AAA Egg Company P/L

Odour Impact &
Dispersion Modelling Assessment of
Proposed Free-Range Egg Layer Farm

Wanerie, Gingin Shire WA.

Supplementary Report v.2

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Report Preparation			
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Report Title: AAA Egg Co. - Odour Impact & Dispersion Modelling Assessment of Proposed Free-Range Egg Layer Farm

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1 EXECUTIVE SUMMARY

This supplementary report describes the outcomes of additional works carried out by The Odour Unit WA Pty Limited (TOU) for AAA Egg Company P/L (AAA Eggs) on the potential for odour emissions from the proposed Redgum Poultry Free-Range Egg Layer Farm to be located on Cowalla Road, Wanerie in the Gingin Shire, WA (***the Redgum farm).***

The purpose of the additional works was to identify a comparable poultry site that currently operates the technology proposed for the Redgum Farm and undertake a site-specific odour assessment of that site using the odour emissions data collected for the assessment of the proposed Redgum Farm. The supplementary report will form part of AAA Eggs Development Application to the Shire of Gingin.

The site identified was located in Bears Lagoon Victoria Australia with 6 laying sheds in total, of which two of the sites are tunnel ventilated free-range egg layers. These tunnel ventilated sheds are of the same design, operation and layer capacity as those proposed for the Redgum Farm.

The study found that when deriving the average odour emission rate, per bird, from the data collected at the Bears Lagoon site, and then applying the odour emission rates to the Redgum Farm, the modelling predicted that ground level odours are comparable (albeit lower) to those predicted in the original assessment where data was collected from a Bullsbrook Egg Layer here in Western Australia.

The Bullsbrook site dataset derived an average odour emission rate per bird of 0.228ou.m^3/s compared to that derived from the Bears Lagoon site of 0.200ou.m^3/s.

2 PROJECT BACKGROUND

In March 2012, AAA Egg Company P/L (AAA Eggs) commissioned The Odour Unit WA Pty Limited (TOU) to conduct an Odour Investigation and Dispersion Modelling Assessment (OIA) of AAA Egg Company's proposed Redgum Poultry Free-Range Egg Layer Farm to be located in the Shire of Gingin, WA (*hereinafter referred to as **the Redgum farm***).

The study was commissioned as part of AAA Eggs' development application submission to the Shire of Gingin to show the potential for odour impacts on nearby sensitive receptors.

The Redgum farm proposes a stage-wise development commencing with the erection of one block of 4 x Free-Range Sheds with each shed having a stocking density of 30,000 layer hens. As part of Stage 1 there will also be 1 x Egg Handling and Storage Shed (inc. Coolrooms), Managers Residence, Sundry Staff Facilities and Support Buildings. It is expected that Stage 1 will be completed within two years from approval with a total bird density of 120,000 layer hens. The age of the layer hens will be progressive amongst the four sheds in Stage 1 allowing a continuous stream of egg production.

The total development will include three blocks of 4 x Free-Rage Sheds, making a total of twelve (12) egg laying sheds. Each shed will be 16.5m wide x 135m long with mechanical (fan) tunnel ventilation at the northern end of each shed. These sheds will also have verandah/annexes between each shed and surrounding to provide the free-range yards for birds to roam.

The results of the March 2012 study **(refer TOU (WA) Report: *"AAA Eggs (Redgum Poultry)_FINAL Report_20120405"*)** were presented to Gingin Shire, and subsequent council meeting which was held on the 17th April 2012. The outcomes of the council meeting deferred AAA Egg Company's development application approval until such time that a more site-specific assessment could be made of the proposed Redgum Farm by sourcing data from a technology comparable egg laying farm.

AAA Eggs sourced a site in Bears Lagoon, Victoria Australia which operates a poultry egg layer farm with the same technology proposed for the Redgum Farm. TOU visited the Bears Lagoon site on the 7th May 2012 and collected eight (8) odour samples from egg layer processes comparable to those proposed for the Redgum Farm.

This report assesses the potential for odour emissions from the proposed Redgum farm by utilising the derived odour emissions rates from the Bears Lagoon operation, and presents dispersion modelling predictions for off-site ground level odour impacts in particular with reference to surrounding sensitive receptors

The proposed Redgum farm is to be located in the Shire of Gingin at Cowalla Road, Wanerie WA **(refer Figures 1a & 1b below).** The land uses surrounding the farm include rural, rural residential, farm land and other ‘typical’ rural and semi-rural activities.

