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Report

Air Quality Impact Assessment

Goolgowi NSW

Tattersall Lander

18 September 2017

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Endorsements

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Checked & Authorised By		Dr Carl Fung - Lead Consultant Process Engineering & Sustainability, (CAQP-CASANZ)	18 September 2017

EXECUTIVE SUMMARY

Advitech Pty Limited (trading as Advitech Environmental) was engaged by Tattersall Lander (TL) to prepare an Air Quality Impact Assessment for a proposed poultry facility at the Mid-Western Highway, Goolgowi NSW. Advitech Environmental understands that the proposed facility involves the installation of 20 new tunnel ventilated poultry sheds in each of the five proposed farms (totalling 100 sheds) located at Lot 1 and 2 DP 749831 McRaes Road, Goolgowi New South Wales. The proposed poultry facility would house up to 6,000,000 birds destined for meat production.

An odour and particulates assessment was undertaken to assess potential impacts on receivers surrounding the project site. Odour was assessed for the 99th percentile, one-second average ground level concentrations (GLC). GLCs were determined using appropriate odour emission rates obtained from available representative literature reports concerning poultry layer facilities. Total solid particulates (TSP), particulate matter less than 10 micrograms (PM_{10}) and particulate matter less than 2.5 micrograms ($PM_{2.5}$) was assessed for the 100th percentile over the respective averaging period using one year of meteorological data.

A population dependent complex odour criterion of 5 odour units (OU) (99th percentile nose response time) was applied to modelled odour emissions from the poultry facility. Cumulative odour impacts that included the nearby Jeanella poultry facility were assessed using a Monte Carlo simulation approach. Based on the assessment bases outlined in this report, the result of CALPUFF modelling suggests that predicted cumulative odour GLCs above the 5 OU criterion will not be encountered at any identified sensitive receivers. The highest predicted off-site odour concentration of 4.9 OU is at sensitive receiver R8.

It is understood that the poultry development will be constructed in two stages over an extended period. The initial Stage 1 development will involve the construction of Farm 3 and Farm 4 with conventional tunnel ventilated sheds. At a future time the remaining farms (1, 2 and 5) will be developed with 10 m stacks constructed on all sheds, including retrofitting 10 m stacks to the existing sheds at Farm 3 and Farm 4.

An analysis has been undertaken to determine the maximum number of sheds that can be constructed without the addition of emission stacks whilst complying with the impact assessment criteria. It has been determined that 40 conventional tunnel ventilated poultry sheds (20 sheds each at Farm 3 and Farm 4) will not exceed that air quality impact assessment criteria. If any additional sheds (other than the 40 sheds specified) are to be constructed on the project site, 10 m stacks must be retrofitted to each existing shed to maintain air quality compliance.

The particulate dispersion modelling indicates that there may be additional exceedances of the 24 hour average PM_{10} impact assessment criteria at nearby sensitive receivers. The exceedances of the criteria are a result of the combination of the ambient dust concentration, poultry shed emissions and wheel generated emissions.

It is recommended that particulate emissions be ultimately managed through the implementation of appropriate measures as identified in a future air quality management plan. To assist with the management of air quality impacts from the poultry facility, it is recommended that a weather monitoring station is installed on-site.

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APPENDIX IV

Scenario Analysis – Stage 1 Development

1. INTRODUCTION

Advitech Pty Limited (trading as Advitech Environmental) was engaged by Tattersall Lander (TL) to prepare an Air Quality Impact Assessment for a proposed poultry facility at the Mid-Western Highway, Goolgowi NSW.

It should be noted that this report was prepared by Advitech Pty Limited for Tattersall Lander ("the customer") in accordance with the scope of work and specific requirements agreed between Advitech and the customer. This report was prepared with background information, terms of reference and assumptions agreed with the customer. The report is not intended for use by any other individual or organisation and as such, Advitech will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

1.1 Project Overview

Advitech Environmental understands that the proposed poultry facility would house up to 6,000,000 birds destined for meat production. The ultimate proposed development consists of five farms totalling 100 tunnel ventilated sheds (i.e. 20 sheds per farm).

The growing period for birds within each shed would occur concurrently, with delivery of day-old chicks and bedding (litter) at the beginning of each growing cycle. Birds would be picked-up for processing between days 32 and 50. Birds would be likely picked-up during night and early-morning periods and is subject to the processors requirements. At the end of the growing cycle, the sheds would be cleaned-out (e.g. removal of manure and litter) and sterilised prior to the next delivery of chicks.

Feed would be delivered daily. This would typically occur during the day period, however under some circumstances, feed may be delivered during the night or evening period.

1.2 Site Location

The site is located approximately 12 kilometres (km) south-west of Goolgowi. The subject site is located within Lot 1 and 2 on DP 749831, on the Mid Western Highway, Goolgowi. The current site includes a rural residential dwelling at each farm which would be utilised as a caretakers dwelling for the proposed poultry facility. Land uses immediately surrounding the site are primarily rural (large acreages and farms). **Figure 1** and **Figure 2** display the regional and local context of the subject site.

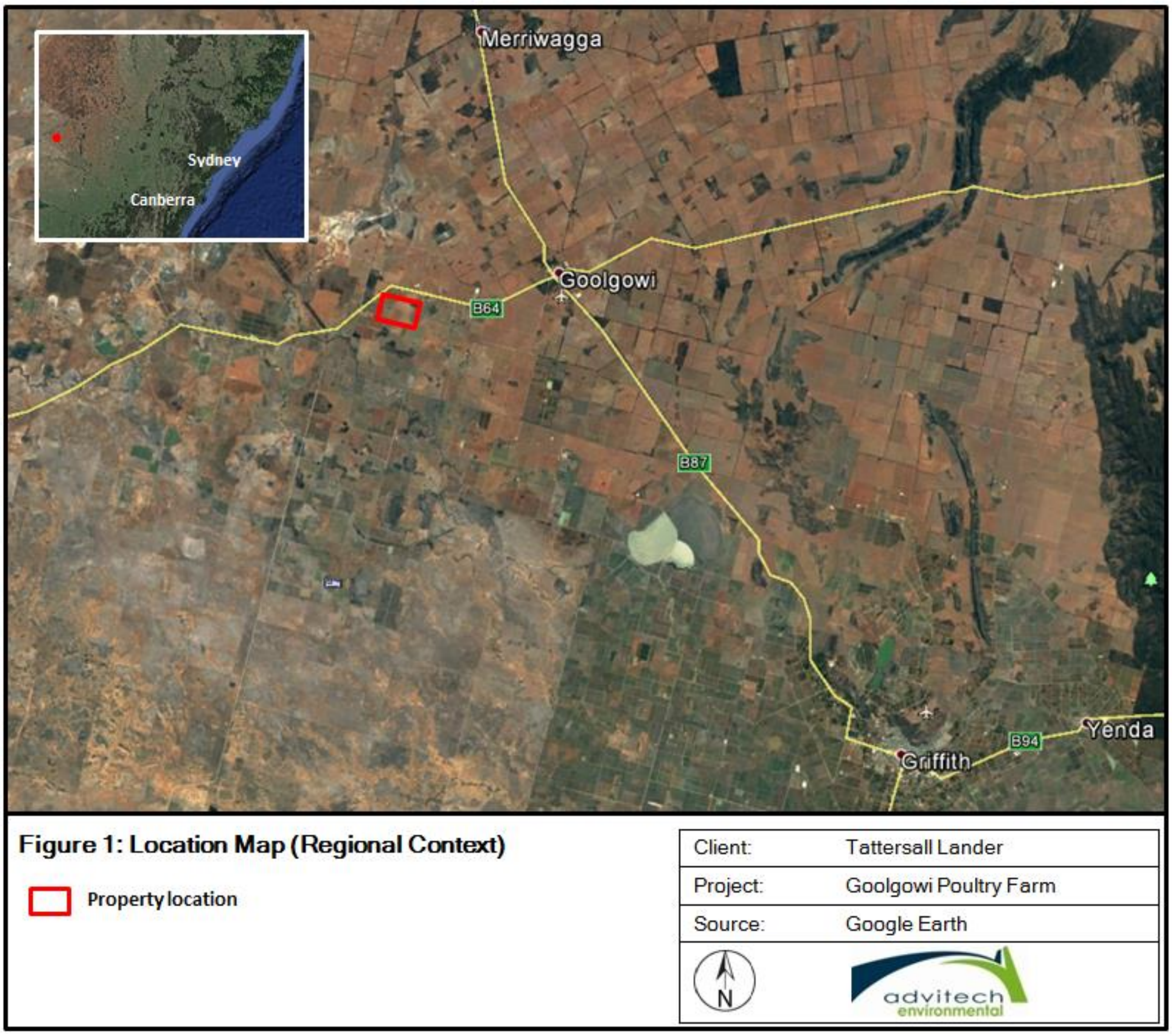


Figure 1: Location Map (Regional context)

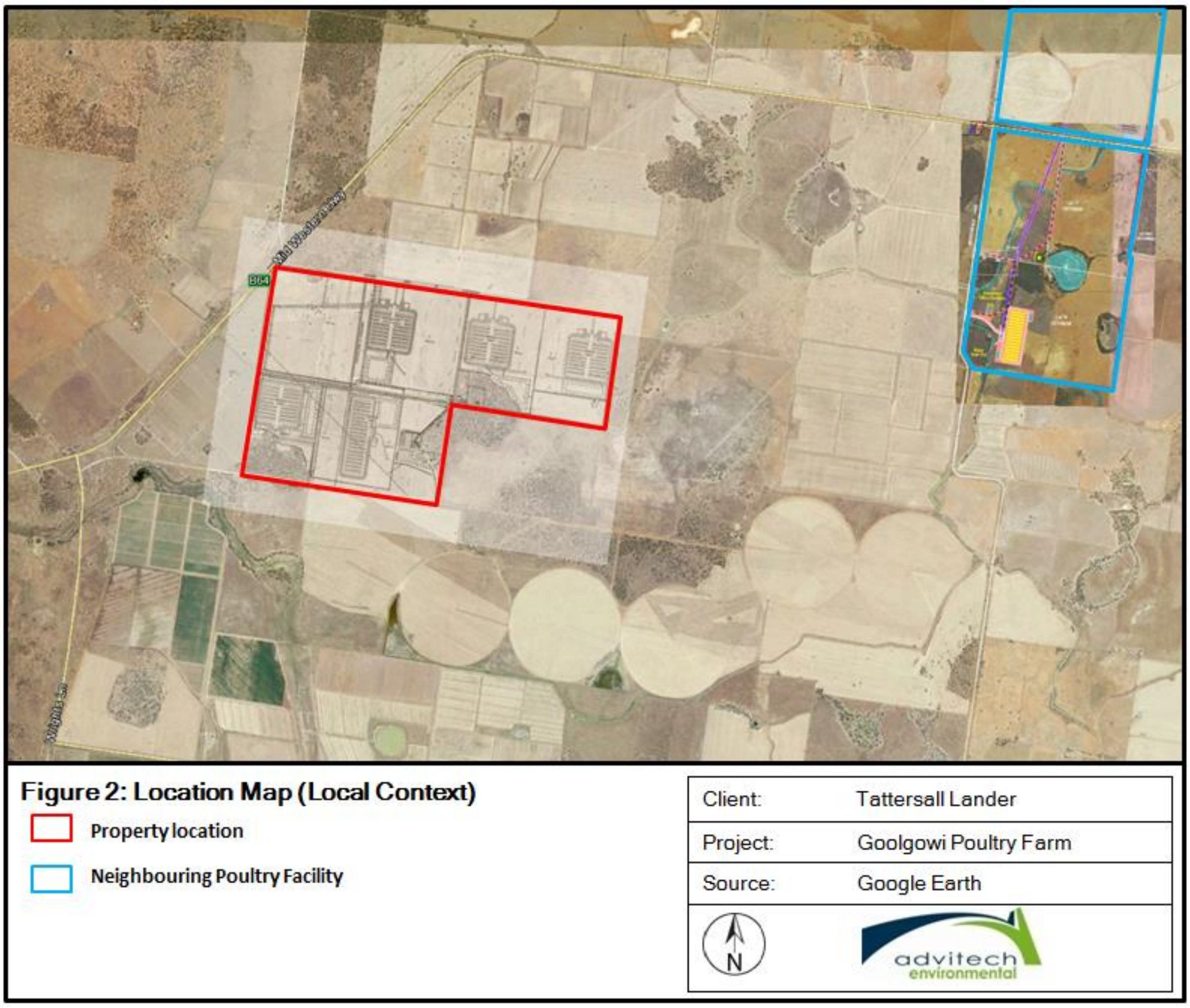


Figure 2: Location Map (Local context)

1.3 Process Description

Advitech Environmental understands that the proposal involves installation of 20 new tunnel ventilated poultry sheds in each of the five proposed farms located at Lot 1 and 2 DP 749831 McRaes Road, Goolgowi New South Wales (refer to **Figure 2** and **Figure 3**). The proposed sheds would be approximately orientated in an east to west direction. Ventilation would be provided by 18 axial fans per shed directed through a 10 metre (m) stack positioned at the earth mound facing end of the shed. The proposed sheds measure 167.75 m by 18.3 m, giving a total floor area of 3,070 m^2. The birds will remain in the sheds at all times.

