Draft

SHOALHAVEN STARCHES ETHANOL EXPANSION PROJECT INDEPENDENT ASSESSMENT OF ODOUR IMPACTS

27 November 2008

Prepared for:

NSW Department of Planning

by

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1. INTRODUCTION

This report has been prepared by Holmes Air Sciences on behalf of the NSW Department of Planning (DoP). It provides an independent assessment of the potential odour impacts of the proposed expansion of the Shoalhaven Starches ethanol plant at Bomaderry, NSW.

The report comprises the following components.

- A discussion of the background to the project
- Review of odour audit prepared by GHD Pty Ltd (October, 2007) in response to a Land and Environment Court prosecution of Shoal Haven Starches (referred to hereafter as the Audit Report).
- A review of the odour assessment submitted as part of the final Environmental Assessment (EA) for the project prepared by GHD Pty Ltd (July, 2008) (referred to hereafter as the EA Report).
- An assessment of the odour impacts of the proposed expansion and the adequacy of proposed odour controls.

2. BACKGROUND TO THE STUDY

The Manildra Group operates a plant referred to as Shoalhaven Starches at Bolong Road, Bomaderry, processing flour and grain to produce ethanol, starch, glucose, gluten and dried distillery's grain (DDG). The plant comprises a factory and an environmental farm.

Shoalhaven Starches lodged a major project application with DoP in December 2007 for expansion of its ethanol production from 126 ML to 300 ML/year. The proposed expansion comprises additional infrastructure within the existing starch, ethanol and stillage recovery plants as well as construction of a new packing plant, container storage area and gas co-generation facility. Included in the expansion will be the physical works for the implementation of odour controls, which include the construction of a wastewater treatment plant and installation of bioscrubbers to control significant odour sources within the factory.

It is our understanding that the application also seeks to surrender all existing planning approvals for the site and replace them with a single project approval.

The plant has a long history of odour complaints and in November 2006, Shoalhaven Starches was prosecuted in the Land and Environment Court by the Department of Environment and Climate Change (DECC) for causing offensive odour. The court judgement required that a suitably qualified person be engaged to conduct a comprehensive odour audit of the site

The odour audit was conducted by GHD Pty Ltd and all significant odour sources were identified and recommendations made for a range of odour control measures

The proposed expansion would incorporate the main features of the odour minimisation measures outlined in the Audit Report.

Holmes Air Sciences have been engaged by DoP to assist in assessing the odour impacts of the proposed expansion and to assist in providing a strategic framework for managing odour from the site in the future. The Consent Conditions for the expansion reflect that framework.

This report provides a review of the odour impacts of the proposal and sets out a process and timeline for the staging and implementation of the odour control measures. In the process of undertaking this assessment, the following reports have been reviewed:

- Shoalhaven Starches – Environmental Audit Odour Sources Volume 1 Report(**GHD, 2007a**)
- Shoalhaven Starches – Environmental Audit odour Sources Volume 2 Appendices(**GHD, 2007b**)
- Shoalhaven Starches – Report on Ethanol Upgrade Air Quality Assessment (**GHD, 2008a)**

- Shoalhaven Starches - Report on Odour Control Works and Ethanol Upgrade, Response to Submissions on the Air Quality Assessment from the NSW Government Department of Planning, (**GHD, 2008b**)
- Shoalhaven Starches - PRP7 Annual Environmental Management Report prepared by Stephenson Environmental (2008) (**SEMA, 2008**)

Submissions on the proposal made to DoP by stakeholders including residents and businesses in the area and State agencies including the Department of Environment and Climate Change (DECC) and the Shoalhaven Council have also been reviewed.

In addition, meetings with DoP and DECC were undertaken on:

- 4 August 2008
- 15 September 2008
- 1 October 2008

3. REVIEW OF ODOUR AUDIT BY GHD

The odour audit was conducted to address the requirements of the Land & Environment Court judgement of 2 November 2006. These requirements were extensive and included amongst others the following key components:

a. Identification through plant inspection and consideration of plant processes all odour sources at the site
b. Benchmarking of each process and activity identified in (a) against comparable international best available technology and industry best management practices with respect to odour control
c. Commissioning of odour measurements from each source
d. Ranking of odour sources and their contribution to potential off-site impacts giving consideration to the hedonic tone (that is the quality of the odour)
e. Recommendations for odour minimisation measures
f. Dispersion modelling of the existing operations with and without odour minimisation measures to determine the impact of the site operations and the benefit of the odour control measures.
g. Review of odour management practices at the site including policies, procedures and training.

