheater No. 1**			
1.1	Leak of syrup from fittings	Flange failure Valve failure Heat Exchanger nozzle failure Pump nozzle failure	1. Hot syrup spillage or spray from failure point. 2. Skin or eye burns 3. Slip Hazard 4. Loss of product 5. Equipment damage	1. Minimise connections / possible failure points 2. Pressure transmitter on syrup feed with a low P alarm 3. Syrup feed/pump shutoff 4. Leak detection in bund sumps
1.2	Leak of syrup in Heat Exchanger	Failure of Heat Exchanger tubes	1. Loss of Syrup into the overheads drum 2. Flooding of the shell side of Heat Exchanger	1. High level switch in Heat Exchanger to detect flooding 2. Syrup differential pressure across Heat Exchanger 3. Syrup feed shutoff
1.3	Leak of Ethanol vapour from fittings	Flange failure Valve failure Heat Exchanger nozzle failure Failure of Heat Exchanger shell	1. Ethanol vapour release. 2. Flash Fire and or Explosion risk if (LEL< Concentration < UEL) 3. Skin or eye burns 4. Loss of product 5. Equipment damage	1. Minimise connections / possible failure points. 2. Vapour detection instrument in adjacent to equipment. 3. Vapour feed shutoff 4. Consider ventilation options 5. Deluge system to reduce explosion and fire risk.
2.0	**Evaporators 1; 2/Evaporators**			
2.1	Leak of syrup from fittings	Flange failure Valve failure Heat Exchanger nozzle failure Pump nozzle failure	As per 1.1	As per 1.1 1. Syrup circulation pump shutoff

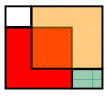
	Facility/Event	**Cause**	**Consequences**	**Prevention/Detection/Protection to be Provided or Existing**
2.2	Leak of syrup in Evaporator 1 or 2	Failure of evaporator tubes	1. Loss of Syrup into shell side 2. Flooding of the shell side of Heat Exchanger.	As per 1.2 1. Syrup circulation pump shutoff.
2.3	Leak of water vapour from fittings	Flange failure Valve failure Evaporator shell failure	1. Skin or eye burns 2. Reduced efficiency of downstream evaporators	1. Pressure transmitter on feed water vapour feed to downstream evaporators.
2.4	Leak of Ethanol vapour	Flange failure Valve failure Evaporator nozzle failure Evaporator shell failure	As per 1.3	As per 1.3
2.5	Leak of Ethanol liquid	Flange failure Valve failure Evaporator nozzle failure Evaporator shell failure	1. Ethanol liquid release 2. Pool fire risk	1. All evaporators will be contained in a bund. 2. High metal clad fence contained along Bolong Rd. prevents ignition sources from entering process areas.
3.0	**Overheads Drum**			
3.1	Leak of overheads	Flange failure Valve failure Drum nozzle failure	1. Overheads release and volatile Ethanol vapour release 2. Flash Fire and or Explosion risk if (LEL< Concentration < UEL) 3. Pool fire risk 4. Skin or eye burns 5. Loss of product 6. Equipment damage	As per 1.3

	Facility/Event	**Cause**	**Consequences**	**Prevention/Detection/Protection to be Provided or Existing**
4.0	**Condenser/Rectifier/Side Stripper**			
4.1	Leak of liquid or vapour release	Flange failure Valve failure Drum nozzle failure	Liquid release and volatile Ethanol vapour release. 1. Explosion risk if (LEL< Conc. < UEL) 2. Fire risk 3. Skin or eye burns 4. Loss of product 5. Equipment damage	As per 1.2
4.2	Loss of cooling water	Cooling water pump or valve failure	1. Higher pressure in the condenser 2. Loss of Containment	1. Pressure transmitter on the condenser 2. Pressure transmitter on the cooling water feed 3. Pressure relief on the condenser
5.0	**Other**			
5.1	Removal of Wall	Removed as part of the new starch waste evaporator project	1. No blast shield during a flash fire and or explosion. 2. Higher risk of damaging other adjacent plant during a flash fire and or explosion.	1. Removing the wall reduces the confinement and the possible of creating an explosive atmosphere. 2. Deluge system.
5.2	Removal of Stairs	Removed as part of the new starch waste evaporator project	1. Reduced access to plant	1. Reinstate adequate access to plant as part of the project.
5.3	Loss of Seal Water	Seal water pump failure	1. Pump overheating 2. Loss of evaporator recirculation 3. Loss of overheads pump	1. Seal water pressure transmitter.

	Facility/Event	**Cause**	**Consequences**	**Prevention/Detection/Protection to be Provided or Existing**
5.4	Loss of product cooling water	Cooling water pump or valve failure	1. Hot product to the Fermenter Tanks	1. Temperature transmitter on the product feed to the evaporators 2. Pressure transmitter on the cooling water feed
5.5	Loss of compressed air	Compressor or receiver failure	1. Loss of air to actuated control valves	1. Safe fail positions for actuated valves
5.6	Loss of Power	Power outage	1. Feed pump shutdown 2. Recirculation pump shutdown	1. Vapour feed shutoff
5.7	Ignition Sources	Non rated Equipment Maintenance / operations error	1. Flash fire and or explosion risk.	1. Hot work permits in area. 2. Rated equipment within zone.
5.8	Escalating fire and or explosion	Fire and or explosion in evaporator plant	1. Escalating fire and or explosion to other plant	1. Deluge system 2. Fire monitoring.
5.9	Loss of firewater	Fire pump failure	1. Deluge system not available during explosion and or failure	1. Duty standby fire pumps 2. Fire pumps on diesel supply 3. Fire pumps on regular maintenance schedule.
5.10	Insulation fire	Fire and or explosion in evaporator plant	1. Damage to equipment	1. Spec appropriate insulation and vapour barrier to minimise fire risk.

4.3 HAZARD IDENTIFICATION - HAZARDOUS INCIDENTS REVIEW

Since 2000, there have been at least 26 major fires in the U.S. involving polar solvents, of which 14 were Ethanol plant fires[4] and three were Ethanol tanker fires.



5. HAZARDOUS EVENT SCENARIOS

A set of failure scenarios was postulated for an evaluation of the potential consequence effects. All scenarios relate to loss of containment from the inlet Ethanol/air piping and connections to process vessels. Failure scenarios were postulated for:

- Pre-heater No. 1.
- Overhead Drum.
- Condenser.
- Pumps P01/06.
- Evaporator Effect 1.
- Evaporator Effect 2.

Failure scenarios were not considered for:

- Evaporator Effects 3 and 4 – as no flammable materials are involved.
- The Fermentation Tanks – as no flammable materials are involved.
- The side-stripper and rectifier – as no additional flammable materials are involved due to the modifications.

5.1 FIRE AND EXPLOSION SCENARIOS

Based on the hazards identified, a set of release, fire and explosion scenarios was postulated for determination of the potential consequence effects. The following credible scenarios, all associated with loss of containment, were identified.

5.1.1 SCENARIO 1: VAPOURISING POOL - FLASH FIRE

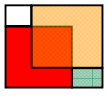
Hot Ethanol vapour is released from piping, vessels or heat exchangers. The vapour condenses forming a small liquid pool within the bund to be provided for Evaporator Effects 1 and 2. Vapourisation from the pool results in formation of a vapour cloud which disperses downwind. The concentration of Ethanol in some parts of the vapour cloud will be within the flammable range for Ethanol/air mixtures. Ignition results in a flash fire.

Failure cases leading to loss of containment are given in Section 10.4.

The amount of vapour produced will be a function of the vapour pressure of Ethanol, the temperature, wind speed and surface area of the spill. The variation of vapour pressure with temperature is shown in the following table. The flash fire envelope is defined by the LEL and UEL concentration boundaries.

Table 5.1-1: Ethanol Vapour Pressure vs. Temperature

Temperature ^{o}C	Vapour Pressure kPa
0	1.6
10	3.1
20	5.8
30	10.4
40	17.8
50	29.2
60	46.5



5.1.2 SCENARIO 2: VAPOURISING POOL - VAPOUR CLOUD EXPLOSION

Hot Ethanol vapour is released from piping, vessels or heat exchangers. The vapour condenses forming a small liquid pool within the bund to be provided for Evaporator Effects 1 and 2. Vapourisation from the pool results in formation of a vapour cloud which disperses downwind. The concentration of Ethanol in some parts of the vapour cloud will be within the flammable range for Ethanol/air mixtures. Ignition results in a vapour cloud explosion. People, plant and equipment are exposed to explosion overpressure.

Failure cases leading to loss of containment are given in Section 10.4.

The amount of vapour produced will be a function of the vapour pressure of Ethanol, the temperature, wind speed and surface area of the spill. The variation of vapour pressure with temperature is shown in the following table.

Table 5.1-2: Ethanol Vapour Pressure vs. Temperature

Temperature ^{o}C	Vapour Pressure kPa
0	1.6
10	3.1
20	5.8
30	10.4
40	17.8
50	29.2
60	46.5

For an explosion to occur, the mass of Ethanol within the cloud must exceed 1.6 tonne of Ethanol (Section 10.1.5). For the modification, a release of Ethanol vapour will not occur at pressure, hence the potential for a VCE is considerably reduced.

5.1.3 SCENARIO 3: PRESSURISED RELEASE - FLASH FIRE

A low pressure release of Ethanol vapour occurs. A vapour cloud occurs which disperses downwind. Effective mixing occurs following the release, due to closely spaced plant and equipment. Delayed ignition results in a flash fire. People are present within the flash fire envelope.

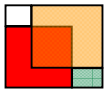
The Ethanol vapour stream considered has the composition shown in Section 3.5.2.

Failure cases leading to loss of containment are given in Section 10.4. The flash fire envelope is defined by the LEL and UEL concentration boundaries.

5.1.4 SCENARIO 4: PRESSURISED RELEASE - VAPOUR CLOUD EXPLOSION

A low pressure release of Ethanol vapour occurs. A vapour cloud occurs which disperses downwind. Effective mixing occurs following the release, due to closely spaced plant and equipment. Delayed ignition results in a vapour cloud explosion. People are present within the flash fire envelope.

The Ethanol vapour stream considered has the composition shown in Section 3.5.2. Failure cases leading to loss of containment are given in Section 10.4.



For an explosion to occur, the mass of Ethanol within the cloud must exceed 1.6 tonne of Ethanol (Section 10.1.5).

5.1.5 SCENARIO 5: PRESSURISED RELEASE - JET FIRE

A low pressure release of Ethanol vapour occurs. The Ethanol/air mixture forms a jet fire on immediate ignition. The pressure of the released vapour is close to atmospheric pressure. Any jet fire will consequently be small.

The Ethanol vapour stream considered has the composition shown in Section 3.5.2. Failure cases leading to loss of containment are given in Section 10.4.

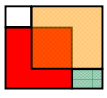
5.1.6 SCENARIO 6: ETHANOL POOL FIRE

A small pool of flammable Ethanol forms within the bund to be provided for Evaporator Effects 1 and 2.

Failure cases leading to loss of containment are given in Section 10.4.

Vapour is released from piping, vessels or heat exchangers. The vapour condenses forming a small liquid pool within the bund to be provided for Evaporator Effects 1 and 2.

Immediate ignition results in a pool fire or ignition results from a flash fire.



6. CONSEQUENCE EFFECTS & VULNERABILITY RESULTS

The magnitudes of the effects that may arise from the Ethanol hazards identified were estimated. The impact that these effects would have on receptors was determined. Receptors considered were:

- People; and
- Plant and equipment.

Consequence effects were determined for flash fires, pool fires & explosions.

The methodology for determination of consequence effects is discussed in Section 10.1.4.

6.1 INPUT DATA FOR CONSEQUENCE EFFECTS ANALYSIS

Typical input data provided for the consequence effects analysis is given in Section 10.2.

6.2 METEOROLOGICAL CONDITIONS

Meteorological conditions, wind speeds and directions used in the consequence effects modelling, are given in Section 10.5.

6.3 IMPAIRMENT THRESHOLD CRITERIA

The impairment threshold criteria[5] in Section 10.1.7 were used in the assessment of the vulnerability of people, plant and equipment to the consequence effects.

6.4 SCENARIO 1 - FLASH FIRE

A flash fire from delayed ignition of vapour from a confined pool within the bunded area was modelled. Flash fire consequence effects are shown in Figure 6.4-1 for a flash fire following a release into the bund. MatrixVapour© was used to determine the flash fire envelope shown. The modelling data and results are given in Table 7.4-2.

The following dispersing vapour properties were used:

- Molecular weight of source gas (kg): 46.07
- Vapor heat capacity, const. P. (J/kg-^{o}K): 838
- Temperature of source gas (^{o}K): 351.3
- Density of source gas (kg/m^{3}): 1.598
- Boiling point temperature (^{o}K): 351.3
- Liquid mass fraction: 0
- Liquid heat capacity (J/kg-^{o}K): 2710
- Heat of vaporization (J/kg): 838000
- Liquid source density (kg/m^{3}): 790

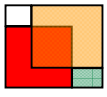


Figure 6.4-1: 1 EFF Flash Fire (Due to Liquid Release)

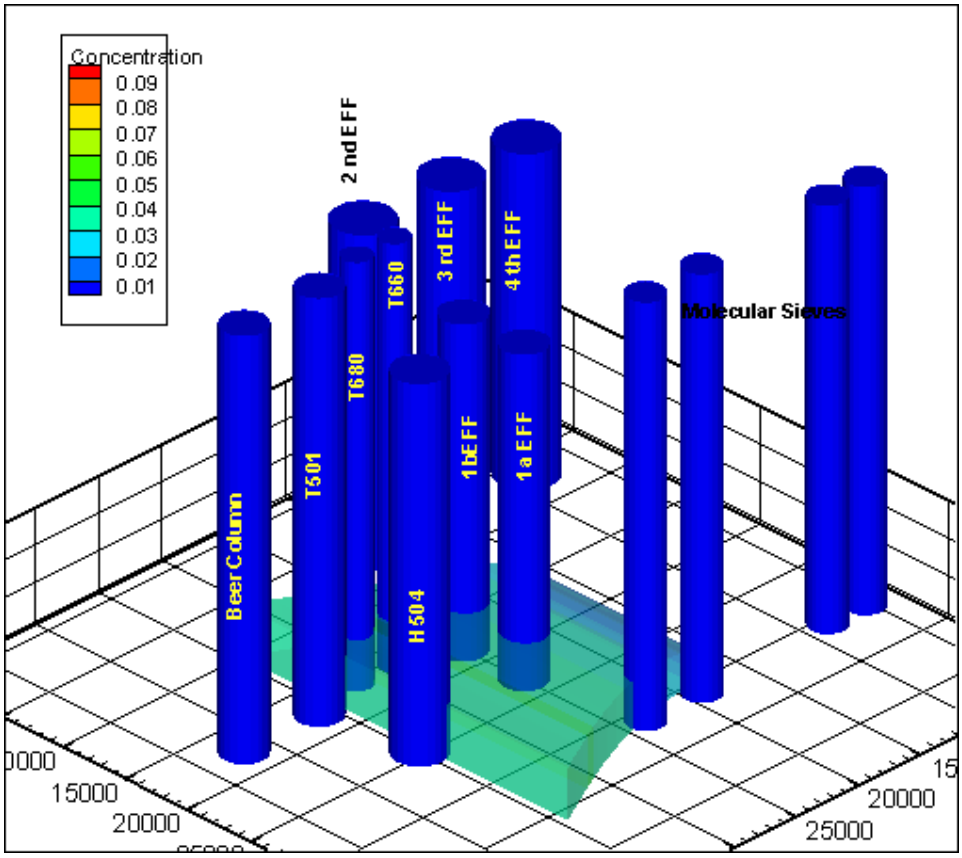


Table 7.4-2 indicates that a fatality may occur within a radius of 11 m – the furthest extent of the flash fire envelope. This does not extend offsite.

The vulnerabilities associated with a flash fire are:

- 100% fatality within the flash fire envelope
- No significant damaging overpressure will be developed.
- Escalation due to overpressure damage is not expected to occur.