It is understood that the poultry development will be constructed in two stages over an extended period. The initial Stage 1 development will involve the construction of Farm 3 and Farm 4 with conventional tunnel ventilated sheds. At a future time the remaining farms (1, 2 and 5) will be developed with 10 m stacks constructed on all sheds, including retrofitting 10 m stacks to the existing sheds at Farm 3 and Farm 4.

The proposed layout of the sheds is shown in **Figure 3**. Access to the site would be via Mid-Western Highway adjacent to the north-west boundary corner.

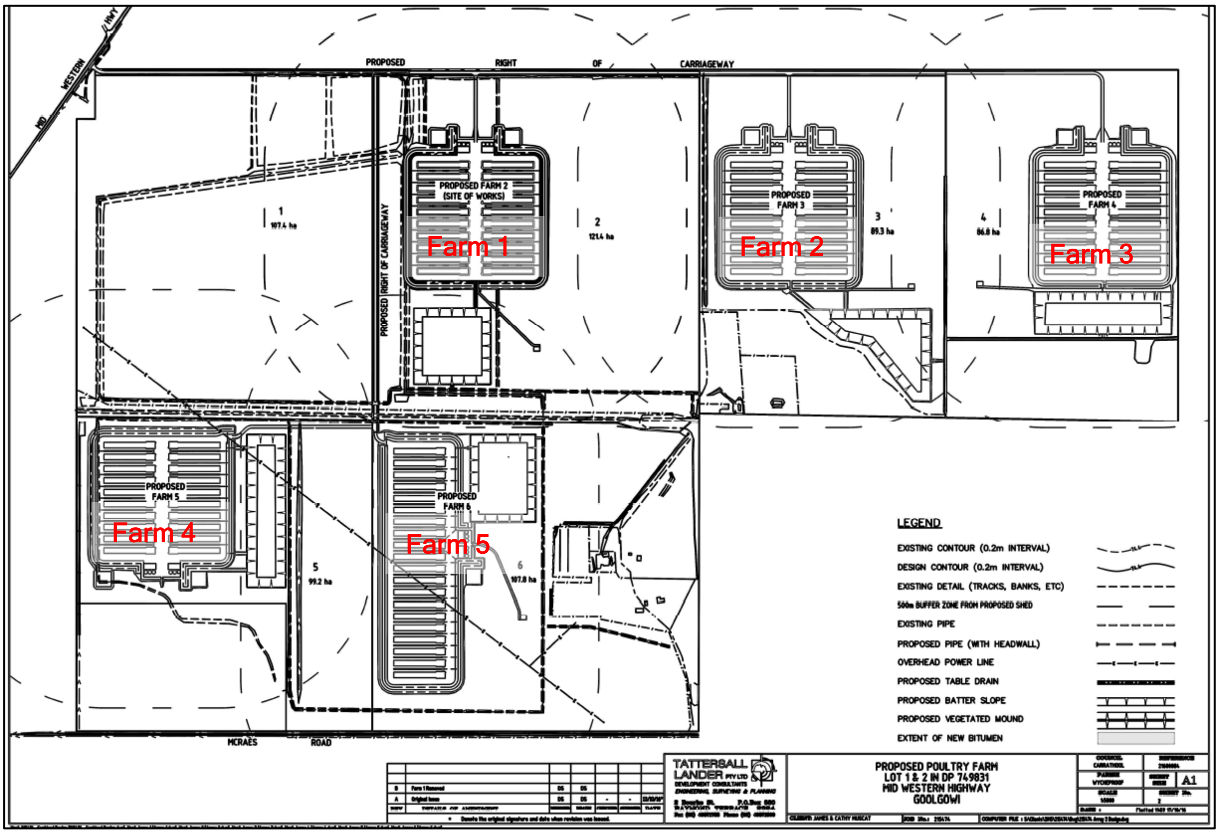


Figure 3: Proposed Shed Plan

1.4 Sensitive Receivers

The site is positioned in a rural receiving environment, with large acreages surrounding the site. The closest urban settlement to the proposed development is Goolgowi located approximately 15 km to the north-east.

Of the 12 identified sensitive receivers within a radius of approximately 6 km of the proposed site, 12 are residential receivers. Sensitive receivers were identified based on their proximity and exposure to the subject site. Dwellings identified at the nearby Jeanella poultry facility were not considered as sensitive receivers. The locations of nearby sensitive receivers are shown in **Figure 4** and detailed in **Table 1**.

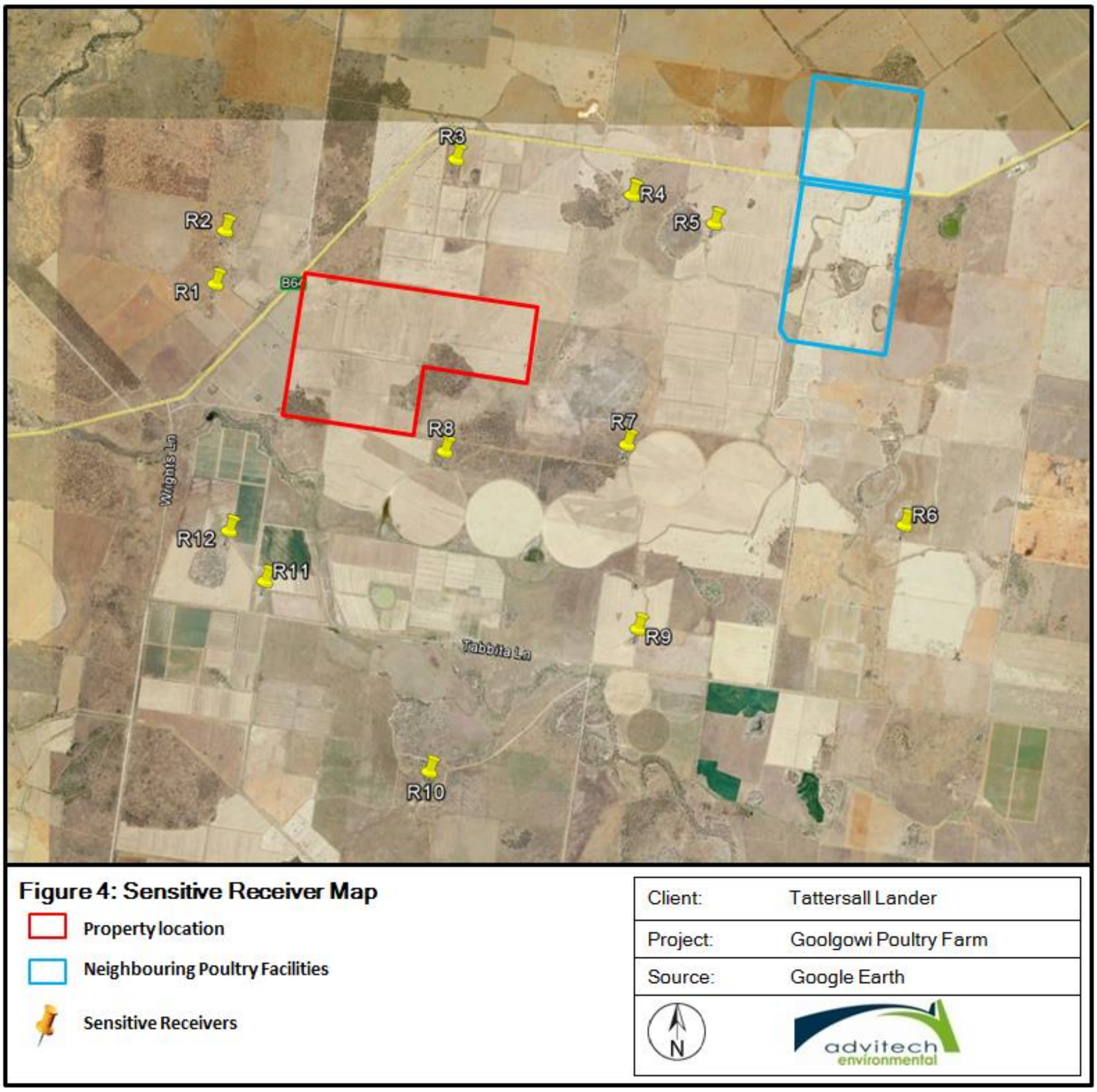


Figure 4: Nearby Sensitive Receivers

Table 1: Nearest Identified Sensitive Receivers

Receiver Identifier (ID)	Receiver Type	Receiver Address	Easting (UTM) (km)	Northing (UTM) (km)
R1	Residential	16354 Mid Western Highway, Goolgowi	364.614	6234.057
R2	Residential	16452 Mid Western Highway, Goolgowi	364.806	6234.676
R3	Residential	16009 Mid Western Highway, Goolgowi	368.206	6236.013
R4	Residential	15701 Mid Western Highway, Goolgowi	370.845	6235.452
R5	Residential	15545 Mid Western Highway, Goolgowi	372.015	6235.097
R6	Residential	536 Garrong Road, Goolgowi	374.981	6230.636
R7	Residential	376 McRaes Road, Goolgowi	370.812	6231.736
R8	Residential	McRaes Road, Goolgowi	368.057	6231.623
R9	Residential	727 Tabbita Lane, Goolgowi	371.011	6229.019
R10	Residential	20 Cameron Road, Carrathool	367.901	6226.858
R11	Residential	157 Tabbita Lane, Goolgowi	365.419	6229.637
R12	Residential	147 Tabbita Lane, Goolgowi	364.869	6230.424

UTM - Universal Transverse Mercator coordinate System based on the WGS84 Datum

1.5 Site Topography

The subject site is located at approximately 100 to 110 m Australian Height Datum (AHD) on flat terrain. A three dimensional representation of the area showing the site location in relation to the surround poultry facility is presented in **Figure 5.**