The odour audit was undertaken in a thorough and competent way with clear identification of the significant odour sources and practical recommendations for their reduction.

3.1 Identification of significant odour sources

The Audit Report identified major sources of odour in terms of both odour emissions and potential off-site impacts.

The factory comprises the starch plant, glucose plant, ethanol and distillation plant and the DDG plant. Other potential sources of odour were the product load out areas and the cooling towers. A total of 100 odour samples were taken during the main survey.

Table 1 summarises the contributors to the total odour emission rated (OER) from the site (taken from Table 16 **GHD, 2007a**). The environmental farm was the most significant odour source, followed by the starch plant and the DDG plant. However, as will be discussed later, the odour emissions from some aspects of the environmental farm are likely to be an overestimate.

Table 1: Total OER contribution

Source group	**OER (OUm^3/s)**	Percent of total OER
Starch plant	310,000	7.3%
DDG plant	230,000	5.5%
Ethanol plant	120,000	2.9%
Glucose plant	8,900	0.2%
Distillation plant	1,900	<0.1%
Environmental farm	3,500,000	83%
Total	4,170,800	100%

Table 2 (taken from Table 18, **GHD 2007a**) lists the top ten individual odour sources within the factory. The DDG sources accounted for 34% of the total factory odour of which the dryer building, cooling towers and finisher feed tank and feed holding tank were identified as sources with very unpleasant odour.

Table 2: Top ten individual odour sources within the factory

Rank	**Plant**	**Source**	**OER (OUm^3/s)**	**% Total factory OER**	**Hedonic tone**
1	Starch	No.4 Gluten dryer (S5)	150,000	22%	Mildly unpleasant
2	Starch	No. 3 Gluten dryer (S3)	73,000	11%	Mildly unpleasant
3	DDG	Dryer building [1] (DDG39)	71,000	10%	Very unpleasant
4	DDG	Cooling towers (DDG46)	68,000	10%	Very unpleasant [2]
5	Ethanol	Cooling towers (E23)	66,000	9.7%	Mildly unpleasant
6	Starch	No. 1 gluten dryer (S2)	38,000	5.6%	Mildly unpleasant
7	Ethanol	Yeast propagators – tanks 4 and 5 (E15)	28,000	4.1%	Mildly unpleasant
8	DDG	Condensate tank (DDG23)	20,000	2.9%	Mildly unpleasant
9	DDG	Finish feed tank (DDG26)	18,000	2.7%	Very unpleasant
10	Starch	No. 2 gluten dryer (S4)	18,000	2.7%	Mildly unpleasant
Sub-Total			**550,000**	**81%**	
Total Factory			**670,800**	**100%**	

1. Fugitive odour emissions from dryer building
2, Sample not analysed for hedonic tone. However, field observations suggested a very unpleasant hedonic tone.

The odour emission rate from the environmental farm are summarised in **Table 3 (**taken from Table 21 ,**GHD 2007a**). Spray irrigation accounted for 85% of the total odour, the majority of which was from pivot irrigation. The use of low-mist nozzles appeared to reduce the odour emission rate compared to irrigators equipped with standard nozzles. However, the methodology for measuring odour flux from these sources has a large inherent uncertainty and interpretation of this result should be treated with caution.

Table 3: OER breakdown - Environmental Farm

Odour Source Group	**OER (OU m^3/s)**	% Total OER
Mixer tank	150,000	4%
Ponds	290,000	8%
Spray irrigation	3,000,000	85%
Irrigated land	90,000	3%
Total	**3,530,000**	**100%**

Dispersion modelling was undertaken with CALPUFF with meteorological input from the automatic weather stations at the environmental farm. The model assumptions and settings as presented in the audit report were appropriate.