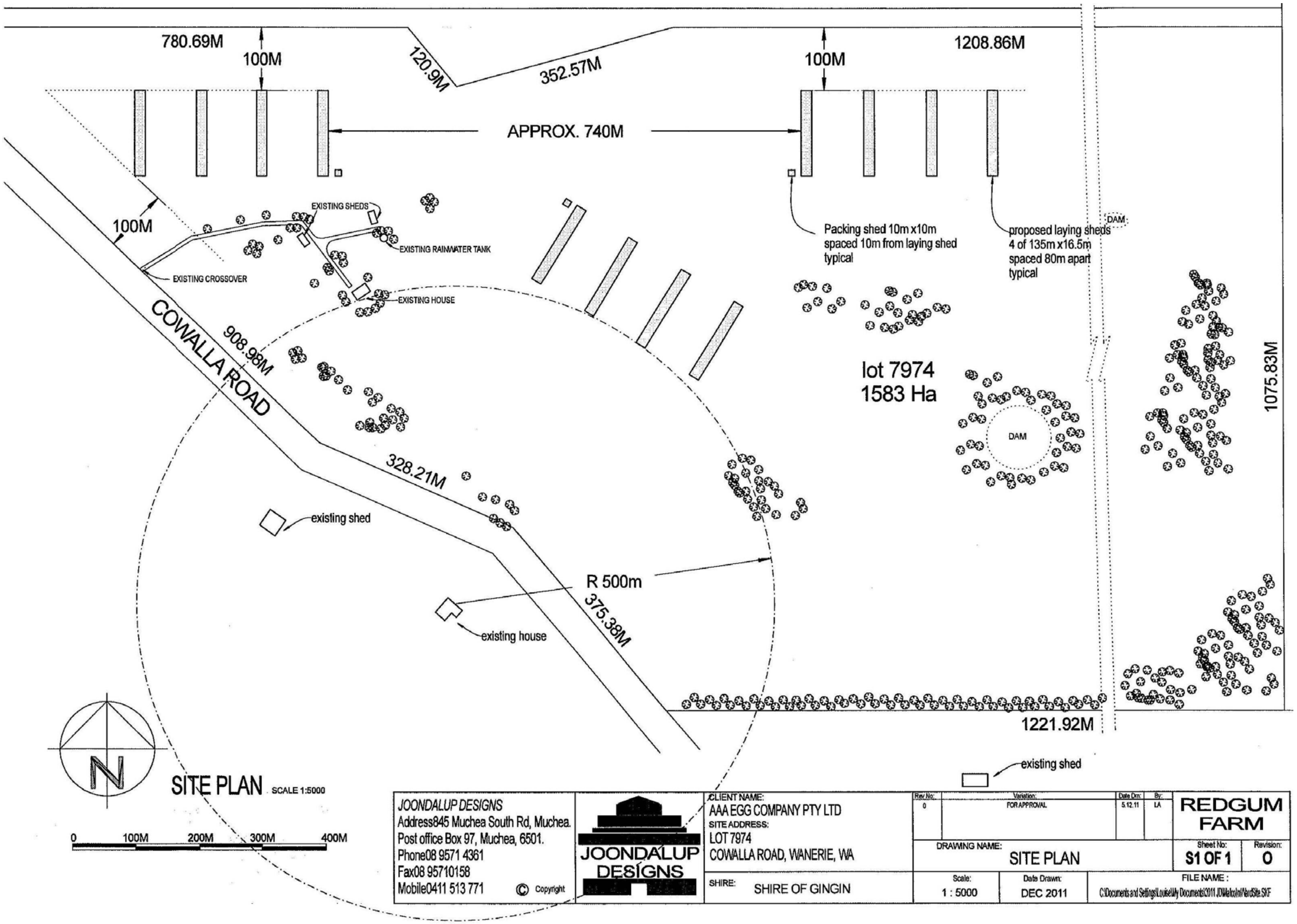


Figure 1a: Redgum Farm Site Layout

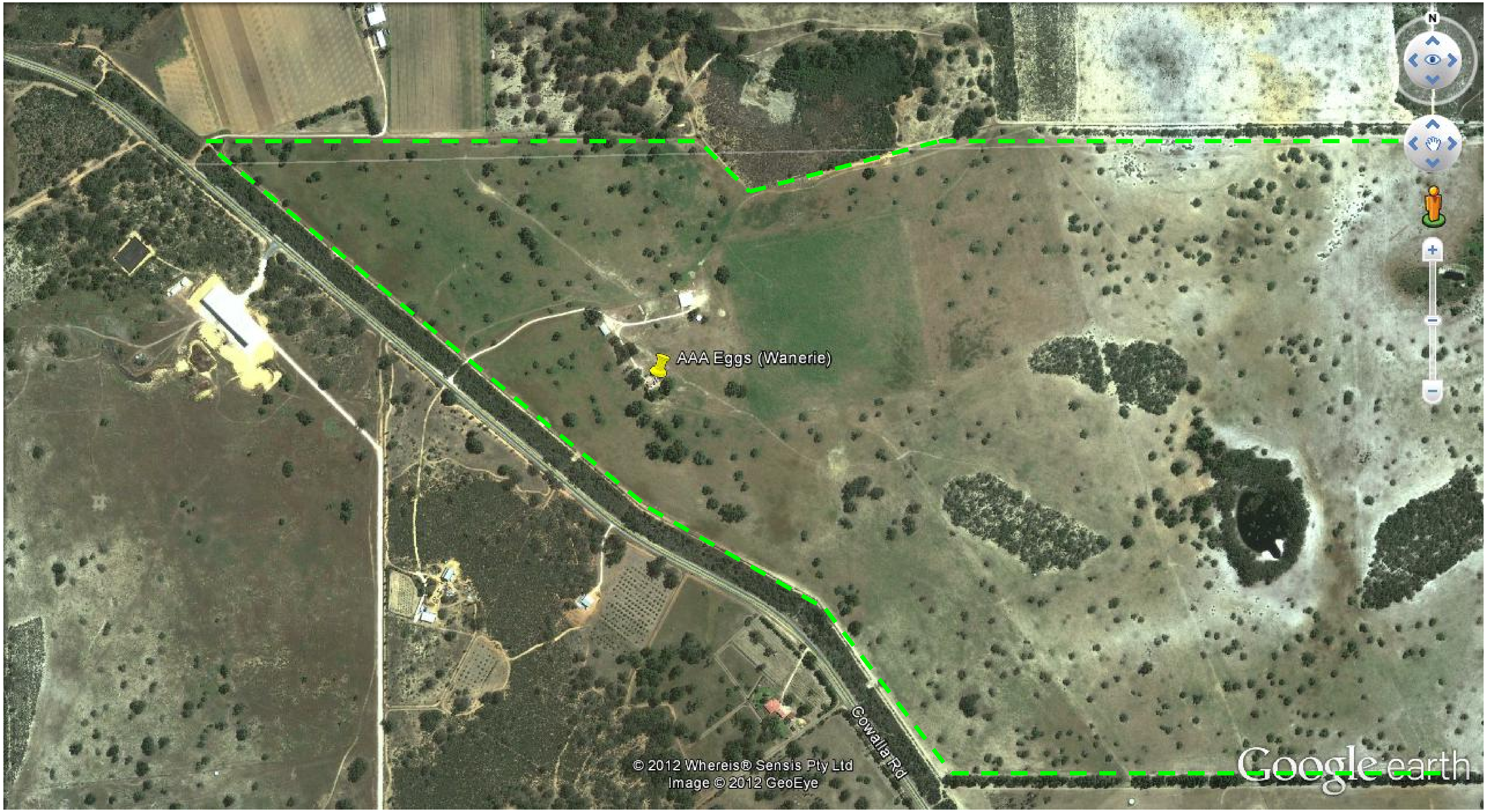


Figure 1b: Redgum Farm Boundary

This supplementary assessment was undertaken utilising site-specific odour sampling and testing from the Bears Lagoon free-range egg layer site and Dispersion Modelling of the derived odour emission rates utilising the Victorian EPA's AUSPLUME modelling software.

To predict the potential odorous impacts emanating from the farm, TOU adopted the current Queensland Environmental Protection Agency (QEPA) 'Ecoaccess' odour performance criterion (OPC), in lieu of the now defunct WA DEC guidelines (Guidance 47). The QEPA OPC is currently accepted by the WA DEC as an 'interim' guidance whilst the WA DEC prepares a formal OPC.

TOU collected 8 odour samples from the Bears Lagoon site from Sheds 4 & 5 which represented free-rage egg layers. Both sheds had a capacity of 30,000 layer hens each, the same stocking density proposed for the Redgum Farm. The dimensions for the sheds were also the same as those proposed for the Redgum Farm (135m long x 16.5m wide) meaning that the volume of odorous air inside the sheds is the same for each site. The number of extraction fans on both Sheds 4 & 5 was 14 per shed which is also the same as that proposed for the Redgum Farm. The age of the birds in both sheds 4 & 5 was an average of 27 weeks with a useful egg laying lifespan of 80 weeks.