There will not be any additional environmental damage due to the modification.

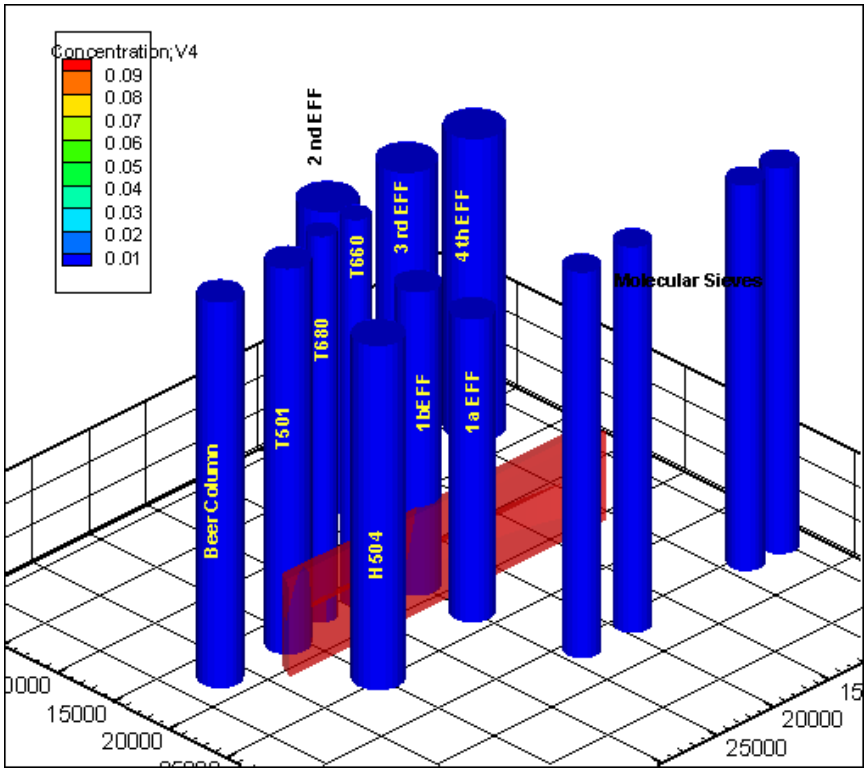
6.5 SCENARIO 2 – VAPOUR CLOUD EXPLOSION

A delayed ignition vapour cloud explosion occurs due to dispersion of vapour from a pool in the bund at ground level. Initially the cloud will be too rich to ignite. The modelling data and results are given in Table 7.4-2. Vapour cloud concentrations are shown in Figure 6.5-1.

The following dispersing vapour properties were used:

- Molecular weight of source gas (kg): 46.07
- Vapor heat capacity, const. P. (J/kg-^{o}K): 838
- Temperature of source gas (^{o}K): 351.3
- Density of source gas (kg/m^{3}): 1.598
- Boiling point temperature (^{o}K): 351.3
- Liquid mass fraction: 0
- Liquid heat capacity (J/kg-^{o}K): 2710
- Heat of vaporization (J/kg): 838000
- Liquid source density (kg/m^{3}): 790

Figure 6.5-1: 2 EFF Instantaneous Liquid Release



For an explosion to occur, the mass of Ethanol within the cloud must exceed 1.6 tonne of Ethanol (Section 10.1.5).

The consequence effects analysis indicates that the mass of Ethanol will exceed 1.6 tonnes of vapour – hence a significant vapour cloud explosion can occur.

Fatalities may occur where exposure to explosion overpressure exceeds the following levels:

- Threshold for potential injury: 7 kPa
- 20% fatality for person within building: 21 kPa
- 50% fatality: 35 kPa
- 99% fatality: 70 kPa

The following damage may occur for exposure of plant, equipment and structures to explosion overpressure:

- Storage tanks fail: 37.5 kPa
- Wagons and plant items overturned: 35.0 kPa
- Complete demolition of houses: 70.0 kPa

There will not be any additional environmental damage due to the modification.

6.6 SCENARIO 3 – FLASH FIRE

A flash fire results from delayed ignition of a 20 mm product leak. The modelling data and results are given in Table 7.4-2. Vapour cloud concentrations are shown in Figure 6.6-1.

Figure 6.6-1: 1 EFF Horizontal Cloud (Vapour Release)

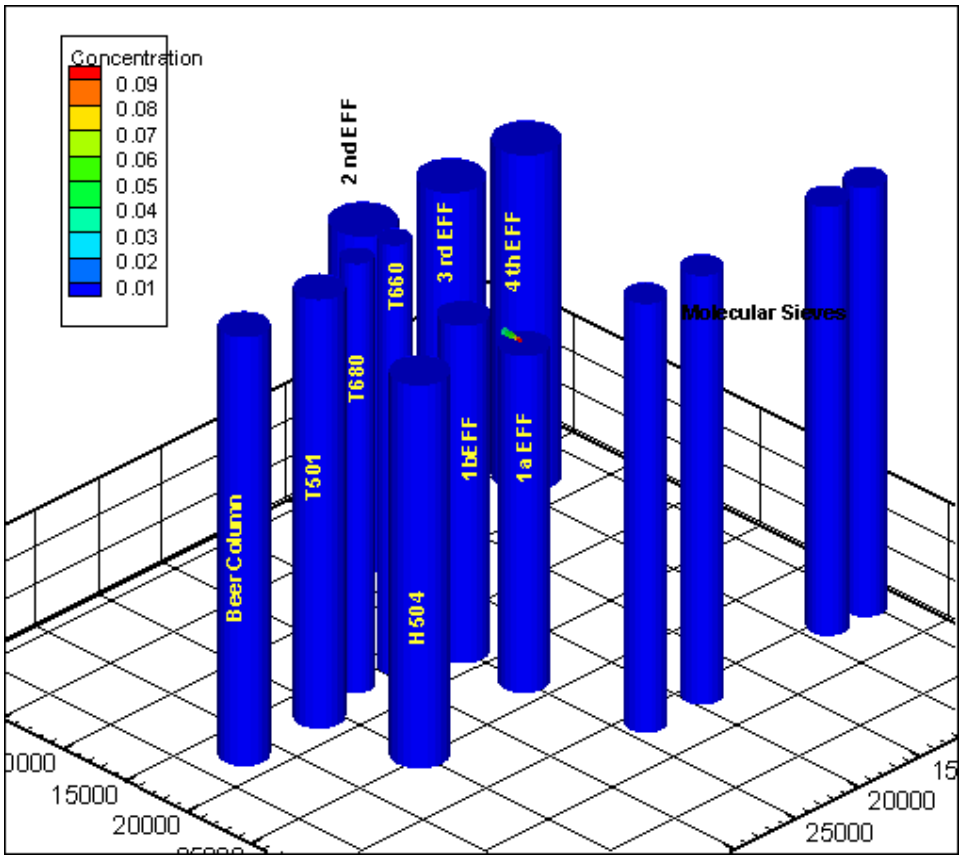


Table 7.4-2 indicates that a fatality may occur within a radius of 4 m – the furthest extent of the flash fire envelope. This does not extend offsite.

The vulnerabilities associated with a flash fire are:

- 100% fatality within the flash fire envelope
- No significant damaging overpressure will be developed.
- Escalation due to overpressure damage is not expected to occur.

There will not be any additional environmental damage due to the modification.

6.7 SCENARIO 4 – VAPOUR CLOUD EXPLOSION

For an explosion to occur, the mass of Ethanol within the cloud must exceed 1.6 tonne of Ethanol (Section 10.1.5). The consequence effects analysis indicates that the mass of Ethanol will not exceed 1.6 tonnes of vapour – hence a significant vapour cloud explosion will not occur.

6.8 SCENARIO 5 – JET FIRE

The fire modelling software[6] MatrixFire© was used to model jet fires. The modelling data and results are given in Table 7.4-2.

A jet fire was modelled for the following conditions:

- Ambient Temperature (^oC): 19.8
- Relative Humidity (%): 58.0
- Atmospheric Pressure(kPa): 101.3
- Wind Speed (m/s): 4.8
- Hole Diameter (mm): 20.0

The flame parameters and geometry were

- Weighted jet flame Parameters
- Mass flow rate (kg/s): 0.038
- Frustum Length (m): 4.879
- Frustum Lift Off (m): 0.269
- Frustum Tilt from Vertical (Deg): 90.000
- Flame Surface Emissive Power (kW/m^2): 25.071
- Frustum Base Width (m): 0.104
- Frustum Tip Width (m): 1.234

Jet fire heat flux envelopes are shown in Figure 6.8-1.

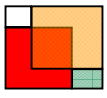


Figure 6.8-1: 1 EFF Jet Fire (Vapour Release)

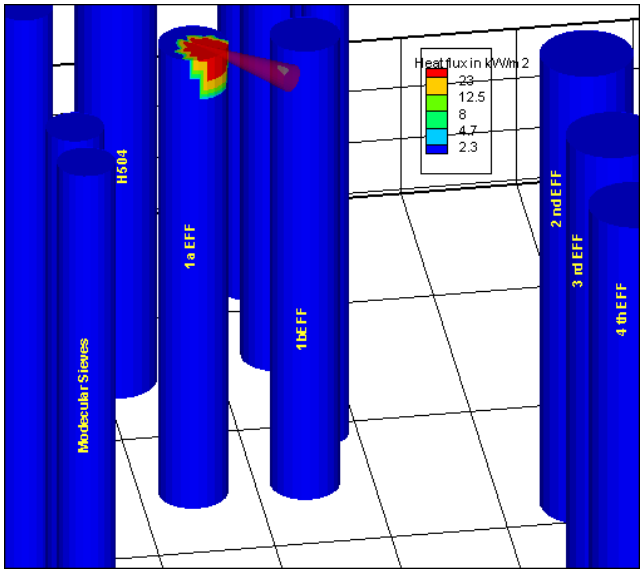


Table 7.4-2 indicates that a fatality may occur within a radius of 7 m – the furthest extent of a jet fire. This does not extend offsite.

Fatalities may occur where exposure to radiant heat exceeds the following heat flux levels:

- Threshold for potential injury: 4.7 kW/m^2
- 1% fatality: 4.7 kW/m^2
- 50% fatality: 12.5 kW/m^2
- 99% fatality: 23.0 kW/m^2

The following damage may occur for exposure of plant, equipment and structures to a jet fire:

- Minimum energy required for piloted ignition of wood: 12.5 kW/m^2
- Structural damage: 32.0 kW/m^2
- Heavy damage to process equipment, piping, building etc: 37.5 kW/m^2

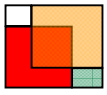
There will not be any additional environmental damage due to the modification.

6.9 SCENARIO 6 – POOL FIRE

The fire modelling software[7] MatrixFire© was used to model pool fires. The modelling data and results are given in Table 7.4-2.

A pool fire was modelled for the following conditions:

- Ambient Temperature (oC): 19.8
- Relative Humidity (%): 58.0
- Atmospheric Pressure(kPa): 101.3
- Wind Speed (m/s): 4.8
- Hole Diameter (mm): 0.0



The flame geometry was:

- Pool Diameter (m): 3.5
- Flame Height (m): 3.8
- Flame Dragged Diameter (m): 5.1
- Flame Tilt (Deg): 64.4
- Spill Rate (m^3/s): 0.000
- Mass Burning Rate (kg/m^2s): 0.034

Heat flux contours are shown in Figure 6.9-1.

Figure 6.9-1: 1 EFF Pool Fire (Liquid Release)

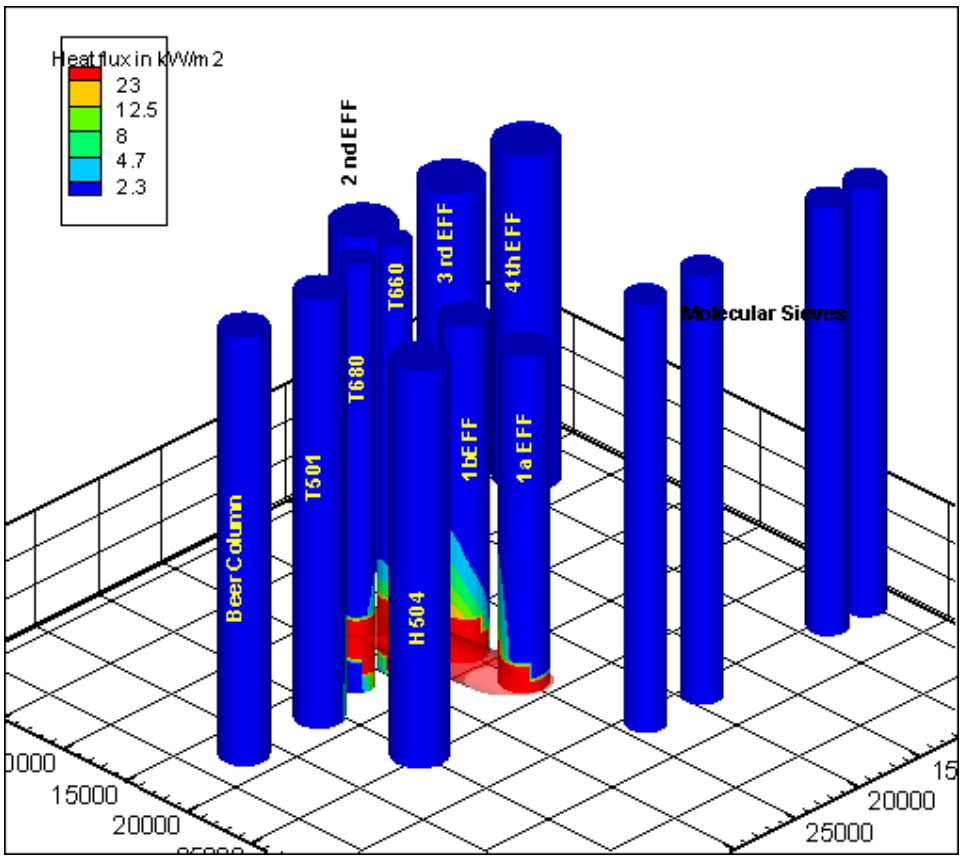


Table 7.4-2 indicates that a fatality may occur within a radius of 16 m from the centre of the flame. Hence consequence effects do not extend offsite.

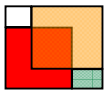
Fatalities may occur where exposure to radiant heat exceeds the following heat flux levels:

- Threshold for potential injury: 4.7 kW/m^2
- 1% fatality: 4.7 kW/m^2
- 50% fatality: 12.5 kW/m^2
- 99% fatality: 23.0 kW/m^2

The following damage may occur for exposure of plant, equipment and structures to a jet fire:

- Heavy damage to process equipment, piping, building etc: 37.5 kW/m^2
- Structural damage: 32.0 kW/m^2
- Minimum energy required for piloted ignition of wood: 12.5 kW/m^2

There will not be any additional environmental damage due to the modification.



7. RISK ANALYSIS

7.1 SCENARIO BASED RISK ANALYSIS

The risk associated with each of the scenarios was determined by summing the risk contributions for loss of containment from piping, piping components, vessels, heat exchangers, pumps and valves within the area to be modified.

The methodology for this is given in detail in Section 10.1.8.

Cumulative risk contours were only determined for consequence effects extending off-site that exceeded the heat radiation and overpressure level criteria for fatalities, property damage or injuries.

7.1.1 INDIVIDUAL RISK CRITERIA

The following risk criterion[1] was adopted:

- Individual fatality risk levels for industrial sites at levels of 50 in a million per year (50×10^{-6} p.a.) should, as a target, be contained within the boundaries of the site where applicable.
- Residential developments and places of continuous occupancy, such as hotels and tourist resorts, should not be exposed to individual fatality risk levels in excess of one in a million per year (1×10^{-6} p.a.).

7.1.2 HEAT RADIATION[1] RISK CRITERIA

A 4.7 kW/m^2 heat radiation level was considered to be the threshold for potential injury to people who are unable to be evacuated or seek shelter. Exposure to this level of heat radiation would cause injury after 30 seconds. Accordingly, a risk injury threshold criterion of 50 in a million p.a. (50×10^{-6} p.a.) at the 4.7 kW/m^2 heat flux was adopted.