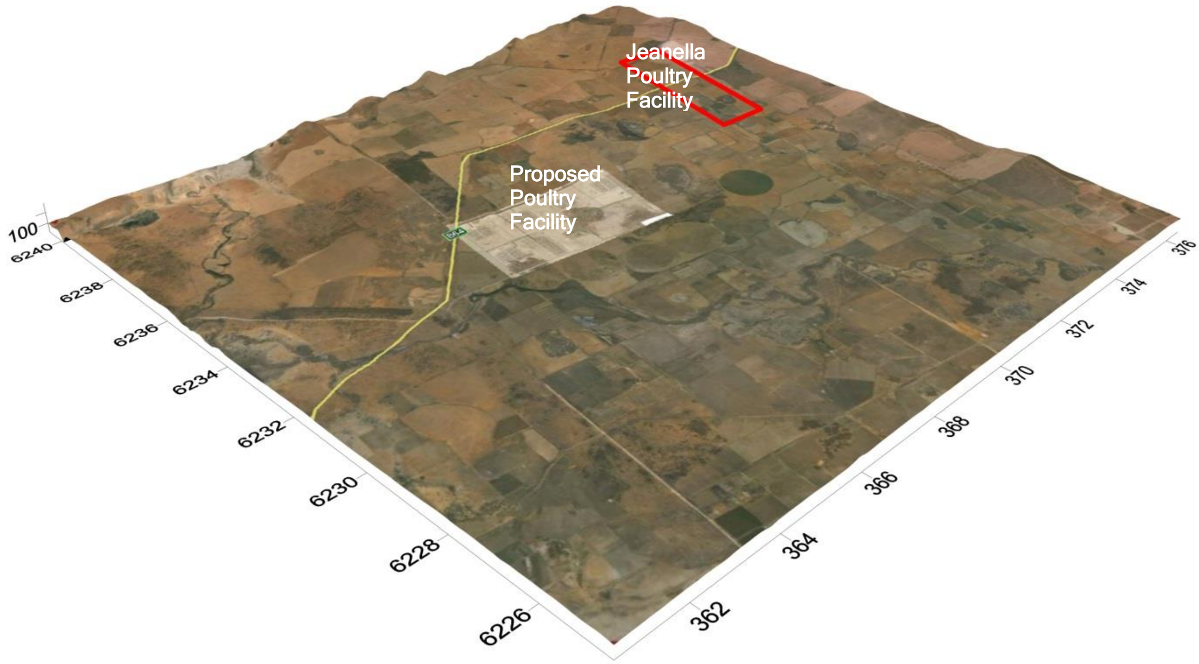


Figure 5: Project Area Showing Topographic Features

2. AIR QUALITY GUIDELINES

The NSW Office of Environment and Heritage (OEH) specify impact assessment criteria for emissions to air and permissible ground level concentrations (GLCs).

> *Note: The NSW Office of Environment and Heritage (OEH) came into existence in April 2011. OEH was previously part of the Department of Environment, Climate Change and Water (DECCW). The DECCW was also recently known as the Department of Environment and Climate Change (DECC), and prior to that the Department of Environment and Conservation (DEC). The terms OEH, DECCW, DECC and DEC are interchangeable in this report.*

3. GROUND LEVEL CONCENTRATIONS

The NSW DEC in the publications *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (NSW EPA, 2016) and the *Assessment and management of odours from stationary sources in NSW* (DEC, 2006) specify impact assessment criteria. The relevant sections from this publication are reproduced below in **Table 2** which presents the GLC criteria for each applicable air pollutant.

Table 2: NSW DECC Impact Assessment Criteria

Pollutant	DECC Design Criteria	Units	Averaging Time
Odour	2-7[a]	OU	1 hour[b]
TSP[c]	90	µg/m^3	Annual
PM_{10}[d]	50	µg/m^3	24 hours
	25	µg/m^3	Annual
$PM_{2.5}$[e]	25	µg/m^3	24 hours
	8	µg/m^3	Annual
Deposited Dust[f]	2[g]	g/m^2/month	Annual
	4[h]		

[a] Source: NSW EPA, *Approved Methods for the Modelling and Assessment of Air Pollutants, 2016* (Table 7.5). The range 2-7 OU represent population-dependant odour performance criteria. Odours below 2 OU are not considered offensive (NSW EPA, 2016).
[b] Odour concentration adjusted to one second nose response time using published peak-to-mean factors.
[c] Total suspended particulates.
[d] Particulate materials with an aerodynamic diameter less than 10 µm.
[e] Particulate materials with an aerodynamic diameter less than 2.5 µm
[f] Dust is assessed as insoluble solids as defined by AS 3580.10.1.
[g] Maximum increase in deposited dust level.
[h] Maximum total deposited dust level.

The air dispersion modelling review was undertaken using the US EPA air dispersion model CALPUFF Version 6.42.

An odour and particulates assessment was undertaken to assess potential impacts on receivers surrounding the project site. Odour was assessed for the 99th percentile, one-second average GLC. GLCs were determined using appropriate odour emission rates obtained from available representative literature reports concerning poultry layer facilities (refer to **Section 14,** Reference 1, 8 and 15).

TSP, PM_{10} and $PM_{2.5}$ was assessed for the 100th percentile over the respective averaging period using one year of meteorological data.

The impact assessment criteria for odour are based upon the NSW OEH affected population performance criteria for complex mixtures of odour. **Table 3** lists the odour impact assessment criteria as a function of population.

Table 3: Odour Assessment Criteria[1]

Population of affected community	Odour Assessment Criteria
Rural single residence (<=2)	7.0
≈10	6.0
≈30	5.0
≈125	4.0
≈500	3.0
Urban area (>= 2000) and/or schools and hospitals	2.0

[1] 99th percentile. Based on nose-response-time average of one-second.

According to the NSW OEH, the affected population is categorised as the number of people who are impacted by odour concentrations of 2 OU and above (refer to **Section 14**, Reference 11). In accordance with the NSW OEH definition of "affected population", eight residences with a residence population of 2.6 (refer to **Section 14**, Reference 2) are estimated to be "affected" within the impacted radius of the proposed poultry. According to the NSW OEH population performance criteria for complex odours, this equates to an odour performance criteria of 5.3 OU. This assessment has applied an odour criterion of 5 OU to determine regulatory compliance.

As the population density increases, the proportion of sensitive individuals is also likely to increase, so that more stringent criteria are necessary. Hence, the impact assessment criteria for complex mixtures of odours were designed to take into account the range of sensitivity to odours within the community and to provide additional protection for individuals with a heightened response to odours. This is achieved using a statistical approach that is dependent upon population size.

To arrive at a one-second averaging time appropriate peak-to-mean factors have been applied to hourly average odour concentrations. Peak-to-mean factors estimate the effects of plume meandering and concentration fluctuations perceived by the human nose. A peak-to-mean factor of 2.3 has been adopted, corresponding to near-field and far-field receivers for point (stack) sources, for all stability classes (A-F).

Peak-to-mean ratios (P/M60) will alter the overall odour emissions rate depending on the type of emissions source. The recommended factors developed by Katestone Scientific and listed in the NSW EPA Approved Methods are shown in **Table 4.**

Table 4: Peak-to-Mean Ratio[1]

Source Type	Pasquill-Gifford Stability Class	Near field PM/60	Far field P/M60
Area	A,B,C,D	2.5	2.3
	E,F	2.3	1.9
Line	A-F	6	6
Surface wake-free point	A,B,C	12	4
	D,E,F	25	7
Tall wake-free point	A,B,C	17	3
	D,E,F	35	6
Wake-affected point	A-F	2.3	2.3
Volume	A-F	2.3	2.3

[1] Source: NSW EPA Approved Methods (refer to **Section 14**, Reference 5)

A peak-to-mean ratio of 2.3 has been applied to the estimated odour emissions rate (OER) as the source type is a wake affected point. The shed ventilation stacks are located approximately 10 m above the ground level and immediately adjacent to the poultry building and it is not considered that the source type is a tall wake free point source.

The odour assessment assumes that if the CALPUFF peak-to-mean adjusted one-hour ground level odour concentration is higher than the regulatory standard, a potential odour problem is apparent.

4. CLIMATE AND DISPERSION METEOROLOGY

4.1 Goolgowi Locality

To determine the most representative 12 month calendar period, required for modelling air emissions from the proposed poultry facility at Goolgowi, historical Bureau of Meteorology (BOM) climate data at Griffith (075041) was reviewed in **Table 5**.

Table 5: Bureau of Meteorology (BOM) Climate Data History for Griffith (075041)

Year	Temperature (degrees Celsius)				Rainfall (mm)	
	Maximum year average	Difference from long term average	Minimum year average	Difference from long term average	Yearly total	Percentage of long term average
2008	24.2	+0.2	10.7	+0.5	282.4	71%
2009	25.4	+1.4	11.5	+1.3	309.4	78%
2010	23.4	-0.6	10.9	+0.7	605.4	153%
2011	24.2	+0.2	10.5	+0.3	489.8	124%
2012	23.7	-0.3	9.5	-0.7	556.8	140%
2013	25.1	+1.1	10.6	+0.4	276.6	70%
2014	25.1	+1.1	10.9	+0.7	345.6	87%
2015	24.3	+0.3	10.9	+0.7	435.2	110%

A review of BOM climate data suggests greater deviations in either the average rainfall or temperatures for the years 2008, 2009, 2010, 2012 and 2013. The years with the least deviation from long term average climate statistics are years 2011, 2014 and 2015. The year 2011 was selected as the most representative year for weather and climate to model air emissions from the proposed poultry facility at Goolgowi.

4.2 CALMET Meteorological Domain

Air dispersion modelling requires the creation of a three dimensional (3D) CALMET meteorological data file that represents the weather and climate for the region (domain) modelled. Briefly, CALMET is a meteorological model that develops hourly (or sub-hourly) wind and other meteorological fields on a 3D gridded modelling domain. Associated two dimensional fields, such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The final time varying wind field thus reflects the influences of local topography and land uses.

Compilation of a 2011 3D meteorological data file for the Goolgowi area representative of the proposed site was obtained from the following data sources:

- Fifth-Generation NCARIPenn State Mesoscale Prognostic Model (MM5) for 2011;
- NSW DECC 2007 Land Use NSW; and
- Terrain data set with SRTM1 30 m resolution topography data.

MM5 is a widely-used 3D numerical meteorological model which contains non-hydrostatic dynamics and a variety of physics options. Extensive comparison between MM5 outputs and observed weather data has validated its use for application in the preparation of 3D CALMET weather files (refer to **Section 14**, Reference 16). MM5 is capable of simulating a variety of meteorological phenomena such as tropical cyclones, severe convective storms, sea-land breezes, and terrain forced flows such as mountain valley wind systems.