This report documents the findings of the odour sampling and testing and plume dispersion modelling. It describes the methods used to collect odour samples, details the assumptions for odour emissions data, describes the methodology and presents the results of the odour dispersion modelling assessments discussing the impacts and potential for any reductions in the odour footprint.

3 REDGUM FARM PROPOSED OPERATIONS

Redgum Poultry Farm proposes to erect 12 free-range egg layer sheds with the first 4 sheds being erected as Stage 1 over the next two years. The stocking density of each shed will be 30,000 birds making a total site population of 360,000 hens.

Each shed is proposed to be state-of-the-art supporting best practices which include:

- Each shed is single aged to maintain optimum health for livestock;
  - Sheds are progressively age stocked to ensure continuous egg production.
- All eggs regularly consigned from property to other facilities for grading, packing, processing and distribution;
- All sheds insulated and internal environment controlled to maintain optimum growth conditions over summer and winter months;
- Manure collected on PVC belts under the raised, ‘mesh’ floor for automatic removal from sheds;
- All manure removed from sheds weekly and protected from weather and removed from site (i.e. kept dry, protected from fly breeding, protected from wind scattering etc);
- Areas not covered by manure belts will be cleared as required and trucked off the property;
- Eggs automatically collected and conveyed to cool room before off-site transport, and
- Tree planting scheme on-site to provide visual screening of development and assist in dispersion of odours.

On-site staff attend to the sheds daily and undertake routine maintenance including removing bird mortalities. The mortalities are temporarily stored in a cool room.

The proposed Redgum Egg Layer Farm is a contained odour source under strict temperature regulation to ensure the internal environment of each shed is commensurate with high levels of bird comfort and optimised egg production. Moreover, the weekly removal of manure and continued diligence in maintaining a high standard of housekeeping inside the sheds means that the effective long-term odour source is that of the birds themselves. Hens have an extremely low level of odour associated with the bird itself; it is the manure and waste deposits that constitute the majority of odour from egg laying operations.

4 ODOUR & DATA SAMPLING METHODOLOGIES

4.1 BEARS LAGOON (VICTORIA) FREE-RANGE EGG LAYER SURROGATE SITE

Odour sampling was undertaken at a surrogate free-range site in Bears Lagoon, Victoria Australia. The site had two free-range sheds (Sheds 4 & 5) with each shed having a density of 30,000 birds. These sheds were tunnel ventilated via a total of 14 extraction fans each. Both sheds also had natural ventilation curtains able to be opened to allow an in-flow of ambient air. A naturally ventilated shed configuration is sometimes adopted depending on the seasonal conditions optimised to encourage strong bird health and egg laying conditions.

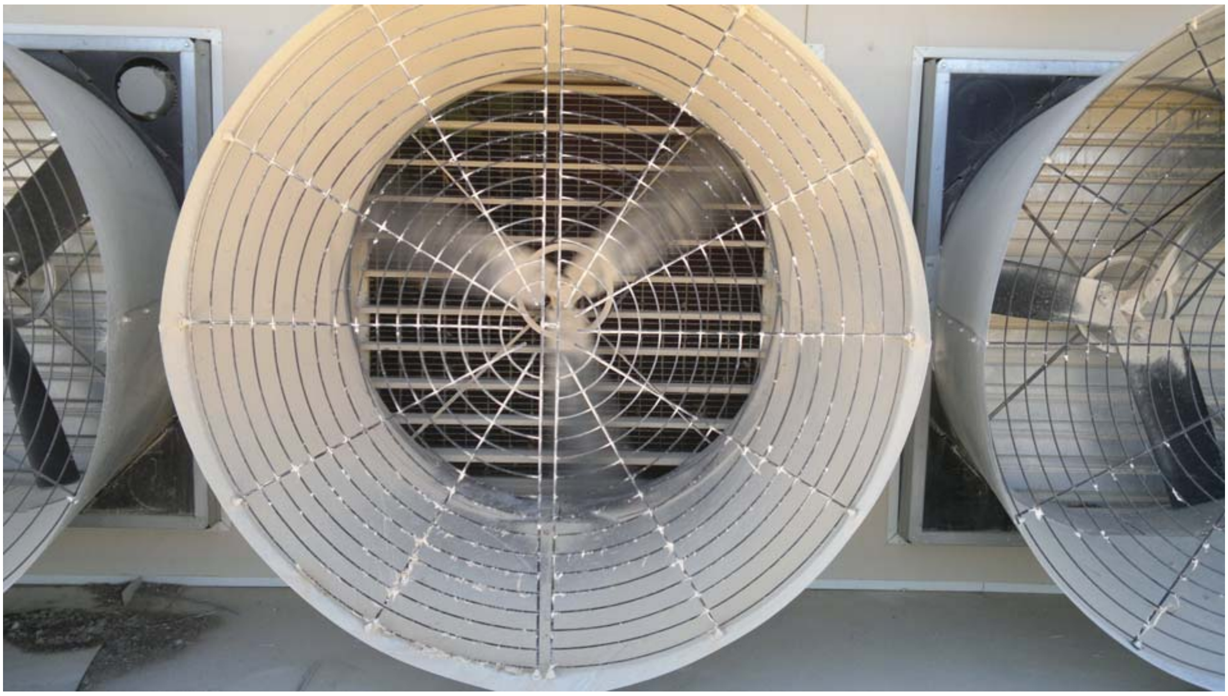
The ambient conditions on the day of sampling were cool and calm with an ambient temperature of typically 20^0C and relative humidity of 56%. Wind speed was less than 2m/s making the sampling highly representative since cross flow winds were negligible thus allowing the technician to capture the full odorous airstream ejected by the extraction fans. The average age of the birds was 27 weeks. The configuration of the Bears Lagoon sheds are the same as those proposed for the Redgum Farm.

The following images depict the sheds at the Bears Lagoon Free-Range Egg Layer Farm.

Rear of Sheds showing 14 x Fan Configuration

3 Fans Operating out of 14 Fans in total

Interior of Shed showing back of Fans



Close-up Of Fan in Operation

Internal of Shed

Internal of Shed

Exterior of Shed with Natural Ventilation Curtains fully opened

Exterior of Shed with Natural Ventilation Curtains opened 50%

4.2 ODOUR SAMPLING

The method used for collecting site-specific samples from the Bears Lagoon poultry sheds involved drawing the air sample gas through a Stainless Steel and/or Teflon™ sampling tube into a single use, Nalophan sample bag. The bag is housed within a container (sampling drum) that is evacuated with a vacuum pump, and the sample collected by induced flow. The "lung method", by which this sampling procedure is known, allows the sample air to be collected without coming into contact with any potentially odorous material.