7.1.3 EXPLOSION OVERPRESSURE[1] RISK CRITERIA

A 7 kPa (g) overpressure level was considered to be the threshold for potentially significant injuries to occur. Accordingly, a risk injury threshold criterion of 50 in a million p.a. (50×10^{-6} p.a.) at an overpressure of 7 kPa (g) was adopted.

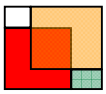
7.2 SOCIETAL RISK

Societal risk was not considered due to the following reasons:

- There are a low number of personnel on site at any given time with a large separation distance to offsite populations; and
- Harm and damage threshold consequence effect contours do not extend beyond the boundaries of the area to be modified.

7.3 PROBABILISTIC DATA

The probabilistic and frequency data used for the determination of frequencies of fires and explosion events are as follows.



TNO[8] failure frequencies for the following items of plant and equipment were used. The frequency and probabilistic data used in the analysis is given in Table 10.3-1:

- Piping / including fittings and flanges
- Stationery vessels
- Heat exchangers
- Valves
- Small bore connections
- Pumps.

The probability of immediate ignition of Ethanol, a K1 liquid (TNO) was taken to be 0.065.

Specified probabilities of failure on demand taken were:

- For isolation valves: 0.1.
- For detection/deluge system: 0.1.

The probability of a significant pool of Ethanol forming due to condensation of a released vapour stream or leakage from the overhead drum was taken to be 0.1 for the following reason. A release during pre-heat would most likely be a small quantity of superheated Ethanol vapour as pre-heat would only occur for a short time during start-up where heating would be accomplished with a superheated Ethanol vapour stream at 97^{o}C. This is significantly greater than the boiling point of Ethanol; hence formation of a pool would be unlikely. Hence a probability of 0.1 that a cloud would form containing 1.6 tonnes of Ethanol vapour is a conservative assumption.

It was assumed that there would be a 10% probability that people would be present in the areas of exposure during any of the fire scenario events.

For a vapour cloud explosion the probabilities of failure on demand for isolation and a detector activated deluge system were not included. It was assumed that significant quantities of vapour will be generated with the concentration of Ethanol in air lying within the flammability range before the release is isolated and further dilution occurs.

7.4 SCENARIO BASED RISK ANALYSIS

The results of the consequence effects analysis, necessary for the risk analysis, are given in Table 7.4-2.

Maximum distances are given to the various:

- Radiant heat contours;
- Overpressure contours; and
- Flash fire envelopes.

The Individual Risk of Fatality for the various scenarios are given Table 10.3-1 through Table 10.3-4 in Section 10.1.8 and summarised in Table 7.4-1 below.

Inspection of the results indicates that the Cumulative Individual Risk of fatality will not exceed 1.1 x 10^{-8} p.a. at any offsite grid-point as the distances to the 1% fatality (PF^{1}) contours all lie within the plant boundaries.

In addition to this, the zones within the 4.7 kW/m^2 contours, the 7 kPa overpressure contour, the flash fire envelopes for all scenarios considered, fall within the plant boundary.

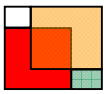


Table 7.4-1: Individual Risk of Fatality

Scenario	Risk of fire/explosion – Events p.a.	Probability of Fatality	Individual Risk of Fatality p.a.	Event	Distance to 1% PF[1] (m)
1	2.02 E-08	0.01	2.0228 E-10	Flash fire	16
2	2.16 E-07	0.01	2.1582 E-09	VCE	34
3	4.19 E-07	0.01	4.19341 E-09	Vapour Flash	4
4	VCE will not occur				
5	4.19 E-07	0.01	4.19341 E-09	Jet fire	<7
6	2.02 E-08	0.01	2.0228 E-10	Pool fire	16
Aggregated Risk	**1.09 E-06**		**1.09496 E-08**		

The level of on-site and offsite risk is reduced substantially by upgrading the deluge system which will be activated by effectively located hydrocarbon detectors. The deluge system will act as a vapour barrier and will be designed to reduce the Ethanol vapour concentration to below LEL.

If effective isolation or a deluge system were not installed and the system was designed with the potential for the formation of a large continuous pool of Ethanol, the level of Individual Risk of Fatality will increase to 1.18×10^{-4} p.a. at the plant boundary.

[1] PF: Probability of Fatality

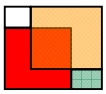


Table 7.4-2: Consequence Effects Analysis

Scenario	Product	Event	Exposure Level	Wind Direction	Wind Speed	RADIANT HEAT IMPAIRMENT CRITERIA					FLASH FIRE
			m		m/s	2.3 kW/m^2	4.7 kW/m^2	8.0	12.5 kW/m^2	23.0 kW/m^2	Envelope
						H&S[2]	H&S[2]	ED[3]	H&S/ED	H&S/ED	H&S
						Distance from Centre of Flame					
						m	m	m	m	m	m
Scenario 1 & 6 - 1EFF											
Pool Fire											
	Ethanol	Confined diameter pool fire within the bunded area.	Exposure at ground level.	Ave	4.8	18	16	14	12	10	
Flash Fire											
	Ethanol	Flash fire from delayed ignition of a confined diameter product pool vapour cloud within the bunded area.	Exposure at ground level.	Ave	1.5						11
	Ethanol	Flash fire from delayed ignition of a confined diameter product pool vapour cloud within the bunded area.	Exposure at ground level.	Ave	3.0						11

[2] H&S: Health and Safety
[3] ED: Equipment Damage

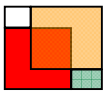
Scenario	Product	Event	Exposure Level	Wind Direction	Wind Speed	RADIANT HEAT IMPAIRMENT CRITERIA					FLASH FIRE
			m		m/s	2.3 kW/m^2	4.7 kW/m^2	8.0	12.5 kW/m^2	23.0 kW/m^2	Envelope
Scenario 5 - 1EFF											
Jet Fire											
			Exposure- release ht.								
	Ethanol	Jet fire from a 20 mm leak.	Exposure at release height.	Ave	4.8					7	
Scenario 3 - Flash Fire	Ethanol	Flash fire from delayed ignition of a 20 mm product leak.	Exposure at release height.	Ave	1.5						4
	Ethanol	Flash fire from delayed ignition of a 20 mm product leak.		Ave	3.0						3
2 Instant R											
Flash Fire											
Scenario 2	Ethanol	Delayed ignition flash fire from liquid release at ground level. Initially the cloud will be too rich to ignite.	Exposure at ground level.	Ave	1.5						6
Scenario 2	Ethanol	Delayed ignition flash fire from liquid release at ground level. Initially the cloud will be too rich to ignite.	Exposure at ground level.	Ave	3.0						4

Scenario	Product	Event	Exposure Level	Wind Direction	Wind Speed	OVERPRESSURE IMPAIRMENT CRITERIA					
			m		m/s	7 kPa	30 kPa	35 kPa	70 kPa	5 kPa	15 kPa
						H&S	H&S/ED	H&S/ED	H&S/ED	H&S	ED
2 Instant R											
Explosion											
Scenario 2	Ethanol	Delayed ignition explosion from liquid release at ground level. Initially the cloud will be too rich to ignite.	Exposure at ground level.	Ave	1.5	105	34	31	18	141	54
Scenario 2	Ethanol	Delayed ignition explosion from liquid release at ground level. Initially the cloud will be too rich to ignite.	Exposure at ground level.	Ave	3.0	101	33	30	17	136	52

8. CONCLUSIONS & FINDINGS

From the risk and consequence effects analysis, the following was concluded:

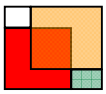
- The offsite cumulative risk of fatalities for adjacent sensitive areas and occupancies will be less than the threshold level of risk of 50 x 10^{-6} p.a. if risk reduction measures that are recommended are implemented.
- The level of on-site and offsite risk will be reduced substantially by upgrading the deluge system which will be activated by hydrocarbon detectors. The deluge system will act as a vapour barrier and will be designed to reduce the Ethanol vapour concentration to below LEL.
- For the modification, a release of Ethanol vapour will not occur at pressure, hence the potential for a vapour cloud explosion (VCE) is considerably reduced.
- Any streams entering or leaving Fermenters 16 and 17 are considered to be non-hazardous.
- The potential for pool fires resulting from releases from the side stripper and rectifier within the Distillery will result in no increase in the Individual Risk of Fatality, as no additional release of flammable material will occur.
- The offsite cumulative risk of fatalities for residential areas will be less than the threshold level of risk of 1 x 10^{-6} p.a.
- The cumulative risk of injury due to exposure to radiant heat at levels in excess of 4.7 kW/m^2 in each of the sensitive areas and occupancies will be less than the threshold level of risk of 50 x 10^{-6} p.a.
- The cumulative risk of injury due to explosion overpressure levels in excess of 7 kPa in each of the sensitive areas and occupancies is less than the threshold level of risk of 50 x 10^{-6} p.a.
- There will be no increase in the level of environmental risk.
- There will be no increase in the level of risk of damage to property and the assets.



9. RECOMMENDATIONS

The following recommendations are made as part of this PHA:

- Review and evaluate the effectiveness of the existing hydrocarbon detectors.
- Determine whether these hydrocarbon detectors are currently installed in optimal locations for activation of an improved deluge system. Installed hydrocarbon detectors have been certified by Gastech, but do not currently initiate a deluge.
- Modify the existing deluge system to act as a water curtain and vapour barrier. This may involve an upgrade/or improvement of the existing system.



10. APPENDICES

10.1 METHODOLOGY

10.1.1 HAZARD IDENTIFICATION

Hazards are defined as an entity or situation with a potential for causing harm or damage to people, property or the biophysical environment.

The hazard identification process in the PHA - a critical step in the hazard analysis process, involved a systematic identification of possible hazards, both on-site and off-site hazards.

The identification of fire, explosion and toxic hazards was accomplished by:

- Review of the P&ID.
- A review of Ethanol hazards given in Codes of Practice and Standards (CP&S).
- Considering the physical and chemical properties of Ethanol.
- Considering the potential for a release or loss of containment of Ethanol.
- Considering the potential for flammable/explosive mixtures of Ethanol and air to occur.
- Considering the potential for ignition of flammable mixtures.
- A review of incidents that have occurred.
- Cause-consequence analysis.

10.1.2 FIRE & EXPLOSION SCENARIO DEVELOPMENT

Following the identification of hazards, fire and explosion release scenarios were determined by considering the causes of:

- Releases of flammable and combustible materials,
- Flammable/combustible atmospheres,
- Ignition, and
- Escalating events.

10.1.3 LIKELIHOOD (FREQUENCY) ANALYSIS

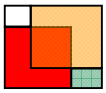
The likelihoods (frequencies) of the following typical incidents were determined:

- The likelihood (frequency) of a release of flammable material;
- The likelihood (frequency) that an explosion or fire will occur in the area of the plant to be modified;
- The likelihood (frequency) that a fire will occur in bunded areas in the modified plant;
- The likelihood (frequency) that a pool or jet fire will occur at various locations in the modified plant area; and
- That likelihood that active ignition sources will be present and cause an explosion.

The likelihood of occurrence of such incidents also considered the level of risk reduction afforded by existing safeguards, controls and “layers of protection” (risk reduction measures) and measures to be implemented with the modification.

The following probability estimates were used in the analysis:

- The probability of ignition of Ethanol;
- The probabilities of various wind speeds and directions at the location under consideration.



10.1.4 CONSEQUENCE EFFECTS AND VULNERABILITY

The magnitudes of the effects that may arise from the Ethanol hazards identified were estimated. This included the:

- Magnitude of the physical effects; and
- Damage caused by these effects.

The magnitude of the physical effects was determined by using 'effect' modelling software to determine initially the effects arising from the:

- Loss of containment of Ethanol, and
- Creation of flammable atmospheres of Ethanol fuel with air.

The effects of subsequent events were then determined, such as fires and explosions. Releases of toxic gas or smoke arising from combustion processes were not considered.

Effects were quantified in terms of:

- Radiation levels from fires;
- Overpressures from explosions; and
- Heat within a flash fire.

The second type – a "vulnerability" model, considered what impact these effects would have on the receptors such as:

- People; and
- Plant and equipment.

Consequence effects models used in the analysis are essentially TNO fire and explosion models[9] and appropriate gas/vapour dispersion models[10].

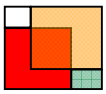
10.1.5 FLASH FIRES & EXPLOSIONS

Unconfined and confined vapour cloud explosions (VCE) are associated with the release of chemical and physical energy. The term unconfined refers to the fact that the VCE occurs in the open air.

Unconfined explosions do not occur frequently as they require a specific combination of factors to prevail before eventuating. These include the physical condition of the material prior to release, type of release, timing of ignition and prevailing meteorological conditions.

Historically VCE have occurred in process plants[15]. The principal causes of these were piping and vessel failures.

The generally accepted theory of the mechanism[15] of a VCE states that it requires a premixed fuel/air mixture to occur and that the flame speed accelerates in the mixture to approximately 10 times the normal speed. Rapid flame propagation causes the damaging overpressure or blast waves, which spread outwards. Substantial flame acceleration requires that the flame radiates heat ahead of itself. A necessary condition is that the cloud must be premixed, i.e. it must have entrained a substantial amount of air and the mixture must lie predominantly in the flammable range. Air entrainment is usually assisted by the release momentum. Normal dispersion in the atmosphere is commonly not sufficient, as it tends to form a cloud, fuel rich in the centre and lean at the periphery. The process is enhanced when the stored pressure from which a release occurs is high and the material stored is a gas stored as a liquid under pressure at a



temperature above its boiling point. Any subsequent liquid release will immediately flash to vapour with considerable turbulence.

For the plant modifications considered, a release of Ethanol vapour will not occur at pressure, hence the potential for a VCE is considerably reduced.

During turbulent conditions a cloud may disperse rapidly without any adverse effects. On the other hand, under relatively calm conditions marked by a low wind speed, a large and well-mixed cloud may form.

In inversion conditions with a low wind speed, the cloud may drift some distance from the source. This is an important consideration where there are residential areas located near the site. R.A. Strehlow[11] has found that the strict control of ignition sources within process plants means that a cloud would have to become very large to extend beyond the site boundaries for a VCE to occur. Under these circumstances, the damage effect would be worse.

The dispersion of heavy gases is affected by the type of terrain, ranging from open plains to heavily built-up areas. In this study, a roughness factor for a medium density built-up area is required.

The timing of ignition is critical factor in determining the possible effects of a VCE. Immediate ignition of a release will result in fireball or a jet fire, where there is sufficient release pressure for this to occur. A VCE will not occur if ignition is delayed too long as the cloud concentration could decrease below the flammable limit or become patchy. Time delays as long as 15 minutes have been reported.

The final consideration is the amount of material released. The cloud must be large enough as a cloud may never be perfectly homogenous and in the flammable range. If the cloud is too small, a flame may start but not have sufficient flammable material to reach the edge. There is no clear cut-off point for this size of the cloud, but it is generally thought that the likelihood of VCE diminishes considerably when the cloud mass falls below a certain threshold.

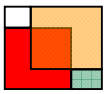
In the event off a vapour cloud igniting and not producing an explosion, the result is a flash fire. A flash fire is the slow combustion of a cloud. It does not produce damaging overpressure. Instead, it acts as an ignition source for secondary fires and rapidly depletes the oxygen content of air to levels where humans may suffer asphyxiation.

An unconfined gas/vapour cloud explosion was only considered for a cloud where the flammable mass threshold exceeded 1637 kg of Ethanol Vapour. This is a more conservative assumption than refinery practice[12] based on the following assumption.

A general threshold, defined in theTNO “Purple Book” for an explosive substance is the amount of energy the substance releases (in kg), equivalent to the energy released by 1000 kg TNT (explosion energy 4600 kJ/kg). This, together with the explosion efficiency, is used to determine thresholds for other explosive hydrocarbons. AIChE[13] data suggests that an efficiency of 3% for an offsite leak and 10% for an onsite leak is a reasonable assumption.