In New South Wales it is a requirement under Section 129(1) of the Protection of Environment Operations Act, 1997 (NSW) (POEO Act) that "*the occupier of any premises at which scheduled activities are carried out under the authority conferred by a licence must not cause or permit the emission of any offensive odour from the premises to which the licence applies".*

The POEO Act introduced the concept of an offensive odour which is defined as follows:

"*offensive odour means an odour:*

(a) that, by reason of its strength, nature, duration, character or quality, or the time at which it is emitted, or any other circumstances:
(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or
(i) *interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
(b) that is of a strength, nature, duration, character or quality prescribed by the regulations or that is emitted at a time, or in other circumstances, prescribed by the regulations."

To assist in assessing compliance with Section 129, the DECC have set odour criteria as summarised in **Table 4**

Table 4 – Odour performance criteria for the assessment of odour

Population of affected community	Odour assessment criteria (ou)
≤ ~2	7
~10	6
~30	5
~125	4
~500	3
Urban (~2000) and/or schools and hospitals	2

Source: ***DEC, 2005***

For this assessment a level of 2 ou was used for Bomaderry and Nowra and a level of 7 ou was used for the isolated residences in proximity to the environmental farm.

These are appropriate design criteria for new plant, however they should be regarded as planning tools rather than regulatory limits. As noted in **GHD 2008b** the overriding aim of the exercise is to minimise odour nuisance and hence complaints (that is compliance with Section 129) rather than achieve strict compliance with a modelling-based goal.

The results of the odour modelling of the existing facility indicated that the factory alone resulted in odour levels of approximately 40 ou on the outskirts of Bomaderry and 30 ou on the northern fringes of Nowra. These levels are very likely to cause an odour nuisance and are consistent with the complaints history of the facility.

The modelling results were broken down into contributions from the various sources and the following conclusions reached

- DDG plant contributes the greatest to the predicted odour impact at receptors adjacent to the factory (Nowra, North Nowra, Bomaderry and Terara). In general, the DDG plant contributes approximately 50 to 60% of the predicted odour concentration at these receptors, which is up to double the contribution from the Starch plant at ~28%.
- Fugitive odour emissions from the DDG dryer building make a significant contribution to the predicted odour impact at all receptor locations adjacent to the factory, and also contribute significantly at receptors farther away, such as Black Forest and Jaspers Brush
- Odour emissions from the glucose, ethanol and distillation plants do not make a significant contribution to the predicted odour impact at nearby receptors. and
- At greater distances from the factory, the dominance of the DDG plant contribution to odour impact diminishes in favour of the starch plant contribution.

Modelling of the environmental farm was undertaken under worst-case operating conditions, which is likely to overestimate the contribution of the spray irrigators. This was the dominant source followed by the storage ponds. Predicted odour levels at nearby rural residences ranged from 25 to 100 ou.

A range of operating scenarios of the irrigators were also modelled and it was acknowledged in the report that the model could be refined to better represent the actual odour impacts under different operating conditions throughout the year.

The cumulative impacts of the factory and the farm were dominated by the impacts from the environmental farm. These result are reproduced here in **Figure 1**

These model results assisted in targeting the odour sources whose control would give the most benefit to off-site odour reductions.

3.2 Recommended odour mitigation measures

The Audit Report reviewed odour prevention and minimisation options for all the odour sources and identified staged odour mitigation measures for the facility, which have been carried forward into the EA. The following summarises the main components of the minimisation measures. Further details are provided in audit report (**GHD, 2007**) and **Section 5** of this report.

The mitigation measures were divided into three stages in order of priority for implementation. **Table 5** summarises these measures and indicates a proposed timeframe as outlined in the EA.

Table 5: Odour Control Measures – Staged Implementation

Odour Source	Odour Control
Stage 1	***To be completed by December 2008***
DDG Plant	Install a bioscrubber and duct key odour sources to the bioscrubber
	Install wet legs on tanks to condense vapour emissions. Wet legs to be installed on odour sources not ducted to the bioscrubber at this stage
	Undertake housekeeping such as ductwork cleaning and maintenance to prevent the buildup of putrescent contamination
	Install a Pelletiser Plant for the DDG product
Ethanol Plant	Decommission cooling towers
	Install wet legs on tanks to condense vapour emissions
Starch Plant	Undertake housekeeping such as ductwork cleaning and maintenance
	Decommission Kestner dryer
Glucose Plant	Install wet legs on enzyme tanks to condense vapour emissions
Flour Mill	Improve dispersion from cyclone and fabric filters
Environmental Farm	Install a biological wastewater treatment plant
Stage 2	***`To assess within 6 months of completing Stage 1 controls***
DDG Plant	Duct condenser drain decanters to bioscrubber
Ethanol Plant	Install a bioscrubber and duct propagation and farm tanks to bioscrubber
Glucose Plant	Install a bioscrubber and duct enzyme tanks to bioscrubber
Stage 3	***If required, depending on the outcomes of Stage 2 implementation***
DDG Plant	Duct light phase tank to bioscrubber
Ethanol Plant and Distillery	Duct remaining odour sources to bioscrubber
Glucose Plant	Duct remaining odour sources to bioscrubber
Starch Plant	Duct remaining odour sources to bioscrubber
	Install a common tall stack for emissions from gluten and starch dryers and the dry gluten bin