The sample line was inserted into multiple extraction fan outlets drawing a few litres of samples at each location. A composite odour sample was collected from the shed at a pre-determined extraction condition by collecting a few litres of air from each running extraction fan.

The extraction conditions (ventilation) were:

1. Shed 4	In Tunnel mode (1 x fan)
2. Shed 4	In Tunnel mode (3 x fans)
3. Shed 4	Natural mode (no fans running)
4. Shed 4	50% natural mode (3 x fans)
5. Shed 5	Natural mode (2 x fans)
6. Shed 5	50% Natural mode (3 x fans)
7. Shed 5	In Tunnel mode (3 x fans)
8. Shed 5	In Tunnel mode (9 x fans)

- Tunnel Mode refers to the Shed being ventilated via tunnel extraction, that is, by operational extraction fans pulling air from the sheds
- Natural Mode refers to the configuration where the natural ventilation curtains are either fully opened or only 50% opened

At the completion of sampling, all samples were stored in a dark environment as this helps to retain the sample character and strength. The samples were then transported to TOU's Perth laboratory for analysis within the 30 hour timeframe specified in AS/NZS 4323.3:2001.

4.3 ODOUR TESTING

TOU's NATA Accredited odour laboratories operate to the Australian Standard for odour measurement 'Determination of odour concentration by dynamic olfactometry' (AS/NZS 4323.3:2001) which prescribes a method for sample analysis that provides quality assurance/quality control and ensures a high degree of confidence in the accuracy, repeatability and reproducibility of results.

The concentration of an odour can be measured using a technique known as dynamic olfactometry. Dynamic olfactometry involves the repeated presentation of both a diluted odour sample and an odour-free air stream to a panel of qualified assessors through two adjacent ports on the olfactometer. TOU utilises four to six trained assessors (or panellists) for sample analysis, with the results from four qualified panellists being the minimum allowed under the Australian Standard AS/NZS 4323.3:2001.

The method for odour concentration analysis involves the odorous gas sample initially being diluted to the point where it cannot be detected by any member of the panel. The assessors step up to the olfactometer in turn, take a sniff from each port, then choose which port contains the odour and enter their response. At each stage of the testing process the concentration of the odorous gas is systematically increased (doubled) and re-presented to the panellists. A round is completed when all assessors have correctly detected the presence of the odour with certainty. The odour is presented to the panel for three rounds and results taken from the latter two rounds, as stated in AS/NZS 4323.3:2001.

The results obtained give an odour measurement measured in odour units (ou). The odour units are then multiplied by an emission rate or volumetric flow (m^3/sec) to obtain an odour emission rate for each source (ou.m^3/sec).

4.4 VOLUMETRIC FLOW MEASUREMENT

Volumetric Flows from those sheds where odour samples were collected were determined by collecting fan exit velocities during odour sampling. TOU collected these measurements using a Hotwire Anemometer with a statistics function that logs maximum, minimum and averages of a dataset.

- The design flow of each of the Bears Lagoon extraction fans is 42,000m^3/hr;
- The diameter of each fan is 1.58m (1.96m^2)
- The average measured exit velocity per fan was 6.38m/s (12.5m^3/s);
    - The average derived volumetric flow per fan is therefore 45,017m^3/hr
    - With 14 extraction fans in operation the total volumetric flow per tunnel ventilated shed is 630,238m^3/hr.

The number of fans running per shed is scarcely the full complement of 14 fans. The typical number of fans running at any one time is 4 with up to 9 fans in operation on the worst days of summer. In general the odour emission rate per shed decreases with an increase in operational extraction fans, since the ventilation rate increases with an increase in the number of fans running. The **Table below** lists the logged data taken from the Bears Lagoon operations computer system showing the operation hours of the 14 fans on Shed 4.

	Design Airflow per Fan (m^3/hr)	Operation Hours (Shed 4)	% of Total Hours
Fan 1	42,000	794	**28.95%**
Fan 2	42,000	794.4	**28.96%**
Fan 3	42,000	793.9	**28.94%**
Fan 4	42,000	145	5.29%
Fan 5	42,000	65	2.37%
Fan 6	42,000	0.1	0.00%
Fan 7	42,000	64.4	2.35%
Fan 8	42,000	64.4	2.35%
Fan 9	42,000	10.1	0.37%
Fan 10	42,000	10.1	0.37%
Fan 11	42,000	0.6	0.02%
Fan 12	42,000	0.6	0.02%
Fan 13	42,000	0.1	0.00%
Fan 14	42,000	0.1	0.00%

The **Table above** shows that 3 fans are in operation for almost 90% of the total operational fan hours. This shows that for a given shed the typical number of fans running at any one time is 3, with only temporary increases in the number of operational fans above 3.

The low number of operational fans is attributed to the controlled internal temperature by air-conditioning.

5 DERIVED ODOUR EMISSION RATES

The odour data collected from the Bears Lagoon Free Range Egg Layer Farm and corresponding derived Odour Emission Rates are presented in **Table 1** below as follows:

Table 1: Measured Odour Concentrations & Derived Odour Emission Rates.

Sample Location	Ventilation Curtains Opened	Odour Concentration (ou)	Average Volumetric Flow per Fan (m^3/s)	Fans Running	Odour Emission Rate ($ou.m^3/s$)
Shed 4	No	281	12.5	1	3,513
	No	208		**3**	**7,800**
	100%	147	[A]3.92	0	[A]1,729
	50%	60	12.5	3	2,250
Shed 5	100%	120		[B]2	[B]3,000
	50%	79		3	2,963
	No	119		**3**	**4,463**
	No	69		9	7,763

[A]based on a maximum measured 2m/s ambient wind cross flow exiting 4 x opened fans (fans not running)
[B]fans only in operation for this sampling regime – fans don't run in natural ventilation mode.

The stocking densities of both Sheds 4 & 5 are 30,000 layer hens. Given that 3 fans are typically run at any one time, and ignoring any naturally ventilated modes of operation which would reduce the overall odour emissions from the shed/s, the two most representative tunnel ventilated odour emission rate data points in **Table 1** are 7,800ou.m^3/s and 4,463ou.m^3/s.

The average representative tunnel ventilated odour emission rate is therefore **6,132ou.m^3/s per shed**. At a stocking density of 30,000 layer hens per shed, the odour emission rate per bird is **0.200ou.m^3/s/bird.**

This odour emission rate per bird of **0.200ou.m^3/s/bird** was applied to the stocking densities at the proposed Redgum Free-Range Egg Layer Farm.

6 ODOUR CRITERIA AND DISPERSION MODEL GUIDELINES

Regulatory authority guidelines for odorous impacts of gaseous process emissions are not designed to satisfy a 'zero odour impact criteria', but rather to minimise the nuisance effect to acceptable levels of these emissions to a large range of odour sensitive receptors within the local community.