On this basis, for a Gasoline vapour explosion, approximately 978 kg of the vapour will result in an equivalent on-site explosion to 1000 kg of TNT, as the heat of combustion for Gasoline is 45000 kJ/kg.

The heat of combustion for Ethanol is 26880 kJ/kg; hence, a greater mass of Ethanol will have the same explosive effects as Gasoline. On this basis, a threshold of 1637 kg is reasonable (45000/2688 x 978)..



The TNO Multi-Energy explosion[14] approach was used to determine the energy released during a vapour cloud explosion and the overpressure developed at various distances from the point of the explosion. This involves definition of regions of confinement and the effect of this on the level of energy released and the overpressures developed.

The analysis also considered whether a Flash Fire would be a credible event. A flash fire will occur if the vapour cloud ignites with slower combustion of the cloud occurring. Damaging overpressure does not occur during such an event. A flash fire could act as an ignition source for secondary fires with rapid depletion of Oxygen. It is generally assumed that a fatality will occur within a flash fire.

10.1.6 RADIANT HEAT & FLAME IMPINGEMENT

Predicting the consequence effects of a fire requires knowledge of the radiation or convection heat levels received by receptors at various distances from the fire.

The radiant heat emitted from pool or jet fires, the amount of convective heat transmitted by flame impingement was determined by use of the fire consequence effects model MatrixFire©. MatrixFire© pool fire models are based on the Mudan-Croce[15] correlations and the Jet Fire model is essentially a modified Chamberlain[15] model. In the model, radiant heat effects are determined in 3-dimensional space enabling full visualisation of the impact of a fire.

MatrixFire© has been extensively verified and accepted for use by a number of oil and chemical companies in Australia and internationally.

10.1.7 IMPAIRMENT THRESHOLD CRITERIA FOR RADIANT HEAT EXPOSURE

The following human impairment and damage criteria[16] were adopted for exposure to thermal radiation:

- Muster areas: Radiant heat exposure < 2.3 kW/m^2
- Escape routes: Radiant heat exposure < 4.7 kW/m^2
- 1% fatality: Radiant heat exposure of 4.7 kW/m^2
- 50% fatality: Radiant heat exposure of 12.5 kW/m^2
- 99% fatality: Radiant heat exposure of 23.0 kW/m^2
- 100% fatality Flash fire envelope

Table 10.1-1: Heat Radiation Exposure Limits for 1% Chance of Fatality

Incident Heat Flux (kW/m^2)	Maximum Exposure Time (s)
50.0	3.0
37.5	4.6
25.0	8.0
15.0	16.0
12.5	20.0
10.0	27.0
6.0	54.0
5.0	69.0
3.0	135.0

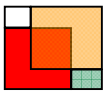


Table 10.1-2: Incident Heat Flux for Various Fatality Levels (30 and 60 s of Exposure)

Probability of Fatality (%)	Incident Heat Flux (kW/m^2)	
	60s	30s
1	5.5	9.3
10	7.5	12.6
50	11.0	18.4
90	15.9	26.8
99	21.7	36.5

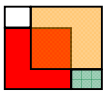
Table 10.1-3: Damage Thresholds

Radiation Intensity kW/m^2	Type of Damage
37.5	Can cause heavy damage to process equipment, piping, building etc.
32.0	Maximum heat flux level for thermally protected tanks.
12.5	Minimum energy required for piloted ignition of wood.
8.0	Maximum heat flux for uninsulated tanks.
4.7	Sufficient to cause pain to personnel if unable to reach cover within 20 seconds (first degree burns).
1.6	Will cause no discomfort with long exposure.
0.7	Equivalent to solar radiation.

The vulnerability of people, plant, structures, building and equipment to explosion overpressure – is given in the following tables.

Table 10.1-4: Threshold Criteria - Explosion Overpressure

Explosion Overpressure (kPa)	Vulnerability
3.5	90% glass breakage. No fatality and very low probability of injury.
7	Damage to internal partitions and joinery but can be repaired. Probability of injury is 10%, but no fatality.
14	Houses uninhabitable and badly cracked. People may suffer temporary hearing loss or injury from secondary blast effects such as debris. No fatalities or serious injuries from direct blast effects are expected.
21	Reinforced structures distort. Storage tanks fail. 20% chance of fatality for a person within in a building.
24	Injuries of a serious nature or possible death are likely from fragments, debris or other objects.
35	Houses uninhabitable. Wagons and plant items overturned. Threshold of eardrum damage. 50% chance of fatality for a person in a building and 15% chance of fatality for a person in the open. Wooden utility poles would be snapped.
70	Threshold of lung damage. 100% chance of fatality for person in a building or in the open. Complete demolition of houses.



10.1.8 RISK ANALYSIS

Risk is defined as the likelihood or frequency of an adverse outcome, such as a fatality, injury or environmental damage.

In order to determine the level of risk, it is necessary to consider the likelihood or frequency and the consequences of each of the hazardous scenarios identified. For public health and safety, risk is expressed as Individual Risk or Societal Risk.

Individual Risk is taken to be the measure of the risk to an individual at a specific location within the effect zone of a fire, explosion or toxic release.

Societal Risk provides mechanism by which the number of people exposed is taken into account as well as the magnitude of the Individual Risk. It is expressed as the likelihood of a specified numbers of fatalities occurring.

For safety planning purposes, assessment of Individual Risk levels is used to determine whether any particular individual would be exposed to unduly high levels of risk, and Societal Risk is used to determine whether there would be any impact on the community as a whole.

The analysis normally considers all major risk contributors, the relevance of proposed and existing safeguards and their adequacy in mitigating effects to people, property and the biophysical environment.

The analysis also determines whether the levels of risk determined comply with the qualitative and quantitative risk criteria set out in Hazardous Industry Planning Advisory Paper No. 4, Risk Criteria for Land Use Safety Planning.

Where applicable, recommendations for reducing the likelihood and consequences of hazardous events on people, property and the biophysical environment are made where such measures are found to be technically feasible and would not adversely affect the economic viability of the project.

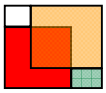
The risk analysis includes the impact on the level of risk of any such measures identified.

Individual and Societal Risk were all considered. The risk of environmental damage was included in the analysis. The risk of property damage was analysed, and the risk of escalation determined by examination of the consequence effects of fire and/or explosions. Individual Risk was determined for each hazardous scenario and the Cumulative (aggregated) Risk determined for all hazardous scenarios.

10.1.9 INDIVIDUAL RISK CRITERIA

The following risk assessment criterion[1] was adopted:

- Individual fatality risk levels for industrial sites at levels of 50 in a million per year (50×10^{-6} p.a.) should, as a target, be contained within the boundaries of the site where applicable.
- Residential developments and places of continuous occupancy, such as hotels and tourist resorts, should not be exposed to individual fatality risk levels in excess of one in a million per year (1×10^{-6} p.a.).



10.1.10 HEAT RADIATION[1] RISK CRITERIA

A 4.7 kW/m^2 heat radiation level is considered to be the threshold for potential injury to people who are unable to be evacuated or seek shelter. Exposure to this level of heat radiation would cause injury after 30 seconds. Accordingly, a risk injury threshold criterion of 50 in a million p.a. (50 x 10^{-6} p.a.) at the 4.7 kW/m^2 heat flux was adopted.

10.1.11 EXPLOSION OVERPRESSURE[1] RISK CRITERIA

A 7 kPa (g) overpressure level is considered to be the threshold for potentially significant injuries to occur. Accordingly, a risk injury threshold criterion of 50 in a million p.a. (50 x 10^{-6} p.a.) at an overpressure of 7 kPa (g) was adopted.

10.1.12 QUANTITATIVE & CUMULATIVE RISK

The methodology considered failure frequencies for the various loss of containment or release scenarios identified during the hazard identification phase.

Having assembled data on possible incidents, the risk analysis involved the summation of risks at given geographical locations on and offsite, providing the "cumulative risk".

Hence for any locational co-ordinate (i,j):

$$\text{Risk}(i,j) = \text{frequency of occurrence}(i,j) \times \text{consequence effect}(i,j)$$

Where:
$i = \text{distance in y direction from a given datum point}$
$j = \text{distance in x direction from a given datum point}$
$\text{Frequency of occurrence}(i.j) = \text{events p.a (e.g. level of radiant heat at } (i,j)$
$\text{Consequence effect}(i,j) = \text{probability of fatality, damage etc. at } (i,j)$

The cumulative risk at (i,j) will then be: $\text{cumulative risk } (i,j) = \sum \text{risk}(i,j)$

If it can be proved that the cumulative risks at or within the boundary do not exceed the threshold levels, contours were not developed.

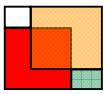
Environmental and property damage risk were evaluated by consideration of any consequence effects.

The level of risk was not determined where the consequence effects were found to be insubstantial. The risk associated with property damage was not determined if offsite consequence effects were insubstantial.

10.1.13 SOCIETAL RISK

Societal risk was not considered due to the following reasons:

- There are a low number of personnel on site at any given time with a large separation distance to offsite populations; and
- Harm and damage threshold consequence effect contours do not extend beyond the boundaries of the depot.



10.1.14 SAFEGUARDS, CONTROLS AND LAYERS OF PROTECTION

As part of the PHA, the adequacy of proposed and existing key safety related hardware, and operational and organisational safeguards were reviewed and assessed. Any deficiencies were identified and recommendations provided to address these, e.g. the adequacy of the existing firewater system.

10.2 INPUT DATA FOR CONSEQUENCE EFFECTS ANALYSIS

10.2.1 VAPOUR DISPERSION INPUT DATA

10.2.1.1 INPUT DATA

Ethanol Gas Properties

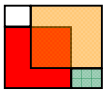
- Molecular weight of source gas (kg)
- Vapor heat capacity at a constant pressure (J/kg-K)
- Temperature of source gas (^oK)
- Density of source gas (kg/m^3)
- Boiling point temperature (^oK)
- Liquid mass fraction in vapour
- Liquid heat capacity (J/kg-K)
- Heat of vaporization J/kg)
- Liquid source density (kg/m^3)
- Saturation pressure constant
- Saturation pressure constant (^oK)
- Saturation pressure constant (^oK)

Spill Characteristics

- The type of release – liquid, vapour or two phase
- Mass source rate through an orifice (hole) (kg/s)
- Continuous source duration (s)
- Continuous source mass - the total mass available for a release (kg)
- Instantaneous source mass – the total mass available for a release (kg)
- Hole size and source area (m^2)
- Vertical vapor velocity (m/s)
- Source height (m)
- Horizontal vapor velocity (m/s)

Field Parameters

- Concentration averaging time for toxicity evaluation (s)
- Maximum downwind distance (m)
- Concentration measurement height (m)
- Molecular weight of ambient air (kg)
- Heat capacity of ambient air at const pressure (J/kg-K)
- Density of ambient air (kg/m^3)



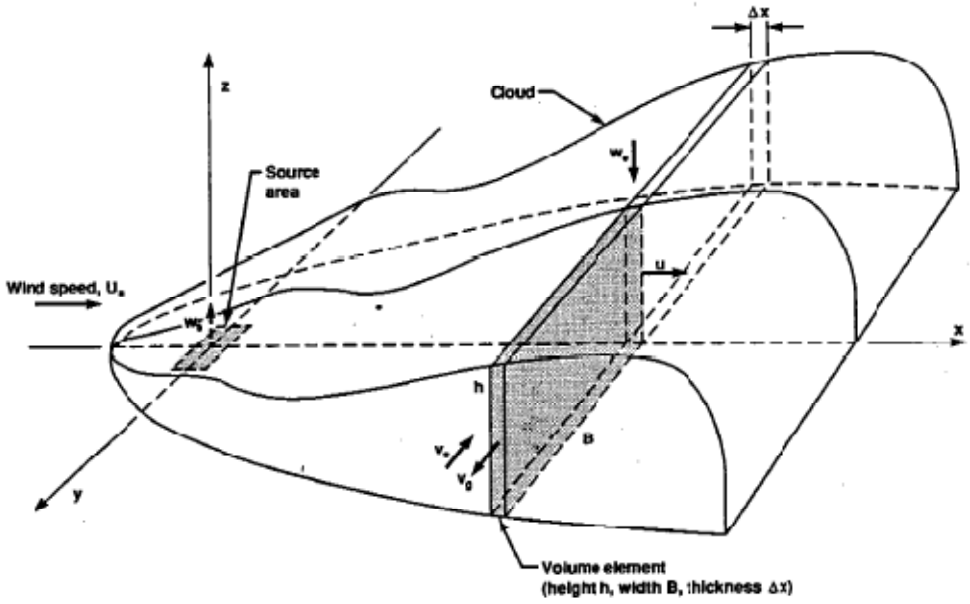
- Ambient measurement height (m)
- Ambient atmospheric pressure (pa)
- Ambient wind speed (m/s)
- Ambient temperature (^oK)
- Relative humidity (percent)
- Ambient friction velocity (m/s)
- Atmospheric stability class value
- Inverse Monin-Obukhov length (1/m)
- Surface roughness height (m)

Additional Parameters

- acceleration of gravity (m/s^2)
- gas constant (J/mol- ^oK)
- von Karman constant

10.2.1.2 OUTPUT DATA

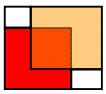
A typical 3 dimensional output from MatrixVapour© is shown.



10.2.2 POOL FIRE INPUT DATA

The following data is required for pool fire modelling.

- Ambient Temperature (^oC)
- Relative Humidity (%)
- Atmospheric Pressure(kPa)
- Wind Speed (m/s)
- Hole Diameter (mm)



The output data from MatrixFire is:

- Pool Diameter (m)
- Flame Height (m)
- Flame Dragged Diameter (m)
- Flame Tilt (Deg)
- Spill Rate (m^3/s)
- Mass Burning Rate (kg/m^2s)

10.2.3 JET FIRE INPUT DATA

The following data is required for jet fire modelling:

- Ambient Temperature (^oC)
- Relative Humidity (%)
- Atmospheric Pressure(kPa)
- Wind Speed (m/s)
- Hole Diameter (mm)

Modelling output results are:

- Weighted jet flame Parameters
- Mass flow rate (kg/s)
- Jet Frustum Length (m)
- Jet Frustum Lift Off (m)
- Jet Frustum Tilt from Vertical (Deg)
- Flame Surface Emissive Power (kW/m^2)
- Frustum Base Width (m)
- Jet Frustum Tip Width (m)

10.3 MITIGATED EVENT FREQUENCIES

The mitigated event frequencies are given in the following tables.