Further modelling was undertaken with the odour emission rates outlined in **Table 5** below (taken from Table 50 taken from **GHD, 2007a**) following implementation of all odour controls. While the odour emissions from the starch plant are not reduced, their impact is lessened due to improved dispersion though a ventilation stack.

Table 6: Total OER contribution following implementation of odour controls

Source group	OER (OU m^3/s) prior to implementation odour control	OER (OU m^3/s) following implementation odour control	% Total OER reduction
Starch plant	310,000	310,000	-[1]
DDG plant	230,000	43,000	80%
Ethanol plant	120,000	7,900	93%
Glucose plant	8,900	1,600	82%
Distillation plant	1,900	390	79%
Total – Factory	670,800	362,890	46%
Environmental Farm	3,500,000	39,000	99%
Total – Factory and Environmental Farm	**4,170,800**	**401,890**	**90%**

1. Odour reduction resulting from duct cleaning cannot be estimated at this stage

The model results are shown in **Figure 2** for comparison with **Figure 1.** There is clearly a substantial reduction in odour which should translate into a reduction in odour nuisance impacts although the odour levels are not reduced to the nominated criterion of 2 ou at Bomaderry and Nowra.

The starch plant is now the dominant source. The Audit Report noted that some improvements (25%) can be achieved by ducting some of the sources through vertical discharge points. However the report recommends that before a commitment is made to this, the efficacy of cleaning the ductwork is assessed. This has not been taken into account in the modelling and is likely to provide some benefit.

One of the greatest uncertainties in the assessment is the estimation of the odour emissions during spray irrigation. A worst-case approach was adopted and while this is an appropriate approach in a regulatory environment, the results need to be viewed with caution in that if the impacts are overestimated then the benefits of reducing those impacts may also be overestimated. We note that in the odour audit it has been assumed that the introduction of low mist spray nozzles on the pivot would reduce the odour emissions from this source by 98%. Our view as noted above is that this benefit may be significantly over estimated.

Regardless, the environmental farm is clearly a significant source of odour nuisance in the community and the proposed measures for reducing this odour, namely the installation of a wastewater treatment plant, are appropriate and practical and are seen as high priority for control of odour from the site.

4. REVIEW OF ODOUR IMPACTS AS PRESENTED IN THE EA

The odour impact assessment undertaken in the EA was also conducted by GHD. It draws substantially from information gathered during the odour audit, supplemented with odour emissions data collected by Stephenson Environmental Management Australia (SEMA, 2008) in the intervening period between the Audit Report and the EA Report. Dispersion modelling details and impact assessment criteria were as presented in the odour audit report.

The following are the significant changes to the plant associated with the upgrade:

- Provision of an additional gluten dryer and gluten grinder from the starch plant
- Additional equipment and storage vessels for the ethanol plant including three additional fermenters, additional cooling towers and molecular sieves
- Upgrades to the stillage recovery plant including six additional dried distillers grains with solubles (DDGS) dryers, ten decanters, storage and feed tanks and two evaporators
- Installation of a DDG pelletiser plant
- Installation of a 20 MW gas-fired boiler
- Installation of a 35 MW gas-fired co-generation plant, and
- Establishment of a new packing plant and container loading area.

A range of modelling scenarios were undertaken including the following.