In Australia, each state and territory's environmental protection agency has developed its own unique odour performance criteria (OPC) for new and existing odour emitting facilities. In Western Australia, the DEC has withdrawn their OPC guideline document *No. 47: Guidance for the Assessment of Environmental Factors – Assessment of Odour Impacts from New Proposals (2002)*, but has yet to replace it. A suitable new OPC is currently being discussed.

In the absence of a current OPC guideline, DEC refers to the Queensland EPA's *Ecoaccess – Guideline: Odour Impact Assessment from Developments (2004)* which is currently acceptable as an 'interim' OPC by the WA DEC. The detail of the relevant QEPA OPC is as follows;

- 2.5ou, 1-hour average, 99.5th percentile for ground-level sources and down-washed plumes from short stacks, and

- Where a facility does not operate continuously, the 99.5th percentile must be applied to the actual hours of operation.

Given the proposed Redgum farm will operate constantly, and the meteorological dataset used in the model represents 8,760 hours annually, the ground level odour criterion of 2.5ou at the 99.5th percentile, the worst 44th hour annually is assessed within the dispersion model.

The odour criterion of 2.5ou represents an observable odour concentration at ground level. If one considers that the odour threshold of a pure compound or gas mixture is 1ou, generally speaking this means that at 1ou an odour is considered detectable but not easily characterised. As a result the use of a 2.5ou criterion (for example) allows for any uncertainty in the detectability of an odour.

In practice an odour is rarely (if at all) observed at 1ou in ambient conditions, the strength of a detectable and characterized odour in ambient conditions is likely to be closer to 5ou and as such the use of 2.5ou provides a conservative criterion for nuisance odour impacts at ground level.

7 ODOUR DISPERSION MODELLING METHOD

The odour dispersion modelling study for the proposed Redgum Free-Range Egg Layer Farm was carried out using AUSPLUME Version 6.0, a Gaussian, steady-state, plume dispersion model developed by the Victorian Environmental Protection Authority (EPA Victoria). Ausplume is one of the approved dispersion model recommended by many of the EPAs in Australia.

The AUSPLUME V6.0 atmospheric dispersion model is used to project downwind ground level concentrations of air contaminants by taking into consideration various factors including:

- Odour emissions data - odour emission rate and source dimensions;
- Site specific meteorology;
- Geophysical impact (topography); and
- Building wake effects.

For this study, the air contaminant was odour and ground level concentrations in odour units (ou) have been projected.

It should be noted that while terrain effects are incorporated within the model, the BPIP building wake algorithm is specific for point sources such as stacks and vents only, but not for area and volume sources. The source inputs into this model were volume sources as Ausplume assumes that the horizontal flow from exhaust fans is zero (0m/s) because there is no vertical momentum. Therefore the BPIP building wake algorithm was not employed.

Ausplume is one of the regulatory models used throughout Australia and is an excellent tool for screening assessments and/or meteorological specific assessments.

Like all models Ausplume has limitations, specifically:

- Ausplume cannot model line emission sources (motorways/traffic);
- Cannot model stacks greater than 100m high;
- Is much less sophisticated than other models to compute complex terrain and meteorological fields; and
- Due to its Gaussian mathematical simulation it assumes a perfect mixture of gas emissions at any point.

Additionally, Ausplume has its limitations such that alternative, more advanced models may need to be considered in one or a combination of the following situations:

- Odour impacts are expected far from the source of release (i.e. beyond the immediate surrounding region);
- Complex terrain e.g. rolling hills and valleys;
- High frequency of calm conditions and/or light winds (< 1.8 km/h, < 0.5 m/s);
- High frequency of convective conditions; and/or
- High frequency of sea-breeze circulations.

The use of Ausplume for low level volume sources is entirely applicable for the assessment, and may be considered a more conservative model for this application when compared to more complex applications such as Calpuff plume models; since Ausplume assumes that the wind speed and direction remain constant over the full length of the plume (model domain). More sophisticated models use complex terrain computations to account for drainage flows, pooled odour plumes proceeding calms and surface friction/roughness effects which disperse the plume. Gaussian plume models like Ausplume can only partially simulate terrain effects and therefore 'shoot' the plume out to the full extent of the model domain.

The terrain at and surrounding the AAA Egg Redgum Farm is rolling rural populated with dense shrub/bushland and trees.

7.1 Meteorological Datasets

The proposed Redgum Free-Range Egg Layer Farm is situated approximately 20 kilometres inland from the coast which may suggest that westerly and south-westerly sea breeze conditions are not as dominant in the area with a larger impact from easterly and south-easterly flows off the Darling Escarpment.

TOU commissioned the development of a meteorological dataset by pDs Consultancy compiled from data taken at the Gingin Bureau of Meteorology (BoM) AWS (Gingin Aero AWS ID#009178) situated approximately 30 kilometres SSE of the farms' location and approximately 35 kilometres inland from the coast. The Gingin_2010 dataset presents meteorological observations from 2010 and represents observations closer to the escarpment which are dominated by east and south-easterly drainage flows and less impacted by coastal sea breezes.

In addition to the use of the Gingin_2010 dataset, TOU under the direction of the WA State Administrative Tribunal (SAT) utilized the WA DEC endorsed Caversham meteorological file (ca94-b) to project odour impacts using the same odour emission scenarios.