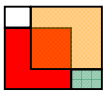


Table 10.3-1: Scenario 1 Frequencies – Flash Fire

Failure Mode	Equipment	Failure Size	Unmitigated Frequency p.a.	Ignition Probability Large Release	Exposure probability	Isolation system	Deluge system & Detectors	Mitigated Frequency p.a.	Event
Piping / including fittings and flanges	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	1.00E-07	0.065	0.1	0.1	0.1	1.30E-10	Flash Fire
Stationery Vessels	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full inventory	5.00E-06	0.065	0.1	0.1	0.1	0.00E+00	Flash Fire
Heat Exchangers	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full inventory	5.00E-05	0.065	0.1	0.1	0.1	0.00E+00	Flash Fire
Valves	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	1.00E-07	0.065	0.1	0.1	0.1	4.55E-11	Flash Fire
Small bore connections	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	7.91E-04	0.065	0.1	0.1	0.1	2.06E-07	Flash Fire
Pumps.	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore	1.00E-04	0.065	0.1	0.1	0.1	0.00E+00	Flash Fire
TOTAL								2.06E-07	
Piping / including fittings and flanges	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	5.00E-07	0.065	0.1	0.1	0.1	6.50E-10	Flash Fire
Stationery Vessels	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	5.00E-06	0.065	0.1	0.1	0.1	0.00E+00	Flash Fire

Failure Mode	Equipment	Failure Size	Unmitigated Frequency p.a.	Ignition Probability Large Release	Exposure probability	Isolation system	Deluge system & Detectors	Mitigated Frequency p.a.	Event
Heat Exchangers	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	5.00E-05	0.065	0.1	0.1	0.1	0.00E+00	Flash Fire
Valves	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	1.00E-07	0.065	0.1	0.1	0.1	4.55E-11	Flash Fire
Small bore connections	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	7.91E-04	0.065	0.1	0.1	0.1	2.06E-07	Flash Fire
Pumps.	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	1.00E-04	60.065	0.1	0.1	0.1	0.00E+00	Flash Fire
TOTAL								**2.06E-07**	

Table 10.3-2: Scenario 2 Frequencies – Vapour Cloud Explosion

Failure Mode	Equipment	Failure Size	Unmitigated Frequency p.a.	Ignition Probability Large Release	Exposure probability / Inherent Safety	Isolation system	Deluge system & Detectors	Mitigated Frequency p.a.	Event
Piping / including fittings and flanges	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	1.00E-07	0.065	0.001	1	1	1.30E-10	Flash Fire
Stationery Vessels	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full inventory	5.00E-06	0.065	0.001	1	1	0.00E+00	Flash Fire
Heat Exchangers	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full inventory	5.00E-05	0.065	0.001	1	1	0.00E+00	Flash Fire
Valves	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	1.00E-07	0.065	0.001	1	1	4.55E-11	Flash Fire
Small bore connections	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	7.91E-04	0.065	0.001	1	1	2.06E-07	Flash Fire
Pumps.	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore	1.00E-04	0.065	0.001	1	1	0.00E+00	Flash Fire
TOTAL								2.06E-07	
Piping / including fittings and flanges	Preheater 1; P01/06; OHD Drum; Condensor	Full bore rupture	1.00E-07	0.065	0.1	0.1	0.1	1.30E-10	Flash Fire
Stationery Vessels	Preheater 1; P01/06; OHD Drum; Condensor	Full inventory	5.00E-06	0.065	0.1	0.1	0.1	3.25E-10	Flash Fire
Heat Exchangers	Preheater 1; P01/06; OHD Drum; Condensor	Full inventory	5.00E-05	0.065	0.1	0.1	0.1	6.50E-09	Flash Fire
Valves	Preheater 1; P01/06; OHD Drum; Condensor	Full bore rupture	1.00E-07	0.065	0.1	0.1	0.1	1.30E-11	Flash Fire
Small bore connections	Preheater 1; P01/06; OHD Drum; Condensor	Full bore rupture	7.91E-04	0.065	0.1	0.1	0.1	0.00E+00	Flash Fire
Pumps.	Preheater 1; P01/06; OHD Drum; Condensor	Full bore	1.00E-04	0.065	0.1	0.10	0.10	1.30E-08	Flash Fire
TOTAL					0.1			2.00E-08	

Table 10.3-3: Scenario 3 Frequencies – Flash Fire

Failure Mode	Equipment	Failure Size	Unmitigated Frequency p.a.	Ignition Probability Large Release	Exposure probability	Isolation system	Deluge system & Detectors	Mitigated Frequency p.a.	Event
Piping / including fittings and flanges	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	1.00E-07	0.065	0.1	0.1	0.1	1.30E-10	Flash Fire
Stationery Vessels	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full inventory	5.00E-06	0.065	0.1	0.1	0.1	3.25E-10	Flash Fire
Heat Exchangers	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full inventory	5.00E-05	0.065	0.1	0.1	0.1	3.25E-09	Flash Fire
Valves	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	1.00E-07	0.065	0.1	0.1	0.1	4.55E-11	Flash Fire
Small bore connections	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	7.91E -04	0.065	0.1	0.1	0.1	2.06E-07	Flash Fire
Pumps.	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore	1.00E-04	0.065	0.1	0.1	0.1	0.00E+00	Flash Fire
TOTAL								2.09E-07	
Piping / including fittings and flanges	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	5.00E-07	0.065	0.1	0.1	0.1	6.50E-10	Flash Fire

Failure Mode	Equipment	Failure Size	Unmitigated Frequency p.a.	Ignition Probability Large Release	Exposure probability	Isolation system	Deluge system & Detectors	Mitigated Frequency p.a.	Event
Stationery Vessels	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	5.00E-06	0.065	0.1	0.1	0.1	3.25E-10	Flash Fire
Heat Exchangers	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	5.00E-05	0.065	0.1	0.1	0.1	3.25E-09	Flash Fire
Valves	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	1.00E-07	0.065	0.1	0.1	0.1	4.55E-11	Flash Fire
Small bore connections	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	7.91E-04	0.065	0.1	0.1	0.1	2.06E-07	Flash Fire

Failure Mode	Equipment	Failure Size	Unmitigated Frequency p.a.	Ignition Probability Large Release	Exposure probability	Isolation system	Deluge system & Detectors	Mitigated Frequency p.a.	Event
Pumps.	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	1.00E-04	0.065	0.1	0.1	0.1	0.00E+00	Flash Fire
TOTAL								2.10E-07	

Table 10.3-4: Scenario 5 & 6 Frequencies - Fires & Explosions

Failure Mode	Equipment	Failure Size	Unmitigated Frequency p.a.	Ignition Probability Large Release	Exposure probability	Isolation system	Deluge system & Detectors	Mitigated Frequency p.a.	Event
Piping / including fittings and flanges	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	1.00E-07	0.065	0.1	0.1	1	1.30E-09	Flash Fire
Stationery Vessels	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full inventory	5.00E-06	0.065	0.1	0.1	1	3.25E-09	Flash Fire
Heat Exchangers	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full inventory	5.00E-05	0.065	0.1	0.1	1	3.25E-08	Flash Fire
Valves	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	1.00E-07	0.065	0.1	0.1	1	4.55E-10	Flash Fire
Small bore connections	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore rupture	7.91E-04	0.065	0.1	0.1	1	2.06E-06	Flash Fire
Pumps.	Preheater 1; Effects 1/b & OHD Drum & Condensor	Full bore	1.00E-04	0.065	0.1	0.1	1	0.00E+00	Flash Fire
TOTAL								2.09E-06	
Piping / including fittings and flanges	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	5.00E-07	0.065	0.1	0.1	1	6.50E-09	Flash Fire

Failure Mode	Equipment	Failure Size	Unmitigated Frequency p.a.	Ignition Probability Large Release	Exposure probability	Isolation system	Deluge system & Detectors	Mitigated Frequency p.a.	Event
Stationery Vessels	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	5.00E-06	0.065	0.1	0.1	1	3.25E-09	Flash Fire
Heat Exchangers	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	5.00E-05	0.065	0.1	0.1	1	3.25E-08	Flash Fire
Valves	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	1.00E-07	0.065	0.1	0.1	1	4.55E-10	Flash Fire
Small bore connections	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	7.91E-04	0.065	0.1	0.1	1	2.06E-06	Flash Fire

Failure Mode	Equipment	Failure Size	Unmitigated Frequency p.a.	Ignition Probability Large Release	Exposure probability	Isolation system	Deluge system & Detectors	Mitigated Frequency p.a.	Event
Pumps.	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous release from a hole with an effective diameter of 20 mm	1.00E-04	0.065	0.1	0.1	1	0.00E+00	Flash Fire
TOTAL								2.10E-06	

10.4 SCENARIO FAILURE CASES

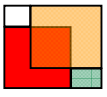


Table 10.4-1: Scenario 1 & 6 Failure Case

Failure Mode	Phase	Plant Area	Equipment	Release Type	Failure Size	Release Rate kg/s
Piping / including fittings and flanges	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Full bore rupture	6.11
Stationery Vessels	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Full inventory	6.11
Heat Exchangers	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Full inventory	6.11
Valves	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Full bore rupture	6.11
Small bore connections	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Full bore rupture	6.11
Pumps.	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Full bore	6.11
Piping / including fittings and flanges	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Continuous release from a hole with an effective diameter of 20 mm	0.061
Stationery Vessels	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Continuous release from a hole with an effective diameter of 20 mm	0.061
Heat Exchangers	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Continuous release from a hole with an effective diameter of 20 mm	0.061
Valves	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Continuous release from a hole with an	0.061

Failure Mode	Phase	Plant Area	Equipment	Release Type	Failure Size	Release Rate kg/s
					effective diameter of 20 mm	
Small bore connections	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Continuous release from a hole with an effective diameter of 20 mm	0.061
Pumps.	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous - condensing vapour	Continuous release from a hole with an effective diameter of 20 mm	0.061
Piping / including fittings and flanges	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Full bore rupture	6.11
Stationery Vessels	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Full inventory	6.11
Heat Exchangers	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Full inventory	6.11
Valves	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Full bore rupture	6.11
Small bore connections	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Full bore rupture	6.11

Failure Mode	Phase	Plant Area	Equipment	Release Type	Failure Size	Release Rate kg/s
Pumps.	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Full bore	6.11
Piping / including fittings and flanges	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Stationery Vessels	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Heat Exchangers	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Valves	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Small bore connections	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061

Failure Mode	Phase	Plant Area	Equipment	Release Type	Failure Size	Release Rate kg/s
Pumps.	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061

Table 10.4-2: Scenario 2 Failure Case

Failure Mode	Phase	Plant Area	Equipment	Release Type	Failure Size	Release Rate kg/s
Piping / including fittings and flanges	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Instantaneous	Full bore rupture	6.11
Stationery Vessels	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Instantaneous	Full inventory	6.11
Heat Exchangers	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Instantaneous	Full inventory	6.11
Valves	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Instantaneous	Full bore rupture	6.11
Small bore connections	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Instantaneous	Full bore rupture	6.11
Pumps.	2 Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Instantaneous	Full bore	6.11
Piping / including fittings and flanges	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Instantaneous	Full bore rupture	6.11
Stationery Vessels	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Instantaneous	Full inventory	6.11
Heat Exchangers	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Instantaneous	Full inventory	6.11
Valves	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Instantaneous	Full bore rupture	6.11
Small bore connections	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Instantaneous	Full bore rupture	6.11
Pumps.	L	Modification	Preheater 1; P01/06; OHD Drum; Condensor	Instantaneous	Full bore	6.11

Table 10.4-3: Scenario 3 & 4 Failure Cases

Failure Mode	Phase	Plant Area	Equipment	Release Type	Failure Size	Release Rate kg/s
Piping / including fittings and flanges	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full bore rupture	6.11
Stationery Vessels	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full inventory	6.11
Heat Exchangers	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full inventory	6.11
Valves	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full bore rupture	6.11
Small bore connections	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full bore rupture	6.11
Pumps.	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full bore	6.11
Piping / including fittings and flanges	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Stationery Vessels	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Heat Exchangers	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061

Failure Mode	Phase	Plant Area	Equipment	Release Type	Failure Size	Release Rate kg/s
Valves	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Small bore connections	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Pumps.	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061

Table 10.4-4: Scenario 5 Failure Cases

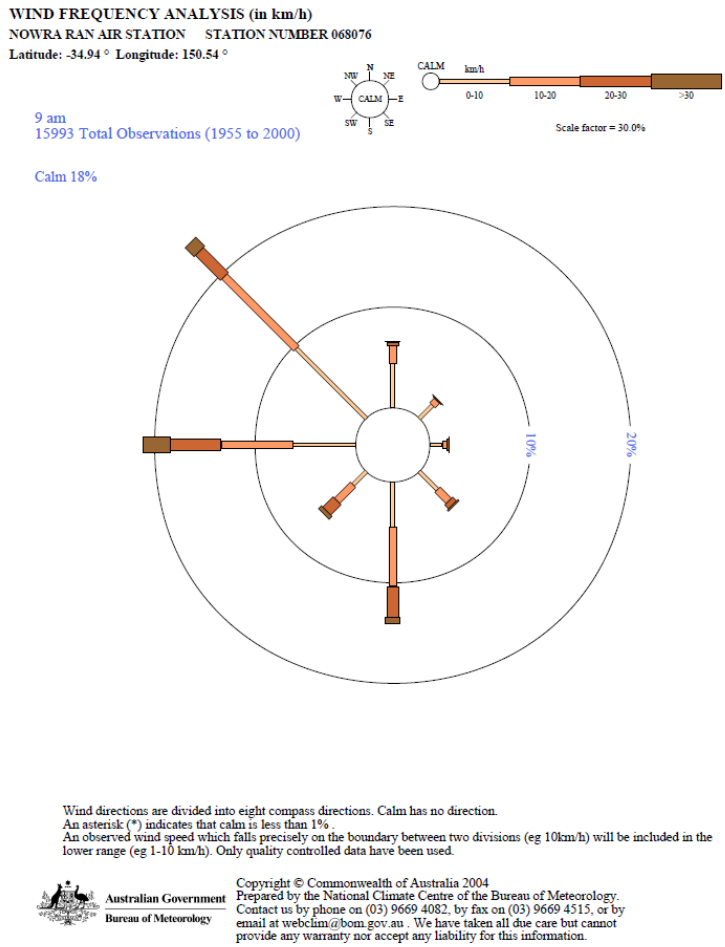
Failure Mode	Phase	Plant Area	Equipment	Release Type	Failure Size	Release Rate kg/s
Piping / including fittings and flanges	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full bore rupture	6.11
Stationery Vessels	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full inventory	6.11
Heat Exchangers	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full inventory	6.11
Valves	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full bore rupture	6.11
Small bore connections	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full bore rupture	6.11
Pumps.	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Full bore	6.11
Piping / including fittings and flanges	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Stationery Vessels	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Heat Exchangers	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061

Failure Mode	Phase	Plant Area	Equipment	Release Type	Failure Size	Release Rate kg/s
Valves	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Small bore connections	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061
Pumps.	Vapour Phase	Modification	Preheater 1; Effects 1/b & OHD Drum & Condensor	Continuous	Continuous release from a hole with an effective diameter of 20 mm	0.061

10.5 METEOROLOGICAL CONDITIONS

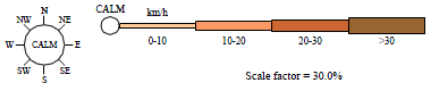
The Nowra meteorological and weather conditions used in the consequence effects modelling are given below.

Nowra Ran Air Station Wind Rose – 9 am



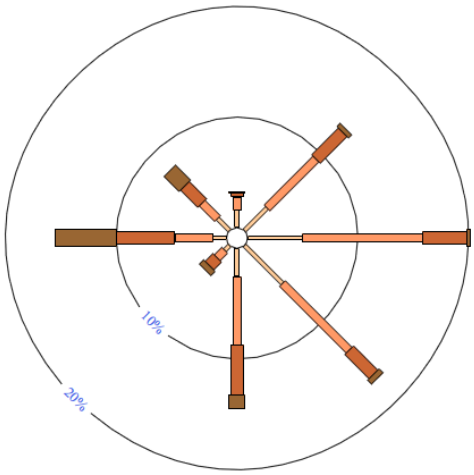
Nowra Ran Air Station Wind Rose – 3 pm

WIND FREQUENCY ANALYSIS (in km/h)
NOWRA RAN AIR STATION STATION NUMBER 068076
Latitude: -34.94 ° Longitude: 150.54 °



3 pm
15992 Total Observations (1955 to 2000)

Calm 5%



Wind directions are divided into eight compass directions. Calm has no direction.
An asterisk (*) indicates that calm is less than 1% .
An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.