Scenario A	Factory principal odour sources with existing level of odour control. This takes into account some reduction in odour emission from the gluten and starch dryers following dust cleaning
Scenario B	Factory principal odour sources with Stage 1 odour control
Scenario C	Factory principal odour sources with Stage 1 odour control **plus** ethanol upgrade odour sources
Scenario D	Factory principal odour sources with Stage 2 odour control **plus** ethanol upgrade

odour sources

Scenario E Factory principal odour sources with Stage 3 odour control **plus** ethanol upgrade odour sources

Scenario F Factory principal odour sources with existing level of odour control **minus** DDG plant odour sources

Scenario G Factory principal odour sources with Stage 1 odour control **plus** ethanol upgrade odour sources plus the environmental farm with odour controls

The odour controls referred to above are those summarised in Table 5.

Table 7 (taken from Table 8-2, **GHD 2008a**) summarises the results of the odour modelling at specific receptors

Table 7: Odour model results - factory

Ref.	Scenario Description	Predicted Ground Level odour (OU, 99 percentile, 1-second average)				
		Bomaderry (R1)	N Nowra (R2)	Nowra (R3)	Terara (R4)	Factory north-west boundary
A	Factory principal odour sources with **existing** level of odour control	40	13	20	18	100
B	Factory principal odour sources with **Stage 1** odour control	5	3	5	5	~20
C	Factory principal odour sources with **Stage 1** odour control **plus** ethanol upgrade odour sources	6	3	5	5	~25
D	Factory principal odour sources with **Stage 2** odour control plus ethanol upgrade odour sources	3	2	3	3	~10
E	Factory principal odour sources with **Stage 3** odour control **plus** ethanol upgrade odour sources	2	1	<2	<2	~5
F	Factory principal odour sources with existing level of odour control **minus** DDG plant odour sources	5	2	5	5	-

The implementation of Stage 1 odour controls without the upgrade (Scenario B) results in a substantial reduction in odour impacts. The upgrade causes a small increase in impacts which are further reduced with the implementation of Stage 2 and Stage 3 controls to a point where the 2 ou criterion is met at Nowra and Bomaderry. The DDG plant is a major contributor to the odour impacts from the factory.

Scenario G models the environmental farm sources with odour controls plus the factory with Stage 1 odour controls plus the ethanol upgrade (Scenario C). The predicted concentrations at selected report are not changed substantially with the inclusion of the environmental farm sources. The 7 ou criterion is met at all the isolated rural residences in proximity to the farm.

The conclusions of the assessment with respect to odour were as follows:

- Stage 1 controls would effectively counter the potential for incremental odour impacts because of the upgrade. Approximately 70% of the emission would be treated via the bioscrubber, the remainder would be subject to odour minimisation measures including adequate dispersion and maintenance
- Based on the model results, Stage 3 odour controls at the factory would be necessary to to achieve compliance with the DECC 2 ou criterion. However it was noted that the wastewater treatment plant at the environmental farm would substantially reduce odour and that this combiner with Stage 2 or even Stage 1 controls may be sufficient to mitigate odour impacts
- When emission from the environmental farm are controlled through the wastewater treatment plant, there is no significant incremental; increase in the predicted odour levels at receptors near the factory

A request for additional information was made to GHD as follows:

1. Please provide model run outputs in the form of contour plots for the existing plant with the environmental farm included as the existing base case.

2. On page 33 of the GHD report it is noted that the bioscrubber has a residual odour from the biomass substrate. It appears that this odour has not been included in the emissions from the bioscrubber and it is the remaining 15% of the process odour that has been modelled. Therefore the claim that this odour will not be inherently offensive needs to be justified

3. Page 65, Section 8.1.1 of the GHD report refers to the fact that the bioscrubber will contribute less than 1 ou to the predicted odour impact at the most sensitive receptor, R1. It is not clear which scenario this relates to. The implication is that it refers to the existing factory with the Stage 1 controls. For the ethanol upgrade and subsequent Stage 2 and 3 controls, the emission rate increases by a factor of about 3-4. This should be clarified.

4. It is noted in Section 8.1.2 and Figure 8.7 of the GHD report that there is not a significant increase to predicted odour levels at the selected receptors near the factory as a result of adding the odour emissions from the wastewater treatment plant from the environmental farm into the model that represents the factory after Stage 1 odour control plus the ethanol upgrade. An additional scenario needs to be presented that shows Stage 3 odour controls, ethanol upgrade and the environmental farm with all proposed odour controls in place. This model run represents the ultimate configuration proposed for the plant

Responses to these questions were provided in **GHD 2008b.** In summary, additional contour plots were provided in response to (1) and (4). These are attached as **Figure 3** and **Figure 4**.