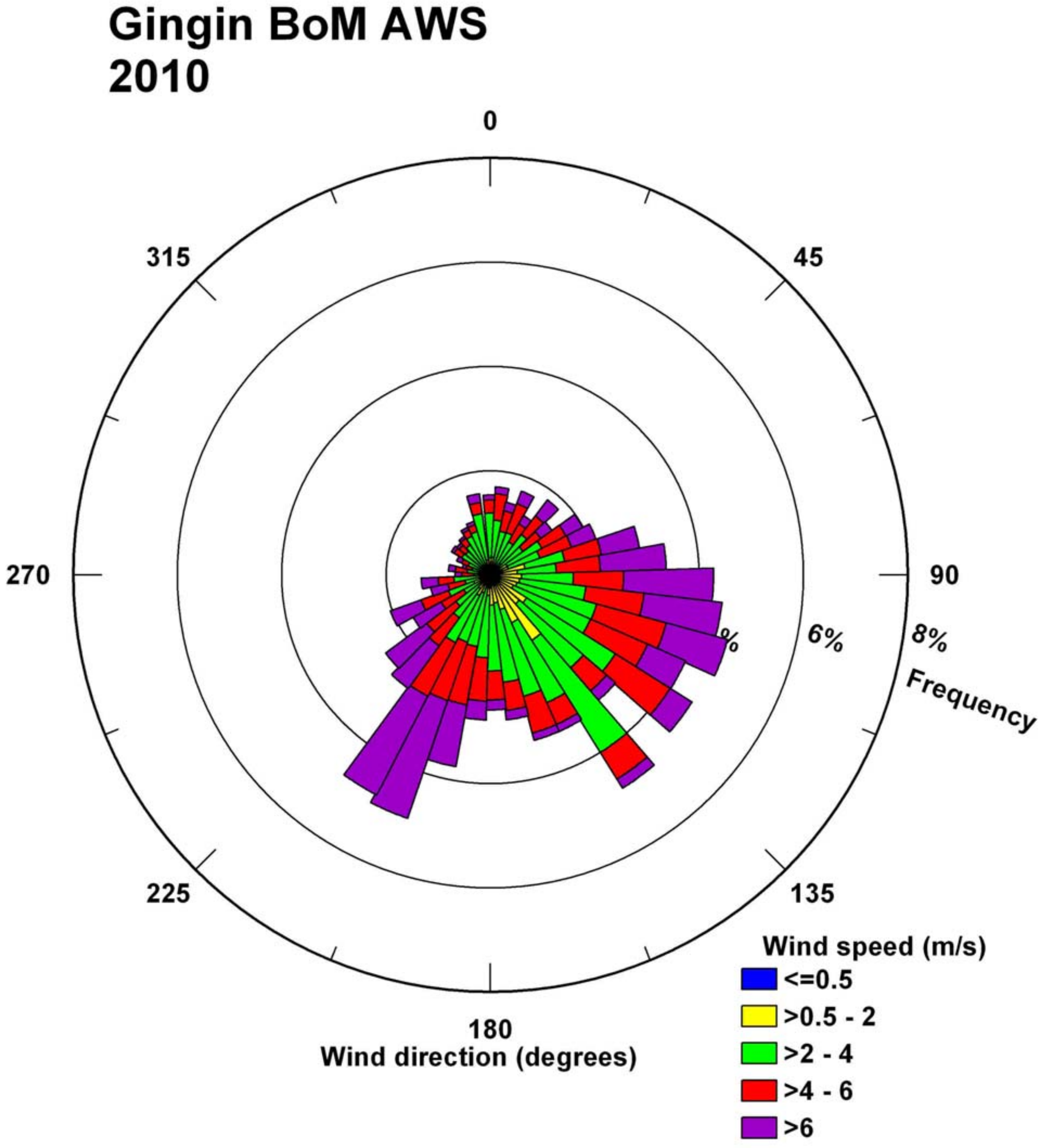
In TOU's opinion, the Gingin_2010 met file can be considered a more local representation of the meteorology in the area, whilst the Caversham_1994 met file can be considered an extremely conservative regional representation. That is, the Gingin data should produce a more moderate projection of ground level odour impacts, and the Caversham data should produce a worst-case prediction for ground level odour impacts.

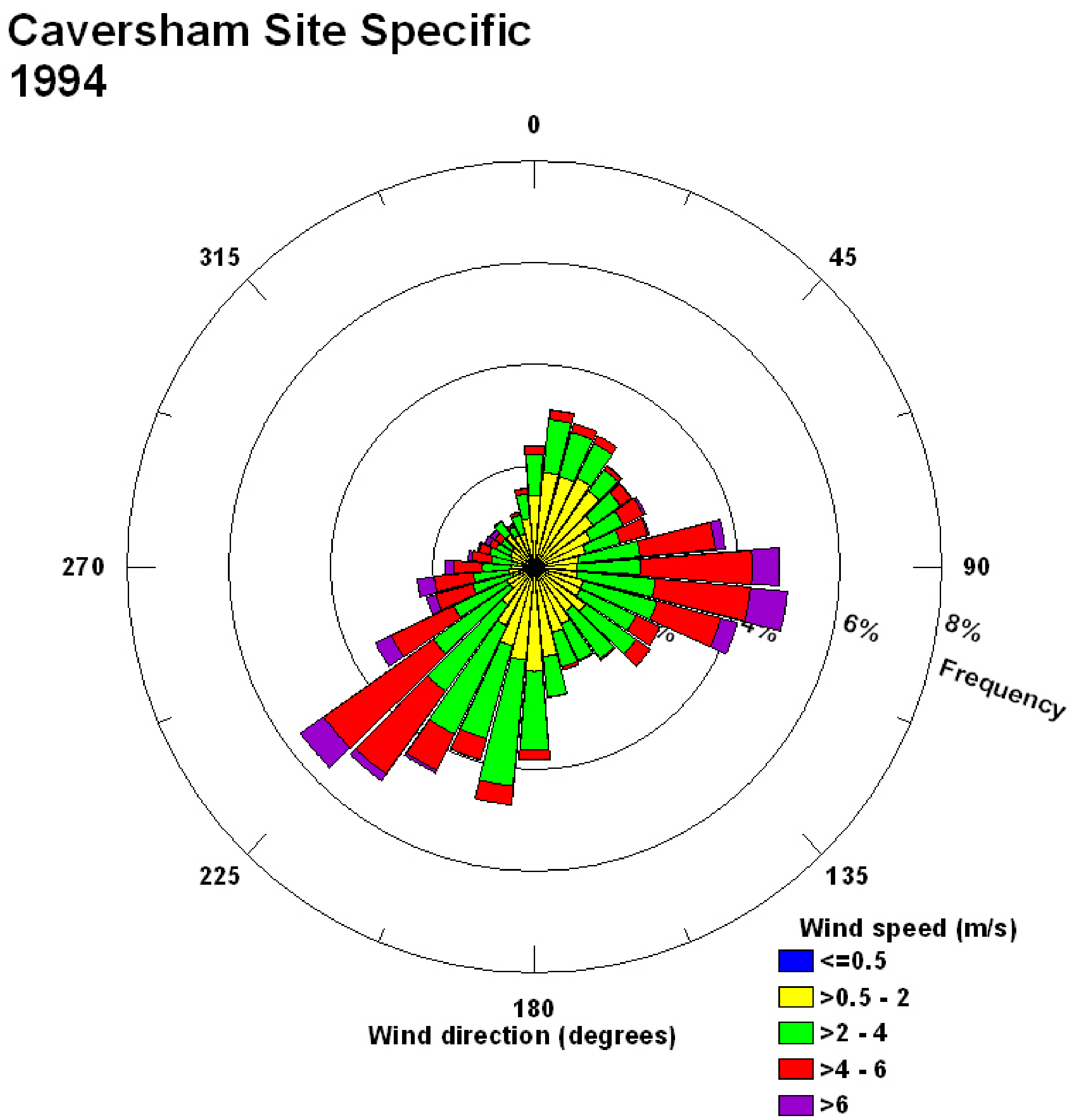
Adverse odour impacts may be more prevalent during warmer months, as elevated temperatures tend to result in higher odour emissions. This is generally true of most odour sources and in particular those exposed directly to environmental weather conditions such as holding dams, liquor ponds and contained odour sources that are not temperature controlled e.g. organic composting inside a shed. Odour emissions are also exacerbated by the raw materials input to a given process in the hotter months such as rendering processes where the raw meat materials are already in decomposition (prior to processing) due to the higher temperatures of summer. Where an odour source is situated close to naturally occurring drainage flows, such as the Darling Escarpment, the incidence of heightened odour impacts from drainage flows may also be prevalent, in particularly under low wind speeds.