Nowra Ran Air Station Conditions

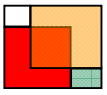
Direction	Nominal Direction	Average Speed	% Occurrence	% F1.0	% D2.0
N	**180**	4.66	12.39	1.73	0.92
NE	**225**	3.86	9.51	2.19	1.37
E	**270**	4.03	18.79	2.99	2.18
SE	**315**	3.84	15.59	2.89	2.08
S	**0**	2.80	6.13	2.19	0.92
SW	**45**	3.07	4.76	1.62	0.81
W	**90**	4.81	14.10	1.97	1.15
NW	**135**	4.78	18.76	1.91	1.10
AVE	**ALL**	4.19	100.00	17.49	10.54

Nowra Ran Air Station Average 9am Weather Conditions

Nowra Air Station		
Average Temperature (Storage Temperature):	16.8	°C
Average Percentage Relative Humidity:	66	%
Atmospheric Pressure:	101.3	kPa
Calculated Average Speed	14.3	m/s

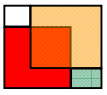
Nowra Ran Air Station Average 3pm Weather Conditions

Nowra Air Station		
Average Temperature (Storage Temperature):	20.5	°C
Average Percentage Relative Humidity:	55	%
Atmospheric Pressure:	101.3	kPa
Calculated Average Speed	20.0	m/s



11. REFERENCES

[1] HIPAP 4: Risk Criteria for Land Use Safety Planning; 2011
[2] HIPAP 6: Hazard Analysis; 2011.
[3] Clayton, G.D. and Clayton, F.E. (Editors); Patty's Industrial Hygiene and Toxicology; 3rd Edition [1982].
[4] The Trouble w
ith Ethanol; Industrial Fire World; David White; 2007.
[5] S. Schubach, Thermal Radiation Targets used in Risk Analysis, Trans IChemE, Vol. 73; Part B; Nov 1995
[6] MatrixFire©; Proprietary Fire Modelling Software – based on TNO models.
[7] MatrixFire©; Proprietary Fire Modelling Software – based on TNO models.
[8] TNO – "Guideline for Quantitative Risk Assessment; "Purple book"; CPR 18E
[9] MatrixFire/Methods for the Calculation of Physical Effects; CPRE 14E; TNO
[10] MatrixVapour/Slab dispersion model.
[11] Strehlow, RA, "Unconfined Vapour-cloud Explosion - An Overview" in Fourteenth Symposium International on Combustion, [Pittsburgh, US: The Combustion Institute, 1973].
[12] Refinery Design Practices; Confidential Material; 2010.
[13] "Fundamentals of Fires & Explosions"; R. French; AIChE SACHE Faculty Workshop; Baton Rouge - Sep 29, 2003
[14] MatrixFire/Methods for the Calculation of Physical Effects; CPRE 14E; TNO
[15] Loss Prevention in the Process Industries; Hazard Identification, Assessment and Control; S. Mannan Ed; 3rd Edition; 2005.
[16] S. Schubach, Thermal Radiation Targets used in Risk Analysis, Trans IChemE, Vol. 73; Part B; Nov 1995



ANNEXURE 3

ANNEXURE 3

Noise Impact Assessment

prepared by

Day Design Pty Ltd

DAY DESIGN PTY LTD

A.B.N. 73 107 291 494

CONSULTING ACOUSTICAL ENGINEERS

9 Moss Street
Nowra NSW 2541
Phone: (02) 4421 2933 Fax: (02) 9584 2619
Email: matthew@daydesign.com.au
www.daydesign.com.au

ENVIRONMENTAL NOISE IMPACT
MODIFICATION TO ETHANOL PLANT AT
SHOALVAEN STARCHES, BOLONG ROAD, BOMADERRY, NSW

REPORT NUMBER: **4701**

PREPARED FOR: Shoalhaven Starches Pty Ltd
C/- Cowman Stoddart Pty Ltd
PO Box 738
Nowra NSW 2541

Attention: Mr Stephen Richardson
Telephone: 02 4421 6198

DATE ISSUED: 29 November 2011

Report Status	**Prepared by:** Matthew Harwood	**Approved by:** Stephen Gauld
Final		

Document R\4701-r1, 11 pages plus attachments

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

Shoalhaven Starches Pty Ltd is part of the Manildra Group of companies and their existing Bomaderry complex produces a range of products including starch, gluten, glucose and ethanol.

The NSW Government approved the Shoalhaven Starches Expansion Project on 28 January 2009. The primary objective of the expansion project is to increase the Company's ethanol production capacity.

Since the commissioning of new plant associated with the expansion, Shoalhaven Starches have had the opportunity to review their processes and determined that operational and energy efficiency improvements can be made.

To achieve these aims, minor modifications are proposed in the fermentation and distillation processes of ethanol production. This will involve the construction of an additional two fermentation tanks and the construction and installation of an additional distillation ('beer') column and evaporator.

These proposed modifications are outside of the works identified in the approved Expansion Project and consequently Shoalhaven Starches Pty Ltd requires a noise impact assessment to determine the potential for noise impact from these modifications.

Shoalhaven Starches is located on the southern side of Bolong Road, Bomaderry. The surrounding area is a mix of commercial, industrial and residential premises. The nearest residences to the site are located in the township of Bomaderry to the north west, on rural land to the north east and across the Shoalhaven River in Nowra to the south and Terara to the south east.

Shoalhaven Starches operates under Environment Protection Licence number 883 which sets noise limits for the overall operation of the complex. Noise goals have been designed for the Proposed Modification so as to ensure existing noise levels are not increased by the introduction of new plant. The noise goals for any new plant are 10 dB below the EPL noise limits and range between 28 dBA and 32 dBA depending upon the residential receptor location.

This is also in accordance with Shoalhaven Starches Noise Management Plan originally prepared 31 October 2009 and revised 7 September 2010 under the Project Approval conditions for the Shoalhaven Starches Expansion Project.

The major sources of noise from the Proposed Modification will be the electric pump motors associated with each proposed item of plant.

Measurements and computations show that the level of noise emitted by the proposed ethanol plant will comply with the Requirements of the Director General and their Environment Protection Licence. We are of the opinion that the noise emission from the Proposed Modification at Shoalhaven Starches, Bomaderry will not cause offensive noise as defined by the Protection of the Environment Operations Act 1997.

2.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Shoalhaven Starches Pty Ltd to assess the environmental noise impact from a proposed minor modification to their ethanol plant at Bolong Road, Bomaderry, NSW.

This commission involves the following:

Scope of Work:

- Inspect the site and environs
- Establish acceptable noise level criterion
- Quantify noise emissions from the proposed modification
- Calculate the level of noise emission, taking into account screen walls, distance attenuation, ground absorption, etc
- Prepare a site plan identifying the development and nearby noise sensitive locations
- Provide recommendations for noise control (if necessary)
- Prepare an Environmental Noise Impact Report.

3.0 SITE AND PROJECT DESCRIPTION

Shoalhaven Starches, part of the Manildra Group of companies proposes to modify their existing ethanol plant located within their complex on Bolong Road, Bomaderry.

The Shoalhaven Starches complex is located on the southern side of Bolong Road across the Shoalhaven River from Nowra.

The area surrounding Shoalhaven Starches is a mix of commercial, industrial and residential premises with vacant land, owned by the Manildra Group, to the north.

The nearest residential locations to the complex are as follows:-

- Location 1 – Nobblers Lane, Terara approximately 1500 metres to the south east
- Location 2 – Riverview Road, Nowra approximately 1000 metres to the south;
- Location 3 – Meroo Street, Bomaderry approximately 480 metres to the north west
- Location 4 – Hanigans Lane, Bomaderry approximately 1200 metres to the north east

Locations are listed in keeping with the order shown in the Environment Protection Licence (see below). The Shoalhaven Starches complex, neighbouring properties and nearby residential locations are shown on the attached site plan in Figure 1.

Since the approval of the Shoalhaven Starches Expansion Project, the company has been implementing and commissioning works in accordance with that approval. As various components of the approved development have been commissioned the company has identified two particular areas in which they may refine their operations and improve energy efficiency.

These are specifically the areas of fermentation and distillation in the ethanol production process. Modifications to the fermentation process are required for operational reasons and modifications to the distillation process are required to improve energy efficiency.

Modifications to the fermentation process will comprise the construction of two new fermentation tanks at the north eastern end of the complex. One tank will replace an existing tank that is to be converted for another use and the other will facilitate continual fermentation so that existing tanks may be cleaned, maintained, etc, without disruption to the process. Each fermentation tank has an associated mechanical pump and no other significant noise producing aspects.

Modifications to the distillation process will comprise the construction of a new 'beer' column with one associated pump and an evaporator with two associated pumps.

The beer column will be erected amongst the existing columns in the central northern part of the complex and the evaporator will be located to the north of the columns adjacent to Bolong Road. See the attached Figure 1.

Beer is the end product from the fermentation process and is transferred from the fermentation tanks to the evaporator and on to the column for distillation.

4.0 ACCEPTABLE NOISE LEVELS

4.1 Director General's Requirements

The NSW Department of Planning and Infrastructure has issued Director General's Requirements for the proposed modifications under application number MP06_0228 MOD 2. There are no specific noise assessment requirements given, however the "General Requirements" section states:-

"- a detailed description of the process and equipment modifications involved (to determine whether any additional impacts are likely (e.g. noise, odour, wastewater and traffic);

- an assessment of the potential impacts of the project, including any cumulative impacts, taking into consideration, any relevant guidelines, policies, plans and statutory provisions."

4.2 Environment Protection Licence 883

Shoalhaven Starches operates under Environment Protection Licence 883 issued by the NSW Office of Environment and Heritage.

Section L5 'Noise Limits' of the licence states:-

"L5.1 the $L_{A10\ (15min)}$ sound pressure level contribution generated from the premises must not exceed the following levels when measured at or near the boundary of any residential premises:

a) 38 dBA at locations in Terara on the south side of the Shoalhaven River;

b) 38 dBA at locations in Nowra on the south side of the Shoalhaven River;

c) 42 dBA at locations in Meroo Street, Bomaderry;

d) 40 dBA at other locations in Bomaderry."

These noise limits apply to the overall operation of the Shoalhaven Starches complex.

4.3 Shoalhaven Starches Noise Management Plan

The recent Project Approval for the Shoalhaven Starches Expansion Project, required the preparation of a Noise Management Plan for addressing and managing noise emission from the expansion project.

The Shoalhaven Starches Noise Management originally prepared 31 October 2009 and revised 7 September 2010addresses, among other things, acoustic criteria relating to the Shoalhaven Starches complex and any new developments associated with the expansion project. Section 3 of the plan lists noise limits from the Environmental Protection Licence as shown in Section 4.1 above and states:-

"Compliance testing conducted on a regular basis on behalf of the Mill [Shoalhaven Starches complex] *has found noise emission from the premises satisfies the EPA criteria as a result of works on the Shoalhaven Starches site. In order to ensure that there is no increase in noise emission from the subject premises, with respect to the noise criteria nominated by the EPA in License Condition 6.3* [now 5.1]*, the design goal for such additional plant should be at least 10 dB below the criteria nominated by the EPA."*

4.4 NSW Industrial Noise Policy

The Office of Environment and Heritage (OEH) published the NSW Industrial Noise Policy in January 2000 (INP). The policy is specifically aimed at assessing noise from industrial noise sources scheduled under the Protection of the Environment Operations Act 1997.

The assessment procedure has two components; controlling intrusive noise impacts and maintaining noise level amenity.

Section 2.1 of the Industrial Noise Policy states that the L_{eq} level of noise intrusion from broad-band industrial noise sources may be up to 5 dB above the L_{90} background noise level at the receptor without being considered offensive. In this instance it is not practicable to measure background noise levels at any nearby receiver locations in the absence of noise from the Shoalhaven Starches complex.

The environment protection licence limits shown in Section 4.2 above are derived from previously measured background noise levels plus 5 dB and should be used to establish intrusiveness noise criteria as follows:-

- 38 dBA ($L_{eq,\ 15\ minute}$) at locations in Terara on the south side of the Shoalhaven River;
- 38 dBA ($L_{eq,\ 15\ minute}$) at locations in Nowra on the south side of the Shoalhaven River;
- 42 dBA ($L_{eq,\ 15\ minute}$) at locations in Meroo Street, Bomaderry;
- 40 dBA ($L_{eq,\ 15\ minute}$) at other locations in Bomaderry.

These levels are derived from the lowest previously measured background noise levels during night time hours and would therefore apply at night. It is reasonable to assume that background levels may be higher in the day and evening and consequently the INP Intrusiveness Criteria could be higher also during these periods.

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. Table 2.1 of the NSW Industrial Noise Policy provides a schedule of recommended L_{eq} industrial noise levels that under normal circumstances should not be exceeded. For example in a suburban residential area, the L_{eq} noise emission level may not exceed 55 to 60 dBA in the daytime (7 am to 6 pm), 45 to 50 dBA in the evening (6 pm to 10 pm) and 40 to 45 dBA during the night (10 pm to 7 am).

In any event, the Environment Protection Licence noise limits are the more stringent and will be used for assessment. Compliance with a noise goal of 10 dB below the licence limits will ensure compliance with any Industrial Noise Policy criterion.

4.5 Project Specific Noise Criteria

When all the above factors are considered, we find that the most stringent noise criterion for the Proposed Modification is the Environment Protection Licence noise limits less 10 dB, as follows:-

- *28 dBA ($L_{10,\ 15\ minute}$) at locations in Terara on the south side of the Shoalhaven River;*
- *28 dBA ($L_{10,\ 15\ minute}$) at locations in Nowra on the south side of the Shoalhaven River;*
- *32 dBA ($L_{10,\ 15\ minute}$) at locations in Meroo Street, Bomaderry;*
- *30 dBA ($L_{10,\ 15\ minute}$) at other locations in Bomaderry."*

These criteria apply at or near the boundary of any residential premises during the operational hours of the Proposed Modification.

5.0 ETHANOL PLANT MODIFICATION NOISE EMISSION

Noise sources associated with the Proposed Modification include the pumps associated with the fermentation tanks, the beer column in the distillery and the evaporator. The author visited the Shoalhaven Starches site on various occasions to measure the noise level of existing plant that is indicative to that which will be used as part of the Proposed Modification.

Details of the instrumentation used, measured sound power levels and predicted noise levels at nearby residential receptors are detailed below in Sections 5.1, 5.2 and 5.3 respectively.

5.1 Noise Survey Instrumentation

Noise level measurements and analysis were made with instrumentation as shown in Table 5.1

Table 5.1 Noise Instrumentation

Description	Model No.	Serial No.
Modular Precision Sound Analyser	B&K 2260	244 3406
Condenser Microphone 0.5" diameter	B&K 4189	244 0653
Acoustical Calibrator	B&K 4231	243 9033
Microphone Windscreen	Acoustically transparent foam	
Real Time Sound level Analyser	CEL 593	035 426
Condenser Microphone 0.5" diameter	MK 250	3300
Microphone Calibrator	CAL 200	3646
Microphone Windscreen	Acoustically transparent foam	

The **B&K 2260 & CEL 593 Sound Analysers** are real-time precision integrating sound level meters with octave and third octave filters, that sample noise at a rate of 10 samples per second. The analysers provide L_{eq}, L_1, L_{10}, L_{50} and L_{90} statistical data at 15 minute intervals (longer or shorter intervals optional) over the desired monitoring period.

All instrument systems had been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 0.3 dB during attended measurements. No adjustments for instrument drift during the measurement period were warranted.

5.2 Measured Noise Levels

Noise measurements were taken of the existing fermentation and distillation plant at the Shoalhaven Starches Complex. Measurements were taken in terms of L_{10} sound pressure levels and have been used to calculate the L_{10} octave band, and overall 'A' frequency weighted, sound power levels, in decibels re: 1 pW, shown in Table 5.2 below.

Table 5.2 Packing Plant L_{10} Sound Power Levels

Description	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dBA	63	125	250	500	1k	2k	4k	8k
Fermentation Tank Pump	**84**	86	81	75	75	77	76	74	80
Beer Column Pump	**90**	92	88	91	87	84	82	76	70
Evaporator Pump	**86**	89	88	82	79	82	77	75	73

5.3 Predicted Noise Levels

Knowing the sound power level of a noise source (see Table 5.2 above), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for distance losses, attenuation from barriers, ground absorption, etc.

The overall level of noise emission from the proposed Ethanol plant when calculated at the nearest residential locations (using computer modelling) is given in Table 5.3 below.