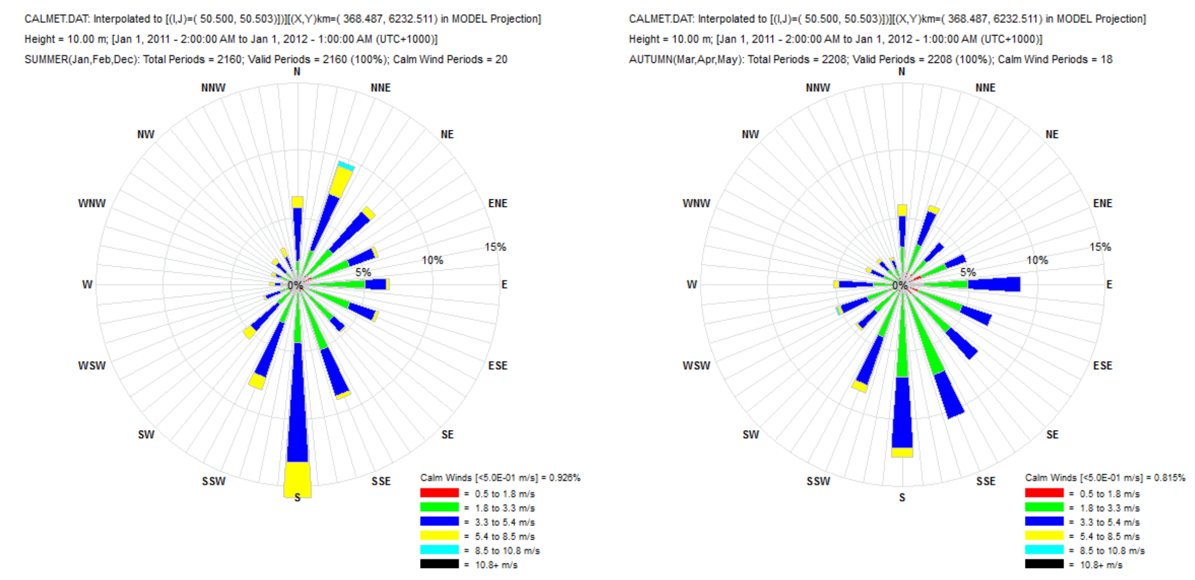
The recording of hourly weather information is not undertaken at Goolgowi by the BOM. The nearest BOM weather station recording good quality hourly weather data is at Griffith, and is located approximately 50 km south-west of the proposed poultry facility. This report has not considered the Griffith meteorological observations as representative to the assessment location. The subsequent generated 3D meteorological file used in this report was developed using high resolution MM5 meteorological information only.

The MM5 wind field was used as an initial guess in CALMET which was subsequently used to generate its wind. The initial wind was then adjusted to account for the kinematic and thermal effects of terrain on wind.

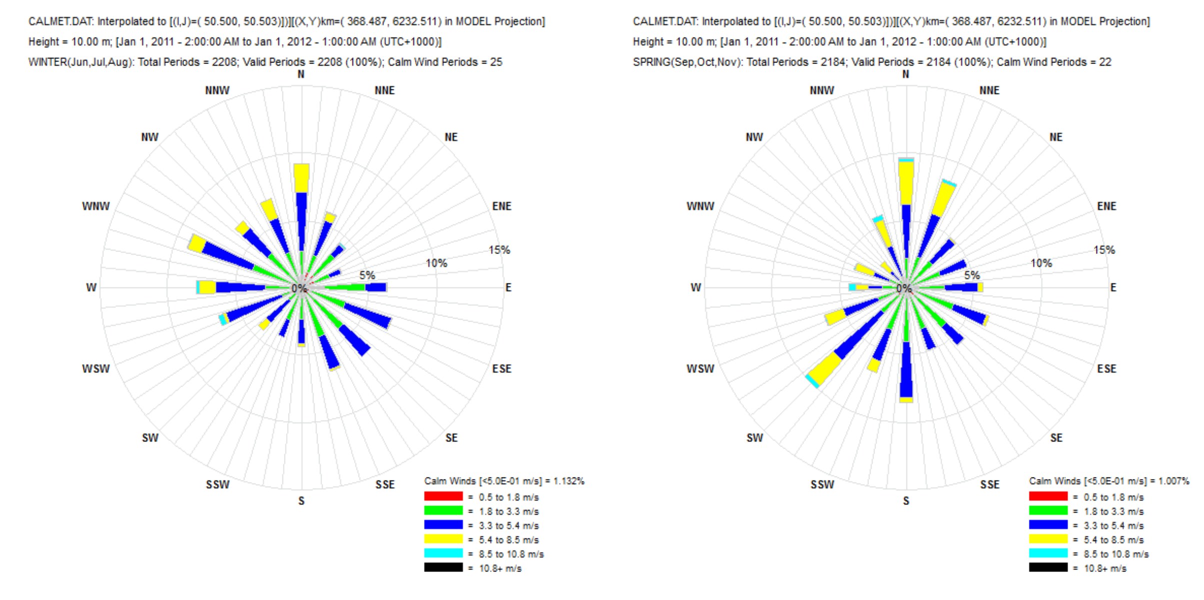
5. POULTRY FACILITY SITE METEOROLOGY

5.1 Wind Direction

The CALMET model wind field predictions of seasonal wind speed, direction and frequency for the year 2011 at the Goolgowi poultry facility site are presented in **Figure 6.**



Summer (Jan, Feb, Dec) Autumn (Mar,Apr,May)



Winter (Jun, Jul, Aug) Spring (Sep, Oct, Nov)

Figure 6: CALMET 2011 Goolgowi Poultry Facility Site Seasonal Wind Rose

The CALMET seasonal wind roses at the Goolgowi poultry facility site predict that the predominant winds are from a southern direction in summer and autumn, with the wind direction being more variable in the winter and spring months. Furthermore, calm winds are predicted to account for 0.8 to 1.1 % of the 2011 modelling period.

5.2 Atmospheric Stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical dilution. The Pasquill-Gifford-Turner assignment scheme identifies six Stability Classes, ‘A’ to ‘F’, to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological conditions.

Stability Class ‘A’ represents highly unstable conditions that are typically found during summer, categorised by strong winds and convective conditions. Conversely, Stability Class ‘F’ relates to highly stable conditions, typically associated with night-time clear skies, light winds and the presence of a temperature inversion. Classes ‘B’ through to ‘E’ represent conditions intermediate to these extremes. **Figure 7** presents the stability class frequency for the proposed poultry facility location.

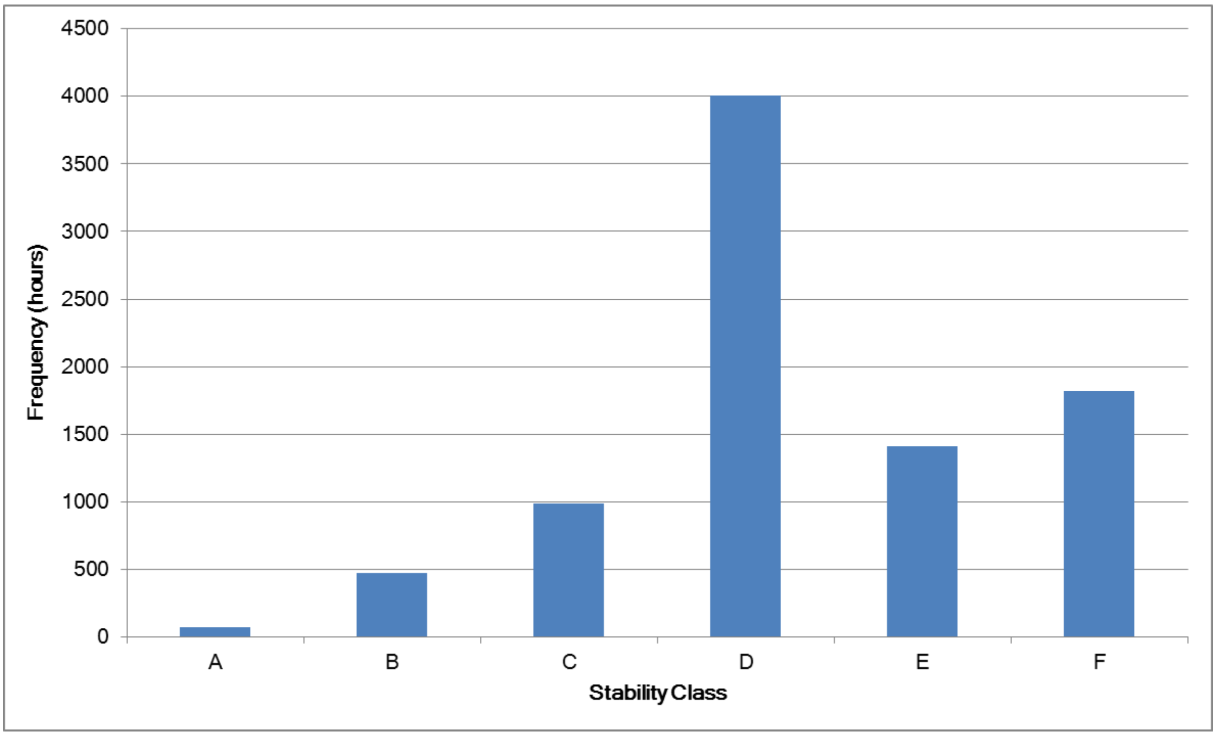


Figure 7: Proposed Goolgowi Poultry Facility 2011 Stability Class Frequency

5.3 Mixing Height

Mixing height is used by meteorologists to quantify the vertical extent of mixing in the atmosphere. It is the height to which vertical mixing extends and is usually defined as the layer of air beneath the inversion. The atmosphere within this layer is usually well-mixed through turbulent motion.

Mixing height usually reaches a maximum in the afternoon and is at a minimum at dawn. The diurnal variation in atmospheric mixing height with time is presented in **Figure 8**. The low mixing height predicted during evening and early morning periods are not conducive to good air dispersion.

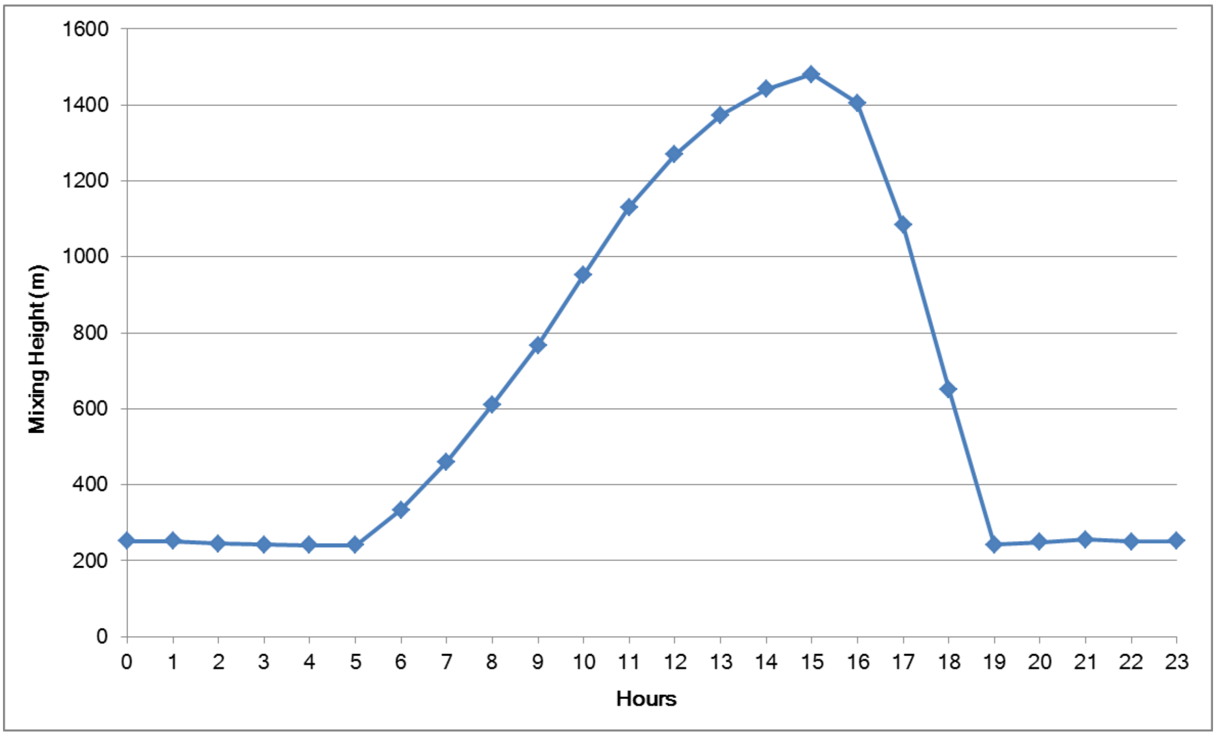


Figure 8: Proposed Goolgowi Poultry Facility 2011 Diurnal Annual Mixing Height

6. MODELLING APPROACH/METHODOLOGY

The current Level 2 odour and particulate assessment utilises the CALPUFF (Version 6.42) modelling system. The CALPUFF modelling system comprises of three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard routinely available meteorological and geophysical databases.