The contribution of the bioscrubber (2 and 3) was estimated by GHD to be less than 1 ou at the most exposed sensitive receptor under all operating conditions.

5. SUMMARY AND RECOMMENDATIONS

The Audit Report and EA Report are both sound studies and the latter complies with regulatory requirements in terms of modelling and odour impact assessment. The proposed odour control measures are appropriate for the application and if properly installed and operated should provide the benefit predicted.

The results and recommendations of these studies can therefore be used with a reasonable level of confidence to set approval conditions for the project.

It is established that the existing operation causes an odour impact in the surrounding community. The implementation of Stage 1 odour controls which are substantially the installation of the bioscrubber and wastewater treatment plant would significantly reduce the odour to a point where any increase in odour due to increased production would be more than offset. Therefore future odour impacts can only be better than current odour impacts provided the odour control measures are operated effectively.

However, given the impacts that the plant has caused in the community in the past, a very substantial reduction in odour impacts is required before any increase in production should be undertaken. It will therefore be necessary to demonstrate that the odour minimisation measures are highly effective rather than simply reduce the odour to a point where, with the increased expansion, the odour is no worse.

It is recommended that, if the project is approved, there should be a suite of mandatory odour controls installed and then depending on performance, additional odour controls as required to substantially reduce the odour impacts from the plant to a point where the levels of odour are acceptable within the community. As noted above, it would not be reasonable to simply reduce odour impacts; it must be a very significant reduction before any increase in throughput can occur. Compliance with S129 of the POEO Act; that is no odour nuisance in the community should be the ultimate goal.

The following is a list of the mandatory odour controls that would need to be implemented within eight months of approval. The effectiveness of these controls would then need to be verified. Following that, and if necessary, additional odour controls may also need to be implemented. The mandatory odour controls comprise the Stage 1 odour controls presented in the EA and summarised in **Table 5**. They are listed below.

Mandatory odour controls

- Install and commission a bioscrubber
- Duct high priority dry distillers grain plant (DDG) odour sources to the bioscrubber. The odorous sources include the DDG liquids line, the DDG solid line, the DDG (liquids) plant concentrate tank, finisher feed tank and feed holding tank (syrup). These have been identified as sources with very unpleasant odour. It is proposed to increase the volume of foul process air from the DDG dryer building to the boiler.
- The bioscrubber must have sufficient capacity or be capable of being readily upgraded to meet the requirements of any other control works that require implementation in the future
- Install and commission a wastewater treatment plant at the Environmental Farm to process the liquid waste streams from the factory
- Install wet-legs on key odour sources that are not ducted to the bioscrubber at this stage. These sources include:
- Farm tank (located near ethanol plant)
- Ethanol plant Jet cooker retention tank “F7”
- Glucose plant enzyme tank
- DDG (solids) plant decanter feed tank

- Clean all starch and gluten dryer ductwork to remove build up of solids that can become odorous
- Improve factory housekeeping in general and in particular the DDG plant grounds
- Pelletise DDG product and fit heavy curtains to openings in the DDG product storage shed and load-out tent , and
- Decommission designated odour sources as follows:
- Ethanol plant cooling towers
- Kestner dryer exhaust at Starch plant

As discussed above, the mandatory odour controls need to be implemented and tested for efficacy before any increase in ethanol production could occur. The increase in production is also best undertaken in a staged approach, with verification of performance at particular milestones.

The process for verifying the effectiveness of the odour controls is provided in detail in the Approval Conditions. In brief, it comprises an odour verification study to demonstrate that the odour control measures enable the facility to comply with S.129 of the POEO Act at its current ethanol capacity, and at an ethanol production capacity up to a staged limit.

Additional odour controls are outlined below. These comprise the Stage 2 and Stage 3 controls identified in the Audit Report and the EA.