Table 5.3 Predicted $L_{10,\ 15\ minute}$ Noise Levels at Residential Receptor Locations – Ethanol Plant Modification

	Nobblers Lane, Terara (Location 1)	**Riverview Road, Nowra** (Location 2)	**Meroo Street, Bomaderry** (Location 3)	**Hanigans Lane, Bomaderry** (Location 4)
Predicted Noise Level $L_{10,\ 15\ minute}$ (dBA)	< 20	< 20	20	27
Acceptable Noise Level $L_{10,\ 15\ minute}$ (dBA)	**28**	**28**	**32**	**30**
Complies	Yes	Yes	Yes	Yes

The above calculations and predictions consider distance attenuation at each receptor location as well as the following:-

- Barrier attenuation from existing site structures for the beer column pump at Locations 1, 2 and 3;
- Barrier attenuation from existing site structures for the evaporator pumps at locations 2 and 3 only; and
- a maximum 5 dB ground absorption attenuation at Location 4 only;

It can be seen from Table 5.3 that the level of noise emission from the proposed ethanol plant modification is well below the acceptable noise level at each receptor location without the need for noise controls.

6.0 NOISE IMPACT STATEMENT

Measurements and computations show that the design noise goal for the modification to ethanol plant, of 10 dB below the licence noise limits, will be achieved.

The proposed minor modifications to the ethanol plant at Shoalhaven Starches Pty Ltd, Bomaderry will not cause offensive noise as defined by the Protection of the Environment Operations Act 1997 and will comply with the requirements of the Director General and their Environment Protection Licence.

Matthew Harwood, MAAS.

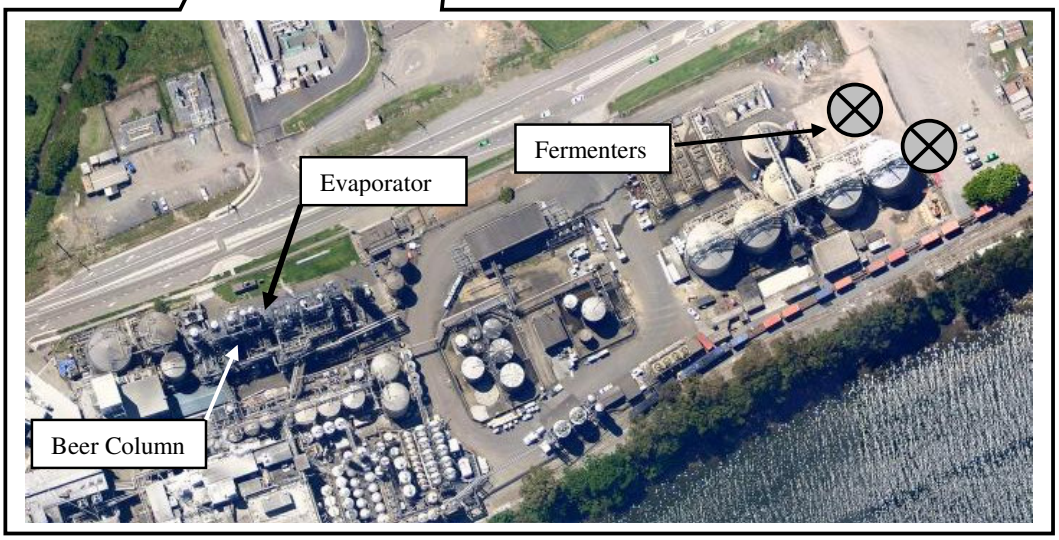
Senior Acoustical Consultant
for and on behalf of Day Design Pty Ltd

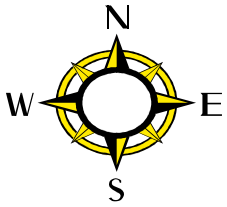
A.A.A.C. MEMBERSHIP
Day Design Pty Ltd is a member company of the Association of Australian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

Attachments:

- Figure 1 – Site Plan

DAY DESIGN	Site Plan Shoalhaven Starches, Bomaderry, NSW	4701 FIGURE 1





ANNEXURE 4

Air Quality Impact Assessment

prepared by

Stephen Environmental Management Australia

ANNEXURE 4

Stephenson
Environmental Management Australia

Peter W Stephenson & Associates Pty Ltd
ACN 002 600 526 (Incorporated in NSW)
ABN 75 002 600 526

Newington Business Park
Unit 7/2 Holker Street
Newington NSW 2127 Australia
Tel: (02) 9737 9991
Fax: (02) 9737 9993
e-mail: info@stephensonenv.com.au

300 Beaconsfield Parade
Albert Park VIC 3206
Tel: 0417 023 140

Level 21, AMP Place
10 Eagle Street
Brisbane QLD 4000
Tel: (07) 3303 8549
Fax: (07) 3303 8445

120 Upper Sturt Road
Glenalta SA 5052
Tel: (08) 8278 2155
Fax: (08) 8278 2199

Level 28, AMP Building
140 St Georges Terrace
Perth WA 6000
Tel: (08) 9278 2582
Fax: (08) 9278 2444

9 December 2011

SEMA Ref No. S 20989
Project No. 4956/11

Mr. Brian Hanley
Manager – Energy & Sustainability
Shoalhaven Starches Pty Ltd
PO Box 123
NOWRA NSW 2541

Dear Mr Hanley,

RE: **Section 75W Modification Application –**
Minor Modification to Ethanol Plant,
As part of Shoalhaven Starches Expansion Project MP06_0228
Bolong Road, Bomaderry NSW

Stephenson Environmental Management Australia (SEMA) has reviewed the documentation, including the original Environmental Impact Assessment, and drawings associated with this minor modification to the Ethanol Plant. The relevant drawings and photographs are attached to this letter report.

In essence the following conclusions have been drawn from this review and assessment:-

1. Shoalhaven Starches has identified two areas of the ethanol production process which can be modified to improve energy efficiency and better refine operational processes. These areas are Fermentation (operational processes) and Distillation (improved energy efficiency);

2. It is noted that these modifications will not increase capacity of the plant or production capability;

3. **Fermentation Process**: It is also noted that it is proposed that two (2) additional fermentation tanks will be installed; that is, one buffer or surge tank and one (1) additional fermenter to facilitate the thorough cleaning of these tanks in a batch process cycle rather than the continuous basis. However, the total volume processed through the fermentation process will not change from that nominated in Project – MP06_0228.

4. **Ethanol Distillery:** To reduce the amount of steam energy consumed by the Ethanol Distillery it is proposed to replace one of the older high pressure distillation columns with three (3) newer improved design low pressure columns. These newer columns will run at a lower steam pressure than the column they will replace. There are various other improved energy efficiency upgrades associated with the peripheral support equipment which is integral these proposed minor modifications.

5. **Boilers:** These distillery modifications are designed to improve energy efficiency by reducing the requirements for steam created from the boilers. Therefore, this reduced steam demand will have the effect of reducing the particulate and gaseous emissions from the boilers.

6. **Overall:** The proposed minor modification to the ethanol plant will not increase production capacity or volume throughput. As presented above, it is designed to improve efficiency of both fermentation process and reduce steam consumption in the distillation process. Furthermore, the fermentation tanks and distillation columns, by their very nature, are sealed, closed loop vessels which are designed to optimise the conversion efficiency in each of the process steps from commencement of fermentation to final ethanol distillation product. Therefore, there will not be any additional emission discharge points associated with this minor upgrade or additional emissions through existing discharge points.

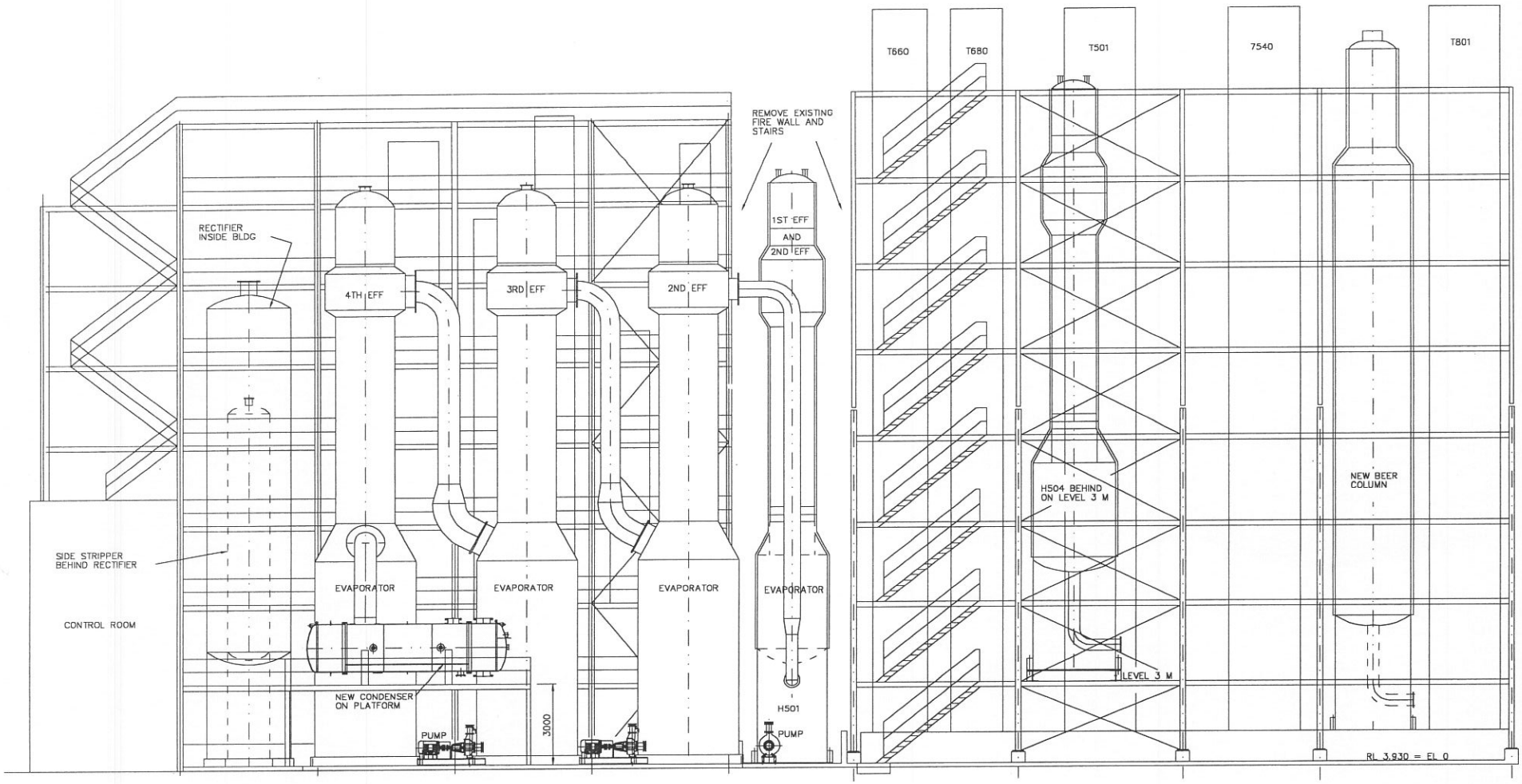
7. **Overview - Emissions:** The proposed minor modification will not increase production throughput and therefore, will not increase the gaseous emission of odour, oxides of nitrogen, volatile organic compounds, such as ethanol, or particulate emissions from the coal fired boilers. In fact, it is likely that there will be an overall reduction in emissions from the plant; in particular, greenhouse gas emissions.

8. **Conclusion - Air Quality Assessment:** Therefore, since these minor modifications are not involved with increasing emissions to atmosphere and are contained within closed loop vessels, it is concluded that the original dispersion modelling conducted to determine the environmental impact on air quality associated with the Shoalhaven Starches Expansion Project – MP06_0228 will not change. In fact, there may be a marginal decrease in impact of greenhouse gas emissions from the boilers.

We trust this summary of the air quality issues associated with the minor modification is satisfactory. Should you, however, require further clarification please call.

Yours Faithfully,

Peter Stephenson
Principal Consultant/Managing Director
STEPHENSON ENVIRONMENTAL MANGEMENT AUSTRALIA



ELEVATION LOOKING SOUTH

0 1 2 3 4 5 6 7 8 9 10 METRE

PRELIMINARY

REF DWG
AO 2212, AO 2214

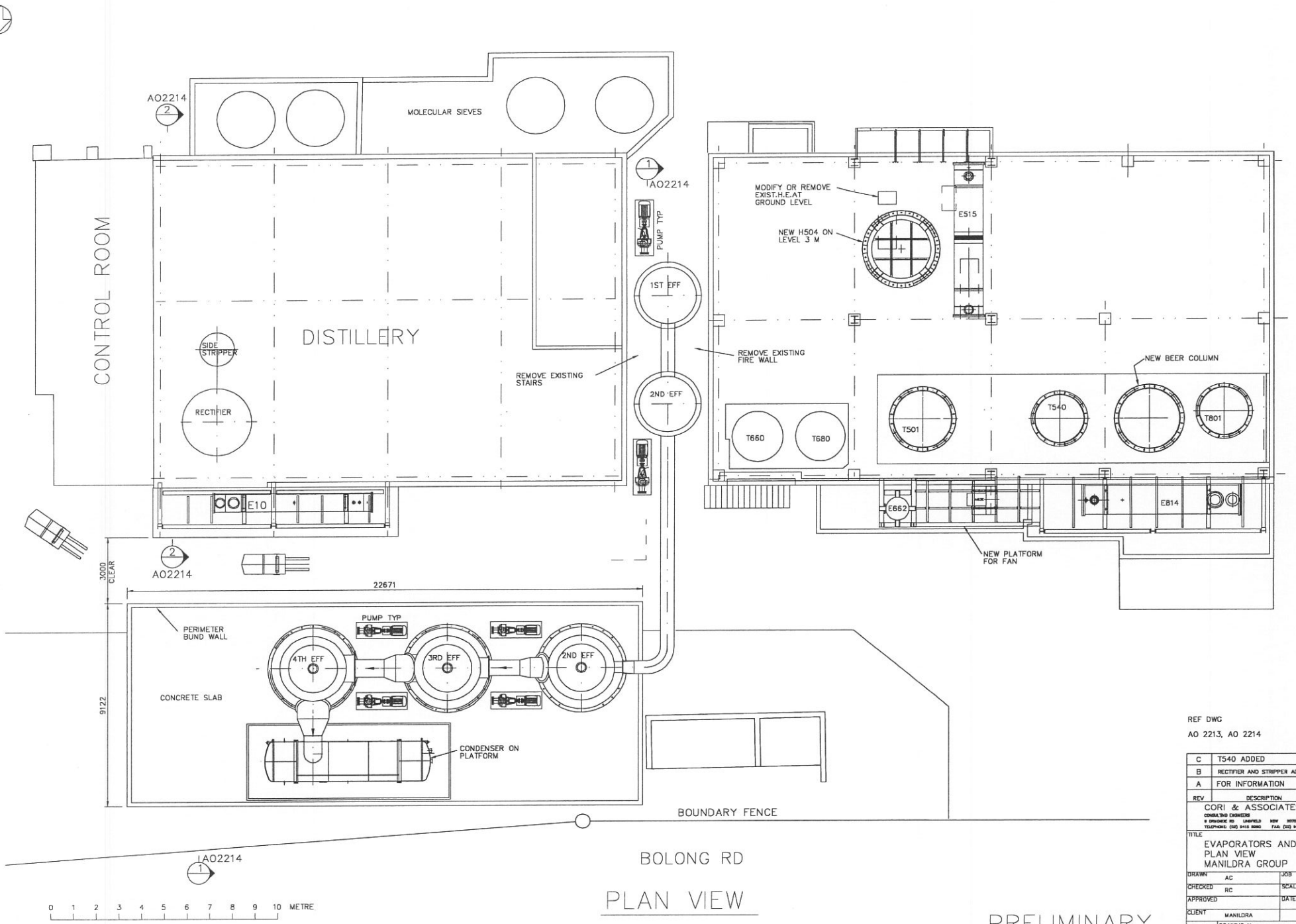
REV	DESCRIPTION	BY	DATE
C	T540 ADDED	AC	8.11
B	RECTIFIER AND STRIPPER ADDED	AC	8.11
A	FOR INFORMATION	AC	7.11