The project site is situated amongst locally significant topography. These particular topological landforms will contribute to the local meteorology. This phenomenon is displayed in the CALMET wind field presented in **Figure 9** where the arrow length of the wind vector is proportional to the wind speed and the direction is representative of the wind direction.

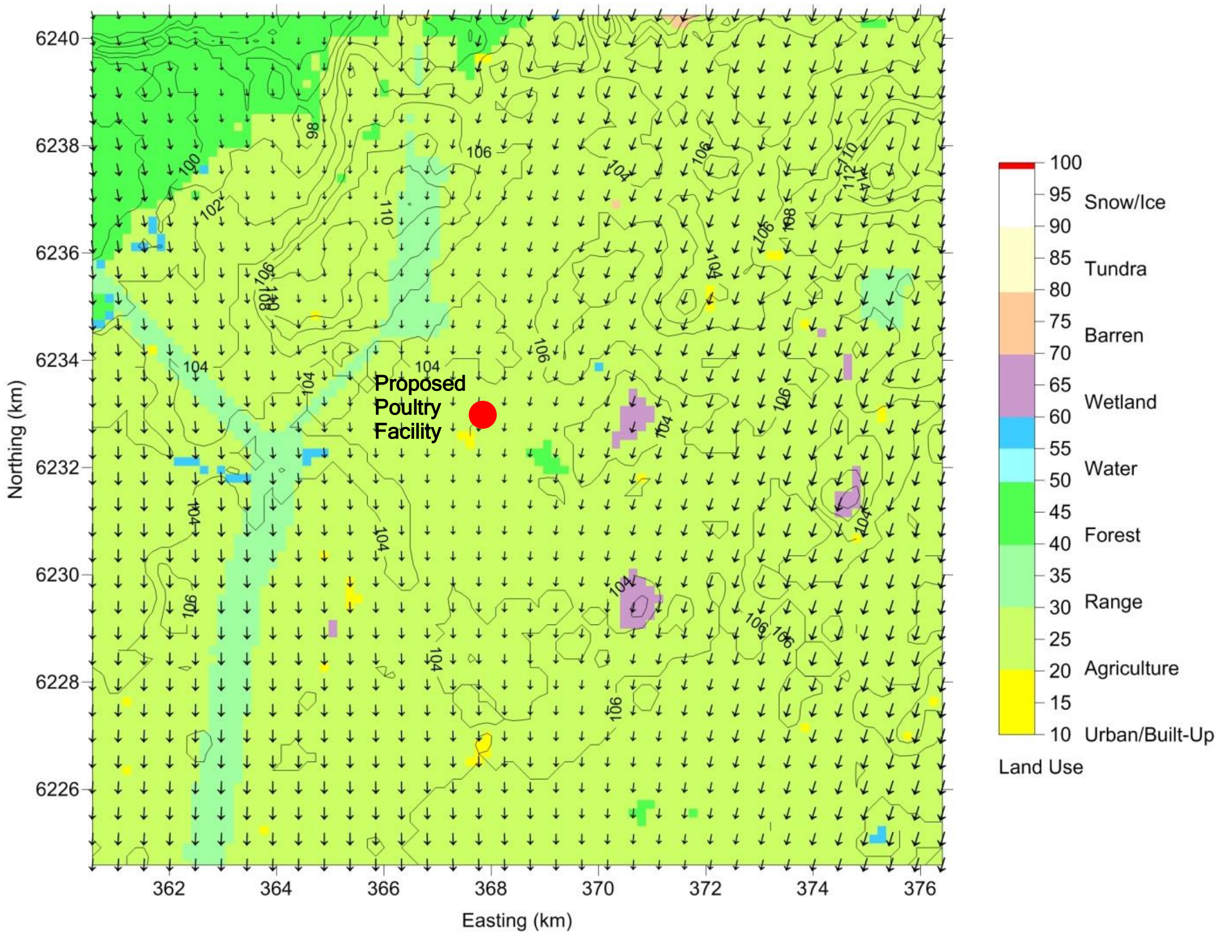


Figure 9: CALMET Modelling Domain – Example of Spatially Variable Surface Winds

7. EXISTING AIR QUALITY ENVIRONMENT

7.1 Odour

Aerial photographs indicate the subject area is rural in nature. Upon inspection, another operational poultry facility (ProTen Jeanella Poultry Facility) is located approximately 5 km east of the subject site. To properly account for cumulative odour impacts associated with the two closely situated poultry facilities, Advitech has modelled the ProTen facility for odour in accordance with the assumptions according to the Pacific Environment Limited (2015) Air Quality Impact Assessment – Jeanella South Poultry Complex (refer to **Section 14**, Reference 14).

7.2 Particulates

The NSW DECCW operate an air quality monitoring program that collects accurate real-time measurements of ambient level pollutants at 28 monitoring sites within the air quality monitoring network (AQMN), located around the greater metropolitan area of Sydney, the Illawarra, the Lower Hunter and selected rural sites around NSW. The monitoring location that is considered to be most representative of the Goolgowi area is located at Wagga Wagga approximately 200 km to the south-east of the proposed development. **Table 6** displays the background particulate concentrations at the Wagga Wagga monitoring station for the 2011 monitoring year (refer to **Section 14**, Reference 12).

Table 6: OEH Background Air Quality

Pollutant	Background Concentration[a]	Units	Averaging Time
TSP	26.4[b]	µg/m^3	Annual
Dust Deposition	na	g/m^2/month	Annual
PM_{10}	Variable (refer to **Figure 10**)	µg/m^3	24 Hours
	13.2	µg/m^3	Annual
$PM_{2.5}$	Variable[c]	µg/m^3	24 Hours
	5.94[c]	µg/m^3	Annual

[a] Reported value is the average 24 hour result
[b] Assumed from PM_{10} background (TSP = 2 x PM_{10})
[c] Assumed from PM_{10} background since $PM_{2.5}$ was not monitored during the entire 2011 period. The historical average ratio of $PM_{2.5}$ to PM_{10} concentrations from 2012 to 2016 at Wagga Wagga North monitoring station is 0.45.
na - Not available

In the absence of DECCW dust deposition data, the maximum increase in deposited dust level (i.e. 2 g/m^2/month) has been used as the impact assessment criteria. **Figure 10** displays the PM_{10} 24 hour average background concentrations for 2011 and indicates one exceedance (i.e. 23 September 2011) above the DECCW impact assessment criteria of 50 µg/m^3. For the purpose of the assessment, a maximum 24 hour PM_{10} concentration of 39.2 µg/m^3 is applied. It should be noted that the Wagga Wagga North monitoring station was commissioned in August 2011 and the highest particulate concentration was used during the overlapping period.

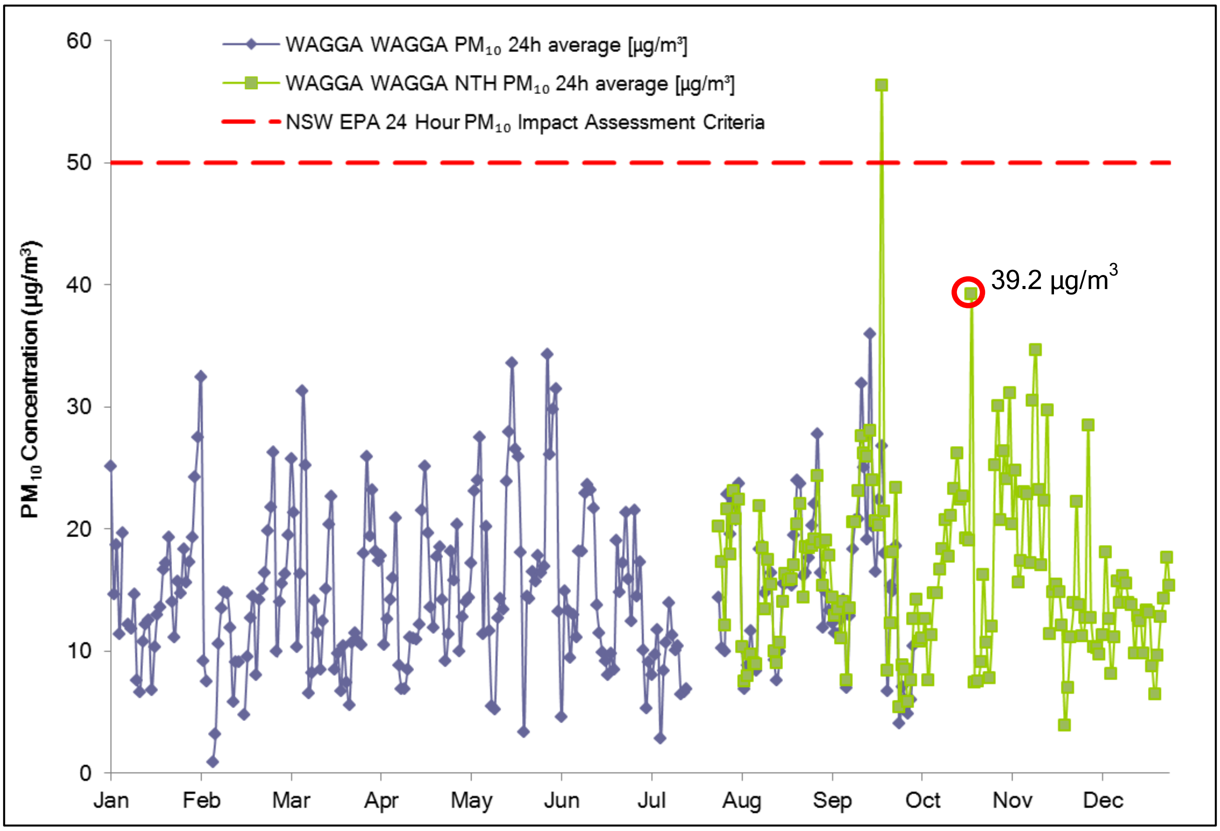


Figure 10: Wagga Wagga Background Monitoring Data from 2011

8. AIR EMISSION APPROACH/METHODOLOGY

There has been considerable research into describing and characterising odour emissions from poultry facilities (refer to **Section 14**, References 1, 8 and 15). It is generally accepted that the poultry shed OER is a function of:

- The number of birds;
- The bird age/mass;
- The shed ventilation rate; and
- The ambient temperature.

The shed OER is dependent upon the ventilation rate at any particular time, and can vary substantially should growing conditions within the shed change.

This report has assumed a three-phase production cycle for the project site facility. The first phase is the brooding phase, which begins from day 1 to 22. During this phase the ventilation system is operated under minimum ventilation. The second phase is between day 23 and 50, where the ventilation system is operated under tunnel ventilation mode. During this growing cycle gradual flock thinning was undertaken to maintain optimum flock health, as well as to account for partial flock harvesting. After day 50, the sheds are cleaned and sterilized and remain ready for chick restocking. This last phase takes 17 days.

This report assessed one year of facility operation for both properties that includes approximately 5.5 growing batches per shed. All sheds (i.e. 100 sheds) are assumed to operate in a synchronous fashion i.e. the batches in all sheds started and finished at the same time, and so peak odour and particulate emission rates from each facility are considered in the modelling. This potentially represents a worst-case operating scenario from an air quality (i.e. odour and particulates) perspective. This is consistent with the modern poultry industry policy of poultry facilities operating on an “all in, all out” basis.