Additional odour controls

- Duct medium priority odour sources to bioscrubber. These sources include:
  - Farm tank (located near ethanol plant)
  - Ethanol plant Jet cooker retention tank “F7”
  - Glucose plant enzyme tank
  - Ethanol plant decanter feed tank
  - Ethanol plant yeast propagators (tanks 1 to 5)
  - DDG (liquid) plant vent condenser drain
  - DDG (solids) plant decanters 1 and 4 and decanter feed
- Duct low priority odour sources to bioscrubber. These sources include:
  - Residual emission from the DDG dryer building
  - DDG (solids) plant load out tent
  - Glucose plant drum vacuum receiver
  - Distillery plant molecular sieve vacuum drum
  - Ethanol plant jet cookers 1, 2 and 4
  - Glucose plant cooker A&B flash tanks
  - DDG (liquids) plant light phase recovery tank
  - Glucose plant ion exchange effluent tank
  - Ethanol plant starch factory rejects collection tank
- Duct individual starch and gluten dryer discharge points to common tall stack

The way in which the additional odour controls are implemented would depend on further odour verification studies and odour audits which are outlined in the Approval Conditions. It is possible that no further measures beyond the mandatory controls will be required.

6. REFERENCES

DEC (2005)

"Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW", August 2005

GHD Pty Ltd (2007a)

"Shoalhaven Starches - Environmental Audit Odour Sources" Volume 1 - Report prepared by GHD Pty Ltd, October 2007

GHD Pty Ltd (2007b)

"Shoalhaven Starches - Environmental Audit Odour Sources" Volume 2 – Appendices prepared by GHD Pty Ltd, October 2007

GHD Pty Ltd (2008a)

"Shoalhaven Starches – Report on Ethanol Upgrade Air Quality Assessment" prepared by GHD Pty Ltd, July 2008

GHD Pty Ltd (2008b)

"Shoalhaven Starches - Report on odour Control Works and Ethanol Upgrade – Response to Submissions on the Air Quality Assessment from the NSW Government Department of Planning" prepared by GHD Pty Ltd, October 2008.

Stephenson Environmental Management Australia, 2008

"PRP7 Annual Environmental Management Report" prepared for Shoalhaven Starches Pty Ltd Project no. 4056/08, June 2008

FIGURES

Figure 15 Maximum predicted ground level odour concentration – factory and environmental farm before odour control

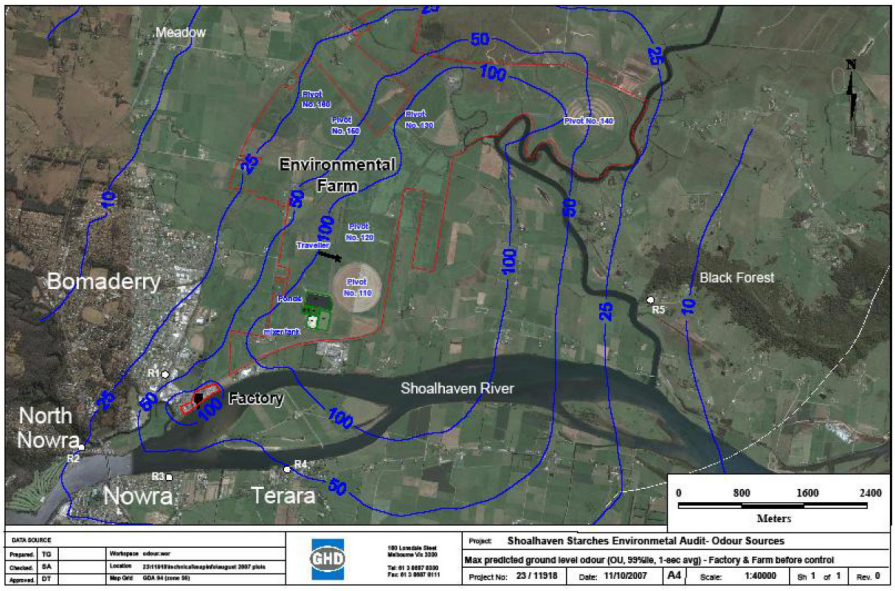

Figure 1 Predicted odour levels at the 99th percentile- factory and environmental farm before odour controls (from GHD 2007a)

Figure 21 Predicted ground level odour concentrations – factory and environmental farm following implementation of odour control

Figure 2 Predicted odour levels at the 99th percentile- factory and environmental farm following implementation of odour controls (from GHD 2007a)