CORI & ASSOCIATES PTY LTD
CONSULTING ENGINEERS
9 ORMONDE RD LINDFIELD NSW 2070
TELEPHONE: (02) 9413 8080 FAX: (02) 9413 8670

TITLE
EVAPORATORS AND COLUMNS
ELEVATION LOOKING SOUTH
MANILDRA GROUP

DRAWN	AC	JOB	
CHECKED	RC	SCALE	NTS
APPROVED		DATE	7.2011
CLIENT	MANILDRA		

DRAWING No AO 2213 REV C



PLAN VIEW

PRELIMINARY

REF DWG

AO 2213, AO 2214

REV	DESCRIPTION	BY	DATE
C	T540 ADDED	AC	8.11
B	RECTIFIER AND STRIPPER ADDED	AC	8.11
A	FOR INFORMATION	JG	7.11

CORI & ASSOCIATES PTY LTD
CONSULTING ENGINEERS
9 DRUMMOND RD LINDFIELD NSW 2070
TELEPHONE: (02) 9416 8080 FAX: (02) 9416 8670

TITLE

EVAPORATORS AND COLUMNS
PLAN VIEW
MANILDRA GROUP

DRAWN	AC	JOB	
CHECKED	RC	SCALE	NTS
APPROVED		DATE	7.2011
CLIENT	MANILDRA		

DRAWING No. AO 2212 REV C

OVERALL SITE PLAN SHOWING ETHANOL MODIFICATIONS FOR SHOALHAVEN STARCHES P/L NOV 2011

RATIO: 1 : 1250 (AT A1 SIZE)	DATUM: AUSTRALIAN HEIGHT DATUM ORIGIN: PM 32610 AT BOLONG RD DATE OF PLAN: 28-11-11 SCALE PLAN: 23132909 10-1-2011	CLIENT: APA DESIGN: DRAWN: PWR CHECK: LAYOUT: 23132-07 SHT 1 28-11-2011	REVISION: D PROPOSED ETHANOL PLANT & ASSOCIATED CONSTRUCTION BUILDINGS — BY: — DATE: —

allen, price & associates
land and development consultants
75 plunkett street, nowra, nsw, 2541
ph (02) 4421 2122 fx (02) 4421 2133

PLAN SHOWING THE LOCATION OF BUILDINGS AND STRUCTURES IN RELATION TO THE SITE AND EXISTING STRUCTURES AT BOLONG ROAD, BOMADERRY FOR THE SHOALHAVEN STARCHES WITHIN THE CITY OF SHOALHAVEN

REF. No. 23132-07 | SHEET 1 | OF SHEETS | REVISION 01

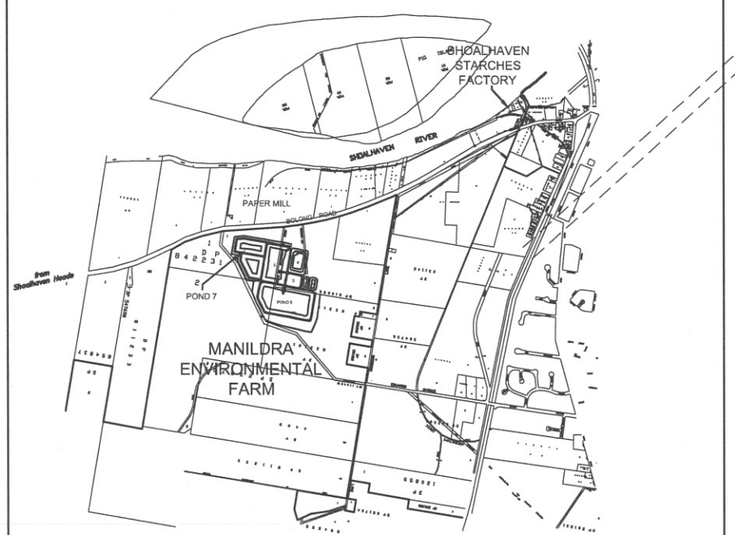
Liability limited by a scheme approved under Professional Standards Legislation.
OWNER OF EXCELLENCE

0 10 20 30 40 50 100
scale:– 1:1250

N

River
Shoalhaven
Creek
Bomaderry
20 WIDE
1 MANILDRA LAND DP 385145
APPROX RAILWAY LINES
PROPOSED ETHANOL PLANT & ELECTY SUBSTN #7
PROPOSED COMPRESSOR ROOM
PROPOSED FERMENTER No.17
PROPOSED CONSTRUCTION CONCRETE SLAB
PROPOSED FERMENTER No.16
PROPOSED BEER COLUMN
PROPOSED CONDENSER AND EFF'S
143 DP 1069758 OPEN PADDOCK MANILDRA LAND
BOLONG ROAD
MANILDRA LAND
OPEN PADDOCKS
PUMP HOUSE
METAL TANK
PROPOSED METAL TANK
COGEN GAS INSTALLATION (APPROX LAYOUT)
INTEGRAL ENERGY GAS NATURAL GAS INSTALLATION
MANILDRA GAS STATION
EXISTING FENCE
OPEN STORMWATER DRAIN
2 DP 538289
(DP 624895)
SETBACK
PRIVATE ROAD
A DP371386 MANILDRA LAND
FACTORY BUILDING
MAINTENANCE WORKSHOP
CARPARK
ACF LAND
ACF STORE AND ASSOCIATED BUILDINGS
OFFICE AND FACTORY
WEIGHBRIDGE
SERVICE STATION
B DP 371388
A DP 371387
A DP 371388
MANILDRA LAND
16 DP 1121337
RAILWAY STREET
SOUTH COAST RAILWAY
COUNCIL SEWERAGE TREATMENT PLANT
FRONTAGE AND ACCESS TO RAILWAY STREET

DIAGRAM SHOWING ENVIRONMENTAL FARM IN RELATION TO MAIN FACTORY



EXISTING STRUCTURES

PROPOSED ETHANOL MODIFICATIONS NOVEMBER 2011

ANNEXURE 5

ANNEXURE 5

Flood Assessment

prepared by

Webb McKeown & Associates

SHOALHAVEN STARCHES

MINOR MODIFICATION TO ETHANOL PLANT

SHOALHAVEN STARCHES

wma water

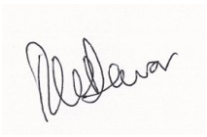
DECEMBER 2011

Level 2, 160 Clarence Street
Sydney, NSW, 2000

Tel: 9299 2855
Fax: 9262 6208
Email: wma@wmawater.com.au
Web: www.wmawater.com.au

MINOR MODIFICATION TO ETHANOL PLANT SHOALHAVEN STARCHES

DECEMBER, 2011

Project **Minor Modification to Ethanol Plant Shoalhaven Starches**	Project Number **111075**
Client **Shoalhaven Starches**	Client's Representative **Mr B Hanley**
Authors **Richard Dewar**	**Prepared by** 
Date **20 December 2011**	**Verified by** **R W Dewar**

Revision	Description	Date
1	Final Report	20 December 2011

MINOR MODIFICATION TO ETHANOL PLANT SHOALHAVEN STARCHES

TABLE OF CONTENTS

LIST OF FIGURES

1. ADDENDUM

1.1. Background

Shoalhaven Starches is located on the northern overbank of the Shoalhaven River, approximately 1.5 kilometres downstream of Nowra Bridge (Figure 1). The plant has been on this site since 1970 and has expanded considerably since that time.

In January 2009 the Minister for Planning issued Project Approval MP06_0228 that enables Shoalhaven Starches to increase its ethanol production capacity. Following commissioning of components of the approved development Shoalhaven Starches has identified areas to better refine operational processes and improve energy efficiency. These modifications are shown on Figure 1.

This report was prepared to assess the impact of the proposed modification works on flood levels, flows and velocities.

1.2. Previous Reports on Flooding

A number of flood assessment reports have been prepared for previous works in the area. The reports listed below have considered the individual and cumulative effects of the following previous developments on flooding:

- **Proposed BOC Gases CO_2 Plant and Dairy Farmers' Pond at Bomaderry Hydraulic Assessment of Cumulative Effects, July 2000.**
  This assessed the hydraulic impacts of works undertaken in the area since 1990, in two stages:
  Stage 1: to include the 5 storage ponds opposite the Paper Mill and the approved protein isolate plant,
  Stage 2: as for Stage 1 plus the proposed BOC Gases CO_2 Plant and the Dairy Farmers' pond.

- **Further Development within the Manildra Starches Plant off Bolong Road, Bomaderry, Hydraulic Assessment, 6 October 2000.**
  This report assessed the impacts of additional infrastructure within the Shoalhaven Starches plant. It concluded that no further computer modelling was required to evaluate the hydraulic impacts of additional development within the built up area of the plant. Some of the currently proposed works are outside the built up "envelope" of the plant area identified in this October 2000 report and for this reason additional hydraulic assessment has been undertaken.

- **Construction of Pond No. 6, December 2000 to March 2001**
  A number of reports were prepared and these are summarised below.
  1. Manildra - Effluent Storage Pond No. 6, Hydraulic Assessment, 18 December 2000,

2. Manildra - Effluent Storage Pond No. 6, Advice Regarding Possible Mitigation Measures, 9 January 2001,
3. Manildra - Effluent Storage Pond No. 6, Hydraulic Assessment - Velocities, 16 January 2001,
4. Manildra - Effluent Storage Pond No. 6, Economic, Social and Environmental Impacts of Flooding, 23 February 2001,
5. Manildra - Effluent Storage Pond No. 6, Economic Impacts of Flooding, 23 March 2001,
6. Letter from Webb McKeown & Associates to Shoalhaven City Council, Re: Development Application No. 00/3555 - Proposed Effluent Pond No. 6, 29 March 2001.

- **Construction of Pond No. 7 and Works at Plant, 25th October 2002**
  This report assessed the impacts of constructing Pond No. 7 together with additional works at the plant. It represented an amalgamation of the previous reports, produced for approval of Pond No. 6, with an update to include the incremental effects of the proposed Pond No. 7 and additional works at the plant.

- **Proposed Flour Mill - Manildra Starches Plant, off Bolong Road, Bomaderry, Hydraulic Assessment, March 2007**
  This report assessed the potential flood impacts and concluded that they are insignificant given the intensive development already present. However there was a need to consider the flood hazard and structural assessment and these would need to be addressed as part of the Construction Certificate.

- **Proposed Flour Mill and Silos - Bolong Road, Nowra: Flood Hazard & Structural Assessment, April 2008**
  This report provided a flood hazard and structural assessment of the proposed works.

- **Proposed Ethanol Production Upgrade including Proposed Odour Reduction and Wastewater Treatment Measures for Existing and Proposed Shoalhaven Operations – Bolong Road, Nowra: Hydraulic, Economic, Social and Environmental Impacts of Flooding, May 2008**
  This report assessed the potential flood impacts and reported on the compliance with Council's DCP 106 – Floodplain Management. A Climate Change Addendum to this report was prepared in August 2008 and assessed the impacts of potential climate change on flooding at the site.

- **Flood Mitigation and Management Plan, June 2009**
  This report was prepared as a condition of consent by the Department of Planning for the works outlined in the May 2008 report. This report was reviewed by Shoalhaven City Council.

1.3. Present Report

This present report is provided as an Addendum to our May 2008 report and as such the background, study approach and other details have not been repeated herein.

Each development on the floodplain has the potential to cause an impact upon flood levels and introduce additional flood risk. Whilst the individual impacts may be small the cumulative increases from several developments may be significant. Therefore, all proposed works need to be assessed in the context of the total cumulative impacts of all development within the immediate area.

This present hydraulic assessment investigates the incremental hydraulic impact of the works shown on Figure 1 compared to the results indicated in our May 2008 report which represent the cumulative impacts of all development by Shoalhaven Starches since approximately 1990.

1.4. Results

The hydraulic model that was used in all past studies to assess the impacts of works on the floodplain was modified to reflect the proposed modification works (shown in red on Figure 1). It was assumed that the Proposed Beer Column and associated Proposed Condenser and EFF's would have no impact on flood levels as they are within the existing plant and surrounded by other structures. The Proposed Electricity sub station #7, Compressor Room, Fermentor #16 and 17 were included in the hydraulic model and were represented by a reduction in the flow path across the site. The Proposed Construction Concrete Slab will involve no filling of the floodplain or restriction in flow path and has therefore been ignored in the hydraulic modelling.

The photograph on the front cover of this report shows the existing Fermentors on the site.

The hydraulic model was run for the Extreme and the 1%, 2% and 5% annual exceedance probability floods (AEP). Events smaller than the 5% AEP were not run as there is no significant inundation of the plant in these smaller flood events.

The results indicate that the incremental increase in flood level (for the full range of design flood events) as a result of the proposed works shown on Figure 1 is less than 0.01m. A change in flood level of +/- 0.01m in flood level is within the order of accuracy of the flood modelling process and cannot accurately be defined. This very small increase in flood level is to be expected given the magnitude of the floodplain of the lower Shoalhaven River and the relatively minor extent of the proposed works.

It should also be noted that the very small scale of the proposed works are such that it is not possible to precisely reflect the works in the existing hydraulic model. Thus they could only be reflected by an adjustment of the flow path from the Shoalhaven River across the Shoalhaven Starches site which likely over estimates the hydraulic effects of the proposed works.

Figures

FIGURE 1

PROPOSED MODIFICATIONS – DECEMBER 2011

OVERALL SITE PLAN SHOWING ETHANOL MODIFICATIONS FOR SHOALHAVEN STARCHES P/L NOV 2011

1 : 1250 (AT A1 SIZE)

allen, price & associates

PLAN SHOWING THE LOCATION OF BUILDINGS AND STRUCTURES IN RELATION TO THE SITE AND EXISTING STRUCTURES AT BOLONG ROAD, BOMADERRY FOR THE SHOALHAVEN STARCHES WITHIN THE CITY OF SHOALHAVEN

23132-07

River

Shoalhaven

Shoalhaven River

Shoalhaven River

Creek

W. B. Bomaderry

1 MANILDRA LAND DP 385145

PROPOSED COMPRESSOR ROOM

PROPOSED FERMENTER No.17

PROPOSED CONSTRUCTION CONCRETE SLAB

PROPOSED FERMENTER No.16

143 DP 1069758 OPEN PADDOCK MANILDRA LAND

PROPOSED CONDENSER AND CT'S

BOLONG ROAD

BOLONG ROAD

BOLONG ROAD

BOLONG ROAD

DP371386 MANILDRA LAND

MANILDRA LAND

OPEN PADDOCKS

2 DP 538289

PRIVATE

B DP 371388

RAILWAY

A DP 371387

A DP 371388

RAILWAY STREET

RAILWAY STREET

MANILDRA LAND

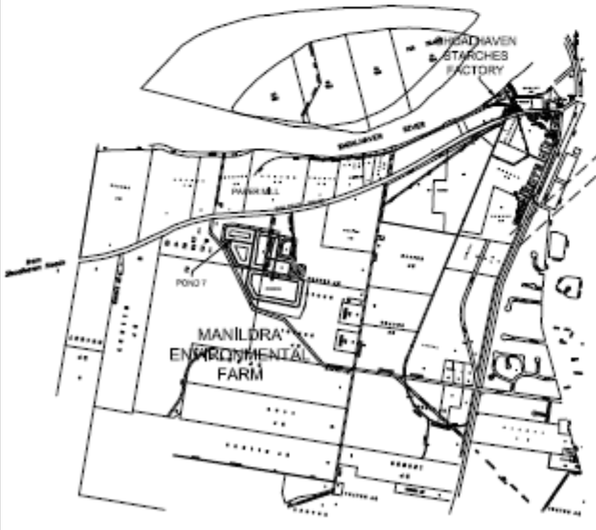
16 DP 1121337

COUNCIL SEWERAGE TREATMENT PLANT

SOUTH COAST RAILWAY

ACF LAND

DIAGRAM SHOWING ENVIRONMENTAL FARM IN RELATION TO MAIN FACTORY



EXISTING STRUCTURES

PROPOSED ETHANOL MODIFICATIONS NOVEMBER 2011