8.1 Ventilation

Ventilation requirements for all types of poultry houses are dependent upon ambient temperatures, the age and bodyweight of the birds and the number of birds housed. There are two dominant modes of shed ventilation offered during the bird growing cycle, ‘minimum’ and ‘tunnel’.

Minimum ventilation is achieved by utilising chimney fans for the proposed poultry facility, located along the roof of the shed. This report has assumed eight horizontal discharge chimney fans equally spaced along the length of the shed roof. Minimum ventilation is the dominant ventilation type applied during the initial 22 days of the bird growing cycle. During this period, birds require warmer conditions for optimal growth. As the growing phase continues throughout the 22 day period the rate of minimum ventilation is increased to account for increases in bird mass. The odour emissions from each chimney fan were modelled with a release height of 4.6 m and a constant efflux velocity of 8 m/s.

After day 22 of the growing cycle, the ventilation mode transitions to ‘tunnel ventilation’. Tunnel ventilation is achieved with the mounting of large axial flow fans at the end of the sheds, resulting in a more controlled and consistent flow of air through the shed. During this period, odour emissions from each fan were modelled considering either a horizontal release at a height of 1.5 m in the Stage 1 development scenario (i.e. 40 sheds) or a vertical release at a height of 10 m in the Stage 2 development scenario (i.e. 100 sheds). A constant efflux velocity of 15 m/s has been applied to both scenarios.

This report has assumed that air would be extracted by 18 exhaust fans for the proposed sheds, providing a maximum ventilation rate of approximately 175 m^3/s for each new shed. To compensate for reduced tunnel ventilation flowrates during cooler periods, this report assumes that the 15 m/s efflux velocity is maintained by numbers of fans switched off while the remaining operational fans operate at full capacity. Ten metre stacks are to be constructed to achieve a vertical release in the Stage 2 development of the poultry farms.

It is also recognised that guidelines regarding the ventilation rate can vary considerably between environments/climates, the bird species farmed and specific poultry grower ventilation program settings (refer to **Section 14**, Reference 3 and 15). This is significant because the shed ventilation rate can greatly influence the predicted odour GLC's during cool overnight conditions when the atmosphere is generally too stable to affect good odour dispersion. It is generally accepted that high OERs that are modelled during cool overnight conditions will significantly impact on the peak percentile GLCs.

The ventilation rate profile for the first growing cycle in the modelled year is presented in **Figure 11**.

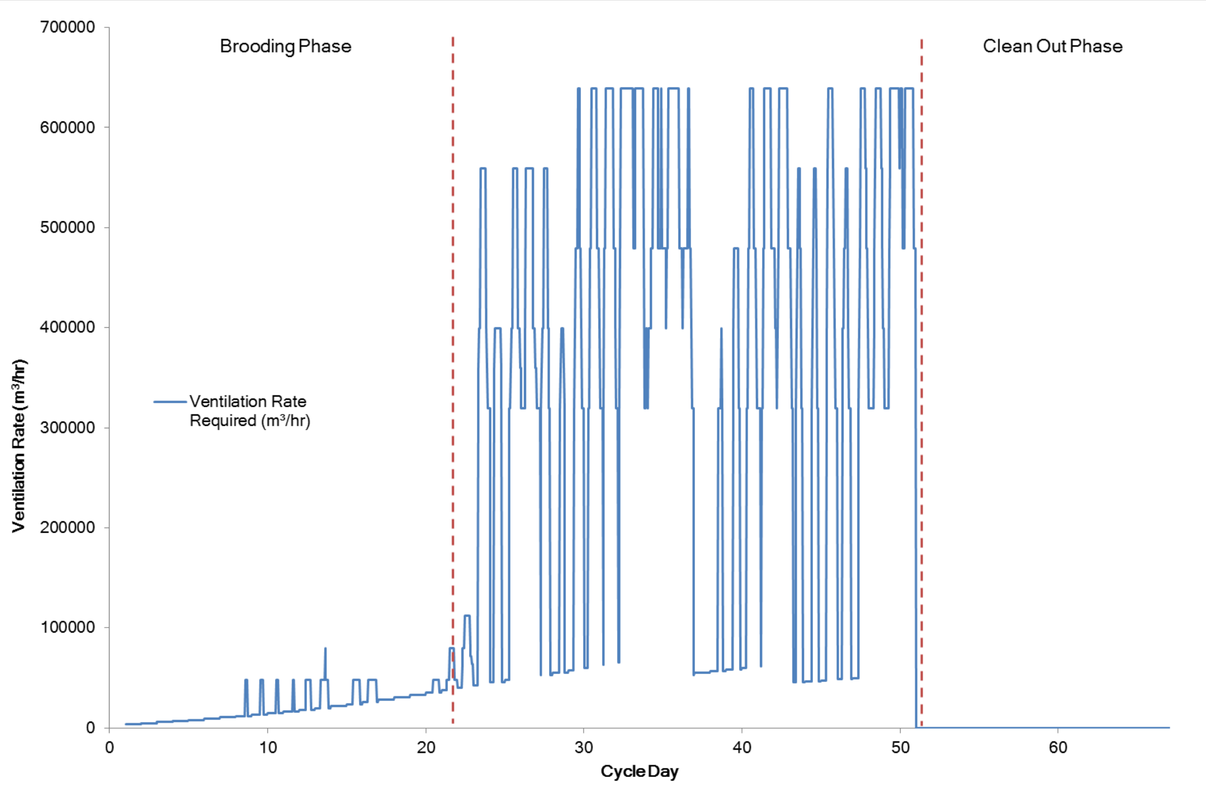


Figure 11: Ventilation Rate Profile – Example for One Proposed Shed

8.2 Odour Emissions

The OER for each ventilated shed (i.e. minimum or tunnel ventilated shed) at any given stage of the growth cycle was calculated according to the following equation (refer to **Section 14**, Reference 8):

$$OER = 0.025 \times K \times A \times D \times V^{0.5}$$

where:

- OER is the odour emission rate ($OU.m^3/s$).

- K = 2.2 (empirical factor unitless). A value of 2.2 represents new poultry facilities confirming to best practice. This is considered conservative as the literature indicates that the value of K may be one (1) for very well designed and managed sheds that operate with minimal odour emissions, and a value of K may be five (5) for a very poorly managed shed with high odour emissions.
- A is the total shed floor area (m^2).
- D is the average shed bird density (kg/m^2). Bird density (D) is related to the age of the birds and the stocking density i.e. the number of birds placed per unit area.
- V is the ventilation rate (m^3/s).

The odour emissions profile for the first growing cycle in the modelled year is presented in **Figure 12**. The corresponding hourly time series odour emissions profile, commensurate of all shed odour emission locations, was generated and included into the CALPUFF modelling dispersion program.

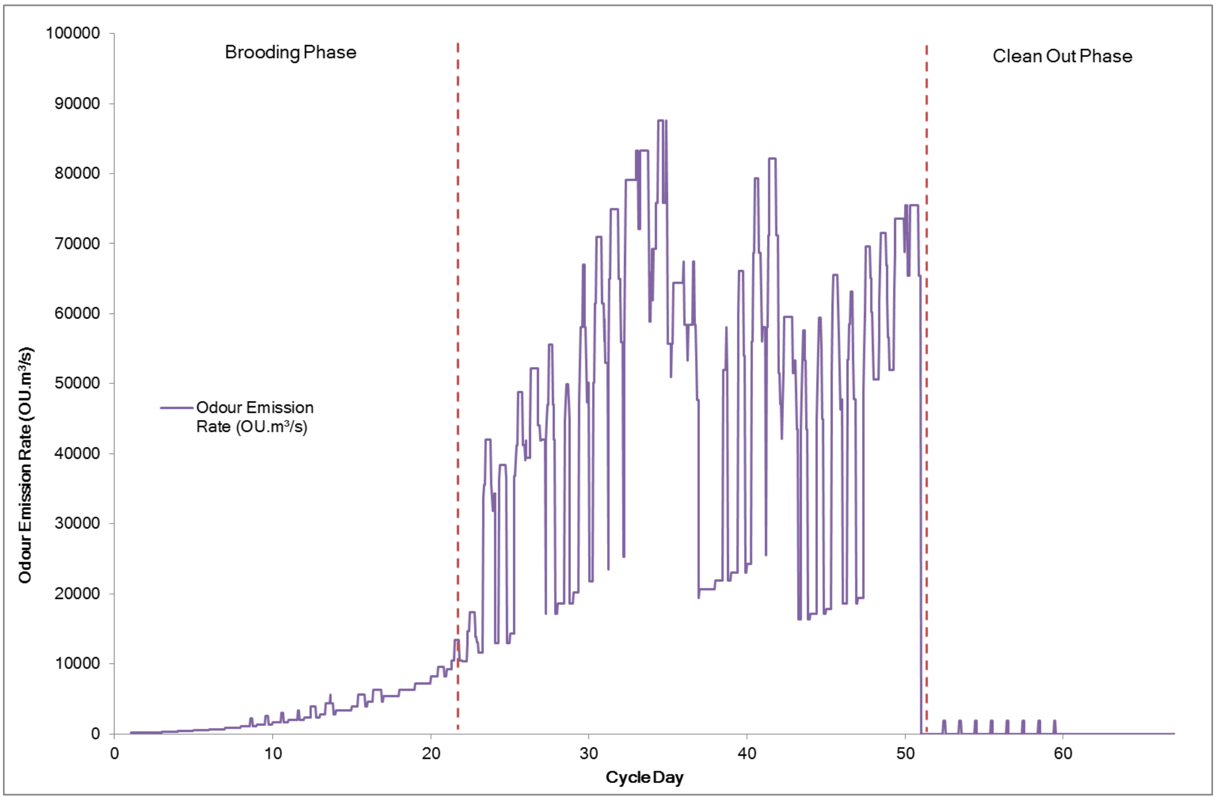


Figure 12: Odour Emission Rate Profile – Example for One Proposed Shed

The clean out phase of the growing cycle occurs after all the birds have been removed from shed. It is understood that the removal of the litter during this phase can be an odorous process. The complete removal of the litter has been assumed to occur during day 52 – 59 between 11 am – 2 pm. The odour emissions have been modelled as a volume source from the open shed doors with an odour concentration of 553 OU/m^3 and 0.5 air changes per hour (refer to **Section 14**, Reference 1).

8.3 Particulate Emissions

The maximum particulate emission concentration (PEC) for a given total bird mass is calculated by the following equation (refer to **Section 14**, Reference 14):

$$PEC = aM + b$$

where:

- PEC is the maximum particulate emission concentration (mg/m^3).
- M is the total mass of birds (tonnes).
- a = 0.270 for TSP or 0.115 for $PM_{10,}$ b = 0.385 for TSP or 0.917 for PM_{10}.

To account for the dilution that occurs under higher flow rates, the particulate emission concentration (PEC_v) is calculated using the equation below:

$$PEC_v = PEC \times (cV^d)$$

where:

- PEC_v is the particulate emission concentration (mg/m^3).
- PEC is the maximum particulate emission concentration (mg/m^3).
- V is the shed ventilation rate (m^3/s).
- c = 3.3 for TSP and 4.11 for PM_{10}.
- d = -0.49 for TSP and -0.58 for PM_{10}.

A particulate emission rate (PER) is calculated by multiplying the PEC_v by the ventilation rate (V). Wheel generated PM_{10} and TSP emissions are calculated using default estimates from the NPI Manual for Mining Version 3.1 (refer to **Section 14**, Reference 7).

$PM_{2.5}$ emission rates are estimated using available literature for poultry shed and wheel generated emissions. The poultry shed $PM_{2.5}$ emissions are estimated using a PM_{10} to $PM_{2.5}$ ratio determined from measured data in the report produced by the Australian Poultry CRC (refer to **Section 14**, Reference 1). Wheel generated $PM_{2.5}$ emissions are calculated using estimates in AP42 Section 13.2.2 Unpaved Roads (refer to **Section 14**, Reference 19).