It is also important to note that, while calm to light wind conditions are the most problematical in terms of poor dispersion and odour nuisance, the standard Gaussian dispersion formulation intrinsic to the Ausplume model fails to adequately cope with wind velocities below 0.5m/s. As a result, all winds < 0.5m/s are treated as 0.5m/s by the model.

In addition to wind direction and speed, atmospheric stability is an important factor in odour transport and dispersion. Stability refers to the vertical movement of the atmosphere and subsequently the dispersion of pollutants vertically within the atmospheric boundary layer. Atmospheric stability is classified under the Pasquill-Gifford scheme where seven stability classes have been defined as: A – very unstable; B – unstable; C – slightly unstable; D – neutral; E – slightly stable; F – stable; and G – very stable. F and G tend to be grouped together as F in dispersion models. When the atmosphere is stable, vertical movement is suppressed and dispersion is poor. This is the case for classes E and F, which are apparent during temperature inversions. Neutral conditions also result in poor vertical dispersion for ambient temperature or cool plumes.

The wind rose figures below illustrate respectively the Gingin BoM AWS_2010 meteorological dataset, and that of the Caversham_ca94-b dataset used in the dispersion modelling assessment.


Gingin BoM AWS
2010
0
45
90
135
180
225
270
315
6%
8%
Frequency
Wind direction (degrees)
Wind speed (m/s)
<=0.5
>0.5 - 2
>2 - 4
>4 - 6
>6


Caversham Site Specific
1994
0
45
90
135
180
225
270
315
6%
8%
Frequency
Wind direction (degrees)
Wind speed (m/s)
<=0.5
>0.5 - 2
>2 - 4
>4 - 6
>6

7.2 LOCAL LAND USE AND TOPOGRAPHY

The proposed Redgum farm locale is typically rolling rural topography and natural bushland surrounds. The surface roughness category (Z_o) chosen for this dispersion model was 0.4m to reflect the surface friction of a rolling rural setting.

7.3 GRIDDED RECEPTOR FILE

The Receptor file used in the model was a Cartesian grid with receptors spaced at 75m x 75m intervals. The grid extended approximately 2,400m to the north and south of the farm, and approximately 3,650m to the east and west.

7.4 DISPERSION MODEL SOURCE AND ODOUR EMISSION RATE CONFIGURATIONS

The dispersion model configuration for each of the individual odour sources (sheds) was developed from site-specific odour sampling and testing at the surrogate Bears Lagoon site and from design and aerial imagery data for the proposed Redgum farm.

The Stage 1 development of 4 Sheds totalling 120,000 layer hens, as well as the combined cumulative impact representing the fully developed site to include 12 sheds (3 x 4 Sheds) at a total of 360,000 layer hens, housed in tunnel ventilated, temperature controlled sheds was assessed.

8 RESULTS & DISCUSSION

The dispersion modelling projection of the proposed Redgum Farm Stage 1 free-range tunnel ventilated egg layer sheds, using both the Gingin_2010 and Caversham_1994 meteorological datasets is presented in **Figure 8.1** to follow.

The criterion used for the modelling projections is 2.5ou at ground level, 1-hour averaging times at the 99.5th percentile.

When comparing the two meteorological datasets the odour impacts at each of the six (6) defined sensitive receptors can be determined.

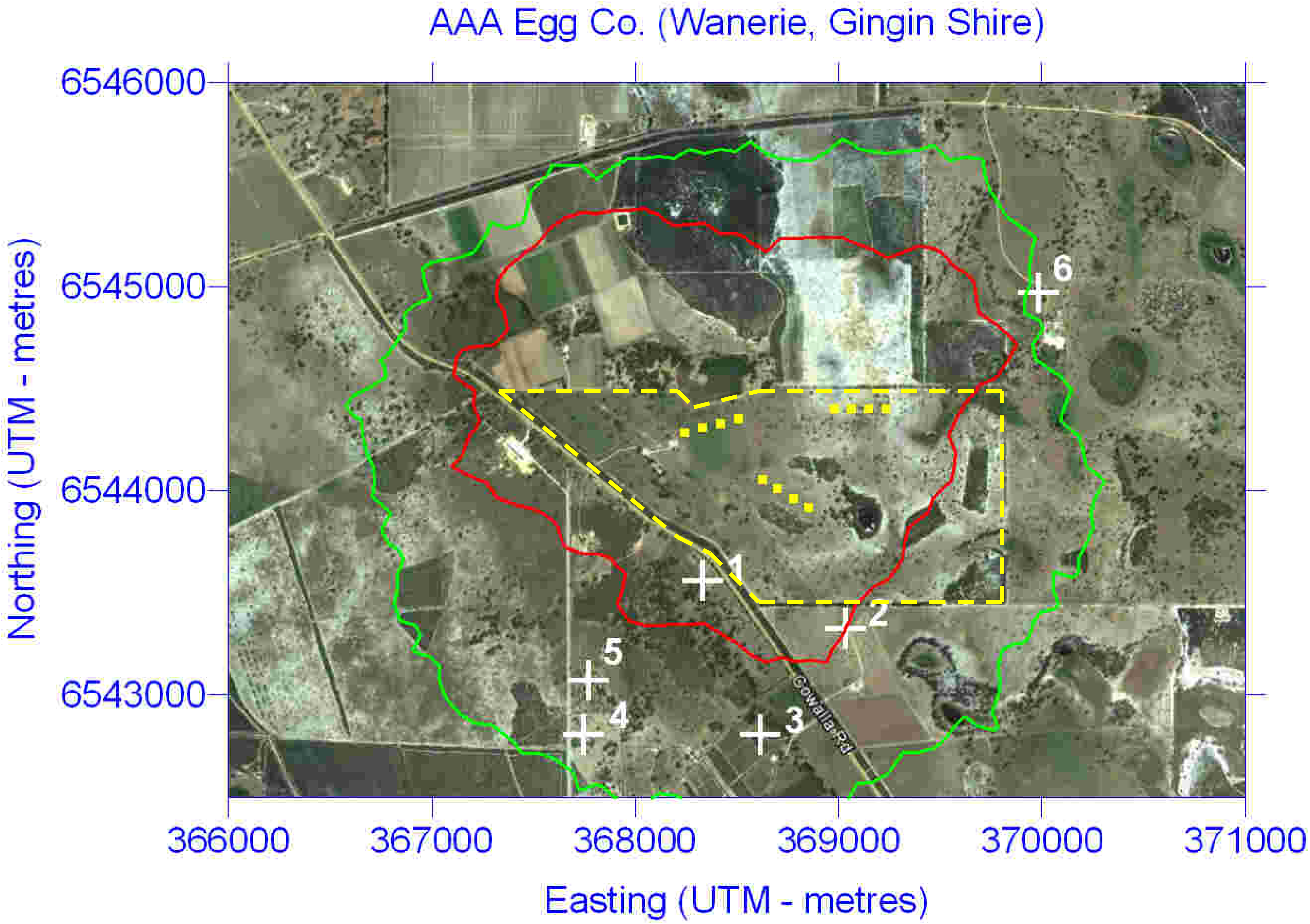
Table 8.1 below lists each receptor location, its co-ordinates (UTM), the total annual hours where the receptor location is projected to exceed a ground level odour concentration of 2.5ou and the individual minimum odour concentrations projected at each receptor location for each of the percentiles; 100th, 99,9th, 99,5th and 98.0th.