Figure 2-1 Factory Odour Impact Model – Existing Factory and Environmental Farm

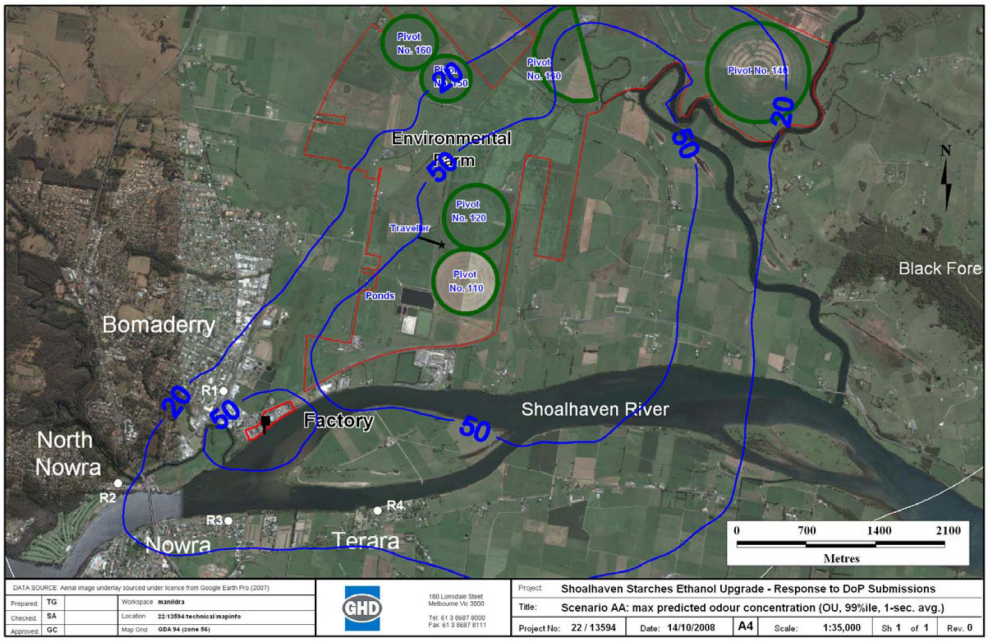

Figure 3 Predicted odour levels at the 99th percentile- existing factory and environmental farm as modelled in the EA (from GHD 2008b)

Figure 2-2 Factory Odour Impact Model – Scenario H (Factory with Stage 3 Odour Control and WWTP)

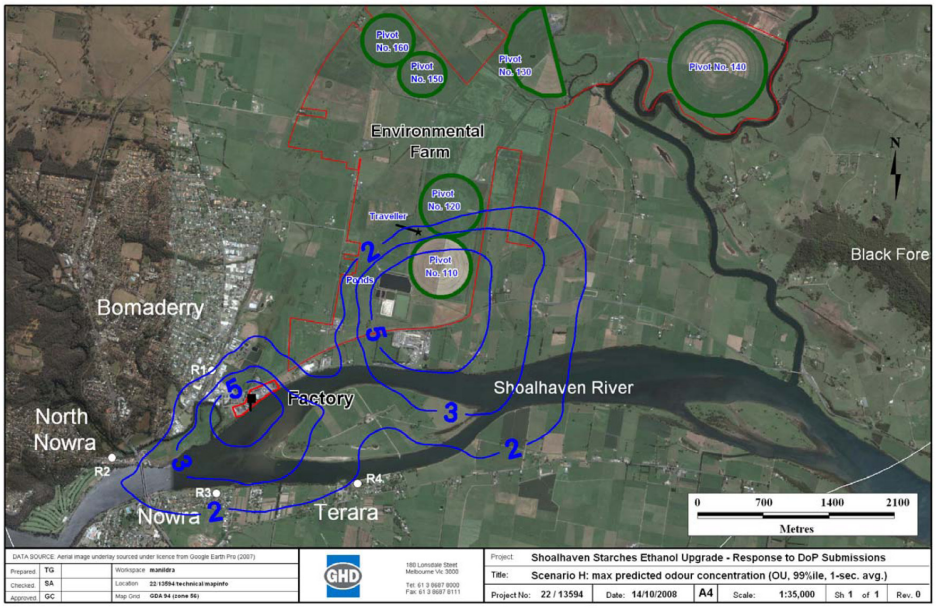

Figure 4 Predicted odour levels at the 99th percentile- factory and environmental farm with Stage 3 odour controls as modeled in the EA (from GHD 2008b)