The particulate emissions profile for the first growing cycle in the modelled year is presented in **Figure 13**. The corresponding hourly time series particulate emissions profile, commensurate of all shed particulate emission locations, was generated and included into the CALPUFF modelling dispersion program.

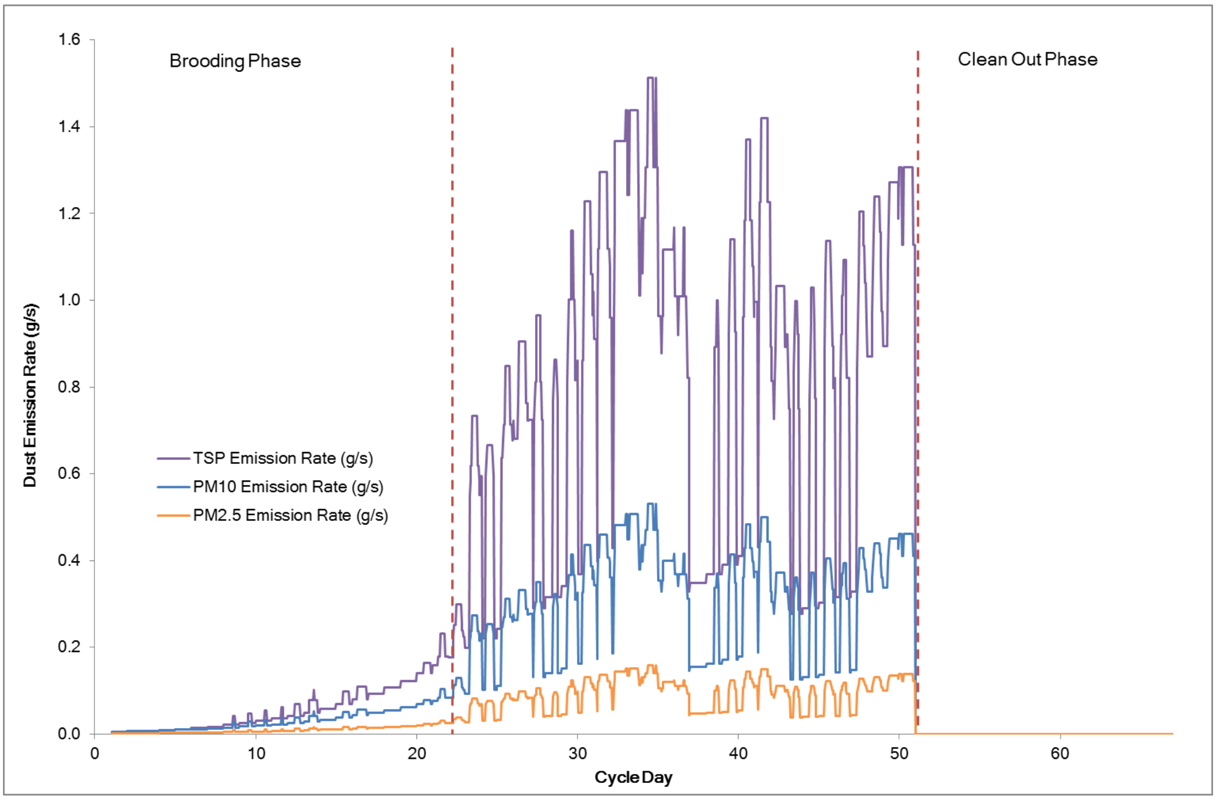


Figure 13: Particulate Emission Rate Profile – Example for One Proposed Shed

9. DISPERSION MODELLING

9.1 Meteorological Model Configuration

Table 7 details the parameters used in the meteorological modelling to drive the CALMET model.

Table 7: CALMET Meteorological Parameters used in this Report

Identifier	Descriptor	Comment
MM5	Grid spacing	1.33 km × 1.33 km
	Year of analysis	2011
	Time step	hourly
CALMET (v 6.333)	Meteorological grid domain	16 km x 16 km
	Meteorological grid origin (SW corner)	360485 m, 6225604 m
	Meteorological grid resolution	0.16 km
	Surface meteorological station	N/A
	TERRAD value	4 km
	Cell Face Heights	0, 20, 40, 80, 160, 320, 700, 1300, 1700, 2300, 3000

9.2 Dispersion Modelling Configuration

CALPUFF is an advanced non-steady-state meteorological and air quality modelling system. The model advects 'puffs' of material emitted from modelled sources, simulating the dispersion and transformation processes along the way. The model has been adopted by the U.S. Environmental Protection Agency (U.S. EPA) in its guideline on air quality models. CALPUFF uses the 3D wind fields generated by CALMET with the primary output files from CALPUFF processed in CALPOST to produce time based concentration or deposition fluxes evaluated at selected receiver locations.

Odour and particulate concentrations were simulated for a regular Cartesian receiver grid covering a 16 km by 16 km computational domain, set within the CALMET modelling domain and centred over the project area, with a grid resolution of 0.16 km. High resolution MM5 meteorological data for the year 2011 has been used as locality specific meteorological data is not available. It is considered that MM5 data (at a resolution of 1.33 km) is as accurate as observational data (refer to **Section 14**, Reference 17).

Section 9.4 outlines the assumptions made for the odour assessment. **Appendix I** contains example CALMET and CALPOST input files.

9.3 Modelling Scenarios

The assessment of particulate and cumulative odour emissions from the proposed poultry facility involved modelling 60,000 birds per shed and the nearby Jeanella Poultry Facility.

Odour and particulate emissions from sheds were modelled as point (stack) sources for the entire 2011 growing cycle period. Poultry sheds have traditionally been modelled as volume sources. Over time it has become known that this approach does not allow for appropriate temperature buoyancy to be considered. It has therefore become more appropriate to model tunnel ventilated poultry sheds as point (stack) sources (refer to **Section 14**, Reference 13). Odour emissions from the cleanout phase have been modelled as a single volume source to simulate the open doors without mechanical ventilation during litter removal. **Table 8** lists the locations of the stack and volume sources.

Table 8: Emission Source Characteristics – Example for One Shed

<table>
<tr><th>Source ID</th><th>Easting (UTM)(km)</th><th>Northing (UTM)(km)</th><th>Ground Elevation (m)</th><th>Stack/ Release Height (m)</th><th>Exit Velocity (m/s)</th><th>Exit Temperature (K)</th><th>Sigma y (m)</th><th>Sigma z (m)</th></tr>
<tr><td>Tunnel 1</td><td>366.042</td><td>6234.172</td><td>104</td><td>10</td><td>15</td><td>Variable</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Roof 1</td><td>366.055</td><td>6234.171</td><td rowspan="8">104</td><td rowspan="8">4.6</td><td rowspan="8">8</td><td rowspan="8">Variable</td><td rowspan="8">N/A</td><td rowspan="8">N/A</td></tr>
<tr><td>Roof 2</td><td>366.075</td><td>6234.168</td></tr>
<tr><td>Roof 3</td><td>366.095</td><td>6234.165</td></tr>
<tr><td>Roof 4</td><td>366.115</td><td>6234.162</td></tr>
<tr><td>Roof 5</td><td>366.135</td><td>6234.160</td></tr>
<tr><td>Roof 6</td><td>366.155</td><td>6234.157</td></tr>
<tr><td>Roof 7</td><td>366.175</td><td>6234.154</td></tr>
<tr><td>Roof 8</td><td>366.195</td><td>6234.151</td></tr>
<tr><td>Volume 1</td><td>366.042</td><td>6234.172</td><td>104</td><td>2</td><td>N/A</td><td>Ambient</td><td>42</td><td>2.3</td></tr>
</table>

9.4 Assumptions

The following assumptions have been used in the CALPUFF model computation of odour and particulate GLCs.

9.4.1 General

- Modelled in CALPUFF using model options prescribed in the NSW OEH Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System, 2011.
- The production cycle is 67 days and consists of three distinct phases. The first phase is the brooding phase and begins from day 1 to 22. During this phase the ventilation system is operated under minimum ventilation. The second phase is between day 23 and 50 where the ventilation system is operated under tunnel ventilation mode. After day 50, the sheds are cleaned and sterilized and remain ready for chick restocking. This period (phase 3) lasts for 17 days.
- The modelling assessment assumes the facility is fully stocked with poultry (i.e. 100 sheds with 60,000 birds per shed) at the proposed facility and in operation for 365 days per annum.
- All sheds are mechanically ventilated. The sheds are not naturally ventilated.
- Shed emissions are effected by building downwash. Plumes are trapped in building wakes in the cavity region immediately downwind of a building or subjected to plume downwash and enhanced horizontal or vertical spreading due to the turbulent zone that exists further downwind. The ISC-method of building downwash has been applied in this report.
- In the event the outside ambient dry bulb temperature fell below 22 degrees Celsius, the tunnel ventilation system reduced to between 1% and 5% of full capacity flow (i.e. between 1% and 5% of 175 m^3/s).
- In the event the outside ambient dry bulb temperature fell below 20 degrees Celsius, the tunnel ventilation system reduced to a minimum ventilation rate (i.e. up to 70,000 m^3/h), as defined by the Ross Broiler Management Handbook 2014. (refer to **Section 14**, Reference 3).
- Farms 1 - 5 are constructed and operating. Each farm has 20 tunnel ventilated sheds (i.e. total of 100 sheds).
- The discharge ducting for the tunnel ventilated fans that are located at the end of each shed is orientated so that all exhaust emissions are emitted as a vertical discharge at a height of 10 m and constant velocity of 15 m/s.

9.4.2 Odour

- Predicted odour GLCs are the one hour average 99^{th} percentile dispersion model value and adjusted using a P/M 60 factor of 2.3 to represent the one second nose-response-time.
- Odour emissions from all tunnel fans on a shed are modelled as one shed specific stack source (e.g. 20 sheds equating to 20 stacks) and odour emissions from roof chimney fans are modelled as grouped stack sources (e.g. eight roof fans on one shed equating to two stacks per shed).
- Odour emissions from the removal of shed litter are modelled as one specific volume source (i.e. large shed doors at eastern end of the shed).

- Shed litter remains in the shed after the final bird pickup, and is removed from the sheds during the following week. The used shed litter is immediately taken off site after the shed cleanout.
- No odour is emitted from areas outside the sheds.
- No odours are generated from loading, storage and distribution of feed material into sheds.
- Poultry mortality losses have not been considered as a potential source of odour. Dead poultry is expected to be stored in an enclosed organic waste bin and transported off-site for rendering.

9.4.3 Particulates

- Wheel generated emissions modelling is based on the expected truck movements during the growing cycle provided in the site traffic impact assessment (refer to **Section 14**, Reference 20).
- Wheel generated particulate emissions are estimated using the default emission rate from the National Pollutant Inventory (NPI) Emission Estimation Technique (EET) manual for mining version 3.1.
- Predicted PM_{10} and $PM_{2.5}$ GLCs are the 24 hour average 100^{th} percentile dispersion model value and predicted TSP GLCs are the annual average 100^{th} percentile dispersion model value.
- Particulate air emissions from poultry shed ventilation use a geometric mass mean diameter of 1.96 µm and a geometric standard deviation of 1.54 µm (refer to **Section 14**, Reference 1).
- Particulate air emissions from unpaved haul roads use a geometric mass mean diameter of 8.30 µm and a geometric standard deviation of 1.18 µm (refer to **Section 14**, Reference 21).