These frequency percentiles represent the following:

- 100th
  - maximum odour concentration projected;
  - lowest probability where the projected maximum odour concentration may occur.
- 99.9th
  - 0.1% probability of the projected odour concentration occurring;
  - worst 9 hours annually.
- 99.5th
  - 0.5% probability of the projected odour concentration occurring;
  - worst 44 hours annually.
- 98.0th
  - 2.0% probability of the projected odour concentration occurring;
  - worst 176 hours annually.

Table 8.1: Comparison of Gingin_2010 & Caversham_1994 meteorological files for ground level odour projections.

Meteorological file →			G'gin_2010	C'sham_1994	G'gin_2010	C'sham_1994	G'gin_2010	C'sham_1994	G'gin_2010	C'sham_1994	G'gin_2010	C'sham_1994
Frequency percentile →					*100th (maximum)*		*99.9th*		*99.5th (WA DEC criterion)*		*98.0th*	
Receptor	x-coord	y-coord	Total Hours Annually where odour exceeds 2.5ou		Odour Concentration (ou) @ Receptor Location							
6	369982	6544967	22	39	7.6	8.2	4.0	5.1	1.9	2.3	0.4	0.5
5	367771	6543070	16	94	6.4	6.5	2.7	5.4	1.7	3.3	0.5	1.9
4	367746	6542806	8	61	4.7	5.6	2.5	4.6	1.3	2.8	0.4	1.7
3	368615	6542806	19	96	5.7	5.8	3.9	4.7	1.7	3.2	0.5	1.7
2	**369036**	**6543326**	**43**	**129**	**11.4**	**11.5**	**3.9**	**9.5**	**2.5**	**4.9**	**0.9**	**2.0**
1	**368332**	**6543556**	**99**	**376**	**12.3**	**12.5**	**5.5**	**10.4**	**3.9**	**6.9**	**1.6**	**4.3**



Green Contour = 0.4m Surface Roughness Caversham 1994 Met

Red Contour = 0.4m Surface Roughness Gingin 2010 Met

White Crosses = Nearest Sensitive Receptors

<u>Figure 8.1:</u> Ausplume Modelling projections for proposed Redgum Free-Range Egg Layer Farm (denoted by yellow hashed line)

The comparison of the two meteorological files presents what can be considered more moderate and locally representative (Gingin_2010) and regionally representative and worst-case (Caversham_1994) for ground level odour impacts at the six pre-defined sensitive receptors downwind of the proposed AAA Egg farm.

Interestingly, the Caversham data shows that odour strength does not decay from the maximum percentile at the same rate as that of the Gingin data. The Caversham dataset expresses a highly conservative meteorological condition (for odour) which does not follow the typical exponential odour trend seen for other meteorological datasets, that is, the decay trend of odour from the maximum impact tends to follow a linear pattern.

Comparing both datasets, the average of the two could be considered a sensibly conservative assessment of the typical projected odour impacts from the AAA Egg farm. These averaged odour impacts at each of the six receptor locations, for the WA DEC odour performance criterion of 2.5ou, 99.5th percentile with 1-hour averaging times are:

Receptor	**x-coord**	**y-coord**	***ou (averaged)***
6	369982	6544967	2.1
5	367771	6543070	2.5
4	367746	6542806	2.1
3	368615	6542806	2.5
2	369036	6543326	3.7
1	368332	6543556	5.4

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Considering the averaged odour impacts at each of the six receptor locations, the projections have shown that receptors 3 & 5 are impacted at a ground level odour concentration of 2.5ou's, and receptors 1 & 2 have projected impacts greater than 2.5ou for the 99.5th percentile (0.5% probability).

When addressing ground level odour impacts within a rural setting, consideration must be given to the number of sensitive receptors located around an odour source and the density of those receptors in relation to one another. Given the receptors are spread apart from one another then each dwelling could be considered a single receptor with respect to the odour source. Consequently the impact level criterion value for ground level odour at a single rural receptor should be more relaxed than when considering a densely populated area because there is more risk of sensitive person/s within a dense population and therefore more risk of that person/s becoming sensitized to the odour source. This is generally not the case for low density or a single dwelling.

Rural receptors often experience a level of exposure to rural odours due to the various farming activities taking place; as such the odour criterion of 2.5ou may be considerably more conservative than what would be considered acceptable in a rural area. In ambient conditions the strength of an odour is more likely to be detectable at an odour concentration greater than 2.5ou as the density of the sensitive receptors decrease. In a more heavily populated area the odour criterion is tighter because there is a higher probability of sensitive persons within the community.

Whilst the results for receptors 1 and 2 are projected at 5.4ou and 3.7ou respectively, these levels of projected exposure to ground level odour impacts are, in the opinion of TOU, considered to be acceptable particularly given the conservative inclusion of the Caversham metrological data, the rural setting in which the proposed development is taking place and rural land use practices and policies.

REFERENCES

i. Department of Environmental Protection (DEP), 2002, "Odour Methodology Guideline", March 2002.

ii. Standards Australia, 2001, "AS/NZS 4323.3:2001 Stationary source emissions – Part 3: Determination of odour concentration by dynamic olfactometry".

iii. Queensland Environment Protection Agency, 2004, "Ecoaccess – Guideline: Odour Impact Assessment from Developments".

Appendix A

NATA Certificate of Odour Concentration Results