10. EMISSIONS SOURCES

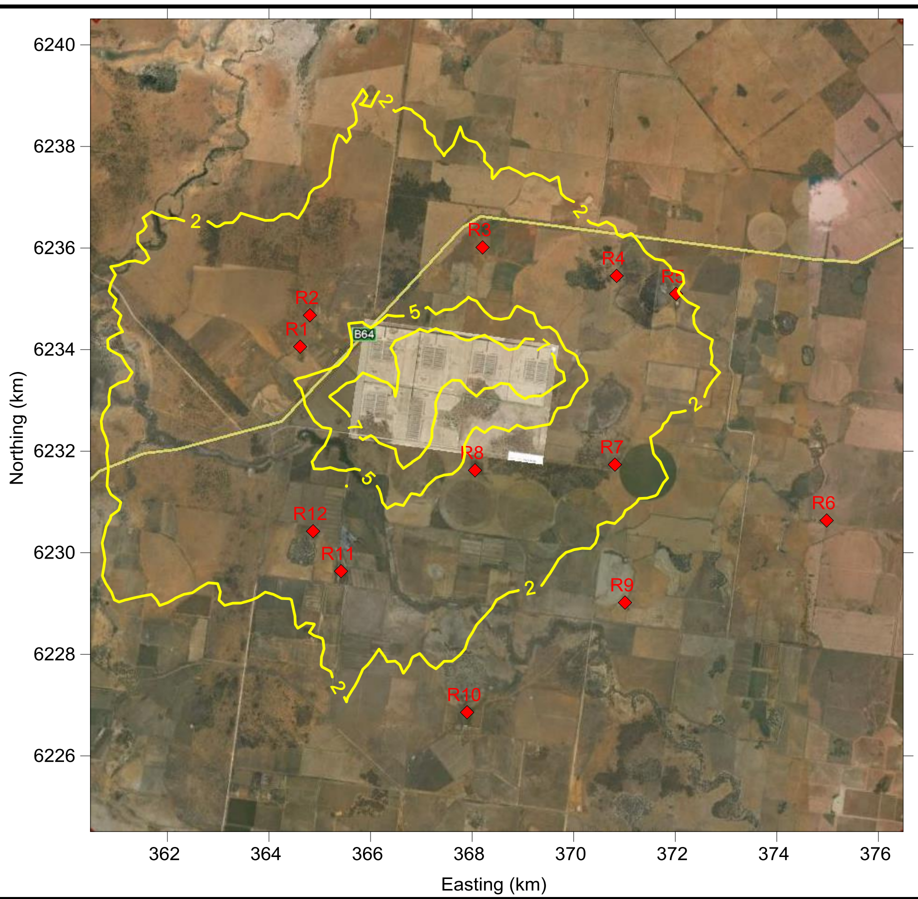
Odour and particulate emission rates vary diurnally, seasonally, throughout the life of the flock and will be different at different poultry facilities depending on management and infrastructure (refer to **Section 14**, Reference 1). The main source of odour from poultry facilities is typically the litter within the chicken sheds. As the litter (made up of dry organic litter, manure, dust and feathers) begins to break down odorous compounds are created which then volatilise. High litter moisture content, low oxygen levels, small particle size, high temperatures and low pH levels encourage anaerobic bacterial activity and the generation of odour. The rate at which the compounds then volatilise is dependent on the litter pH and temperature, ventilation rates and climate (refer to **Section 14**, Reference 10).

This report presents the modelling of odour and particulate emissions associated with the McRaes Road, Goolgowi poultry facility operating at 6,000,000 chickens. The chickens and waste material within the chicken shed are the only sources onsite that have the potential to generate odour.

11. DISPERSION MODELLING RESULTS

11.1 Odour

Figure 14 and **Table 9** present the incremental 99th percentile one-second average GLC of odour at the surrounding sensitive receiver locations, as predicted by CALPUFF, for the proposed operation. The DECCW odour criterion as outlined in **Table 3** is 5 OU.



Client:	Tattersall Lander
Project:	Goolgowi Poultry Facility
Source:	Google Earth

Figure 14: 99th Percentile One-Second Average Odour Concentration

(Contour labels = 2, 5, 7 OU)

Table 9: Predicted Odour at Sensitive Receivers

Receiver	Receiver ID	Predicted GLC 99th Percentile One-Second Odour (OU)	Impact assessment criteria (OU)
R1	Residential	3.71	5 OU
R2	Residential	4.02	
R3	Residential	3.04	
R4	Residential	2.69	
R5	Residential	2.13	
R6	Residential	0.91	
R7	Residential	2.75	
R8	Residential	4.48	
R9	Residential	1.41	
R10	Residential	1.47	
R11	Residential	2.97	
R12	Residential	3.26	

The results indicate the 99th percentile one second average odour GLC criteria is not exceeded at any sensitive receivers. The Jeanella poultry facility was assessed to determine the cumulative impact on the sensitive receivers odour GLCs.

11.1.1 Cumulative Impact

A Monte Carlo simulation was undertaken to assess the potential cumulative impacts of the existing poultry facility. The simulation involves the repeated random selection of data points from the model predictions of both the proposed project site and the existing Jeanella poultry facility to determine an odour GLC frequency distribution for each sensitive receiver.

The process assumes that a randomly selected background value (i.e. Jeanella Poultry) would have a chance equal to that of any other value from the dataset of occurring on the given 'model day'. Over sufficient time this would yield a good statistical estimate of the combined and independent effects of varying background and site contribution to total odour.

The simulation in the assessment used 250,000 iterations to determine the distribution of odour GLCs at each sensitive receiver. **Table 10** presents the results of the Monte Carlo simulation for sensitive receivers.

Table 10: Predicted Cumulative Odour GLCs at Sensitive Receivers

Receiver	Predicted 99th Percentile Odour GLC from the Proposed Poultry Facility (OU)	Predicted 99th Percentile Cumulative Odour GLC by Monte Carlo Simulation[1] (OU)	Impact assessment criteria (OU)
R1	3.71	3.88	5 OU
R2	4.02	4.14	
R3	3.04	3.33	
R4	2.69	3.77	
R5	2.13	3.50	
R6	0.91	1.74	
R7	2.75	3.81	
R8	4.48	4.90	
R9	1.41	1.79	
R10	1.47	1.67	
R11	2.97	3.00	
R12	3.26	3.50	

[1] The predicted Monte Carlo method outcome combines the frequency odour distribution for the proposed poultry facility with the modelled Jeanella poultry facility.

The Monte Carlo Simulation results indicate the 99th percentile one second average odour GLC criteria is not exceeded at any sensitive receiver.

11.2 Particulates

11.2.1 Annual Average PM_{10}

The predicted concentrations of annual average PM_{10} for the proposed operation are presented in **Figure 15** and **Table 11**.

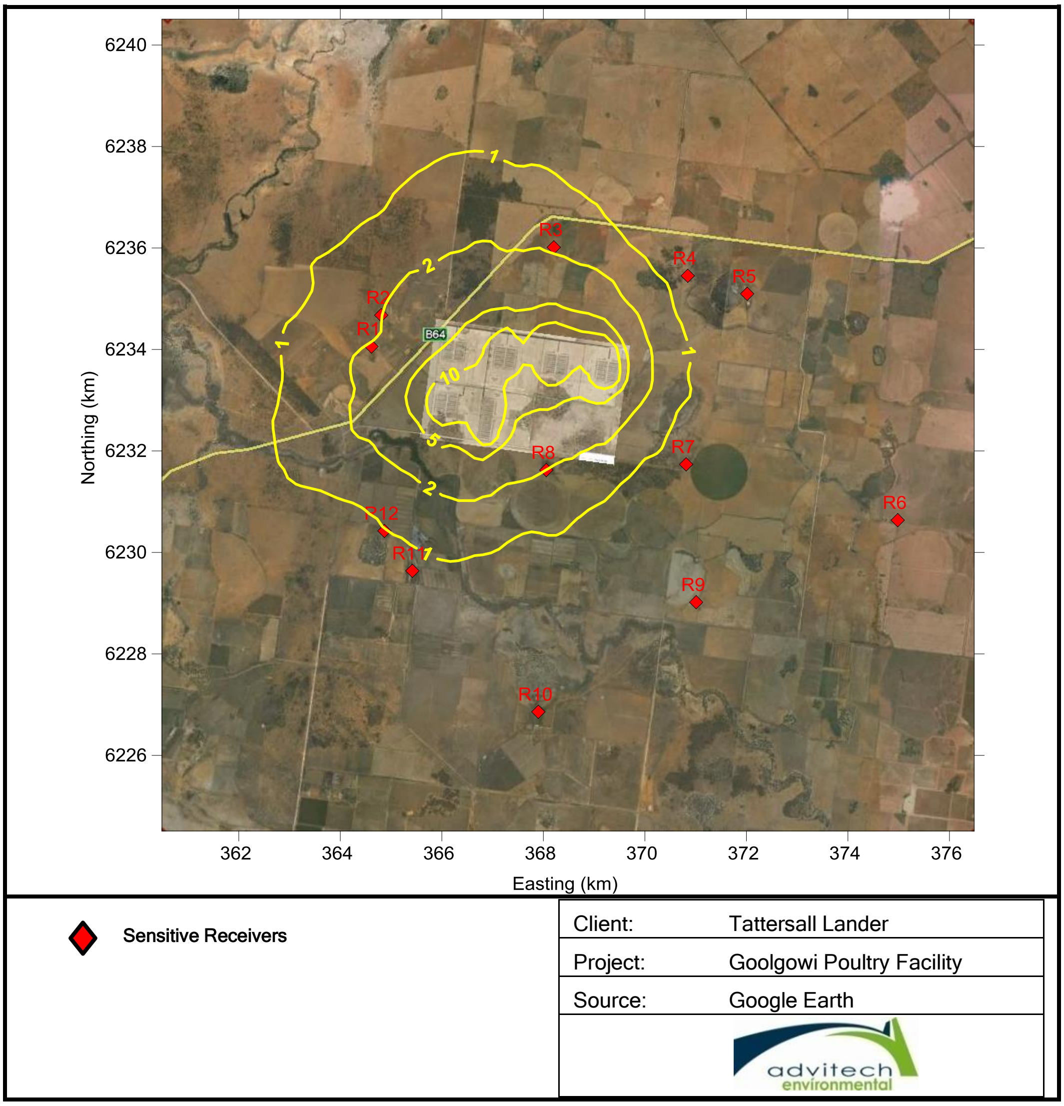


Figure 15: 100th Percentile Annual Average PM_{10} Concentration

(Contour labels = 1, 2, 5, 10 µg/m³)

Table 11 presents the predicted cumulative 100th percentile annual average PM_{10} for sensitive receivers respectively. A maximum annual PM_{10} background concentration of 13.2 µg/m³ has been applied (refer to **Table 6**) to determine if further assessment is required.

Table 11: Predicted Annual Average PM_{10} at Sensitive Receivers

Receiver	Predicted Increment (µg/m³)	Background Concentration	Total (µg/m³)	Impact Assessment Criteria
R1	2.1	13.2 µg/m³	15.3	25 µg/m³
R2	2.0		15.2	
R3	1.8		15.0	
R4	0.8		14.0	
R5	0.4		13.6	
R6	0.1		13.3	
R7	0.7		13.9	
R8	2.0		15.2	
R9	0.3		13.5	
R10	0.3		13.5	
R11	0.8		14.0	
R12	1.0		14.2	

The annual PM_{10} impact assessment criteria are not exceeded at any sensitive receivers. According to the NSW OEH guidance, no additional contemporaneous assessment of annual average PM_{10} is required.

11.2.2 24 Hour Average PM_{10}

The predicted concentrations of 24-hour average PM_{10} maximum increment for the proposed operation are presented in **Figure 16**.

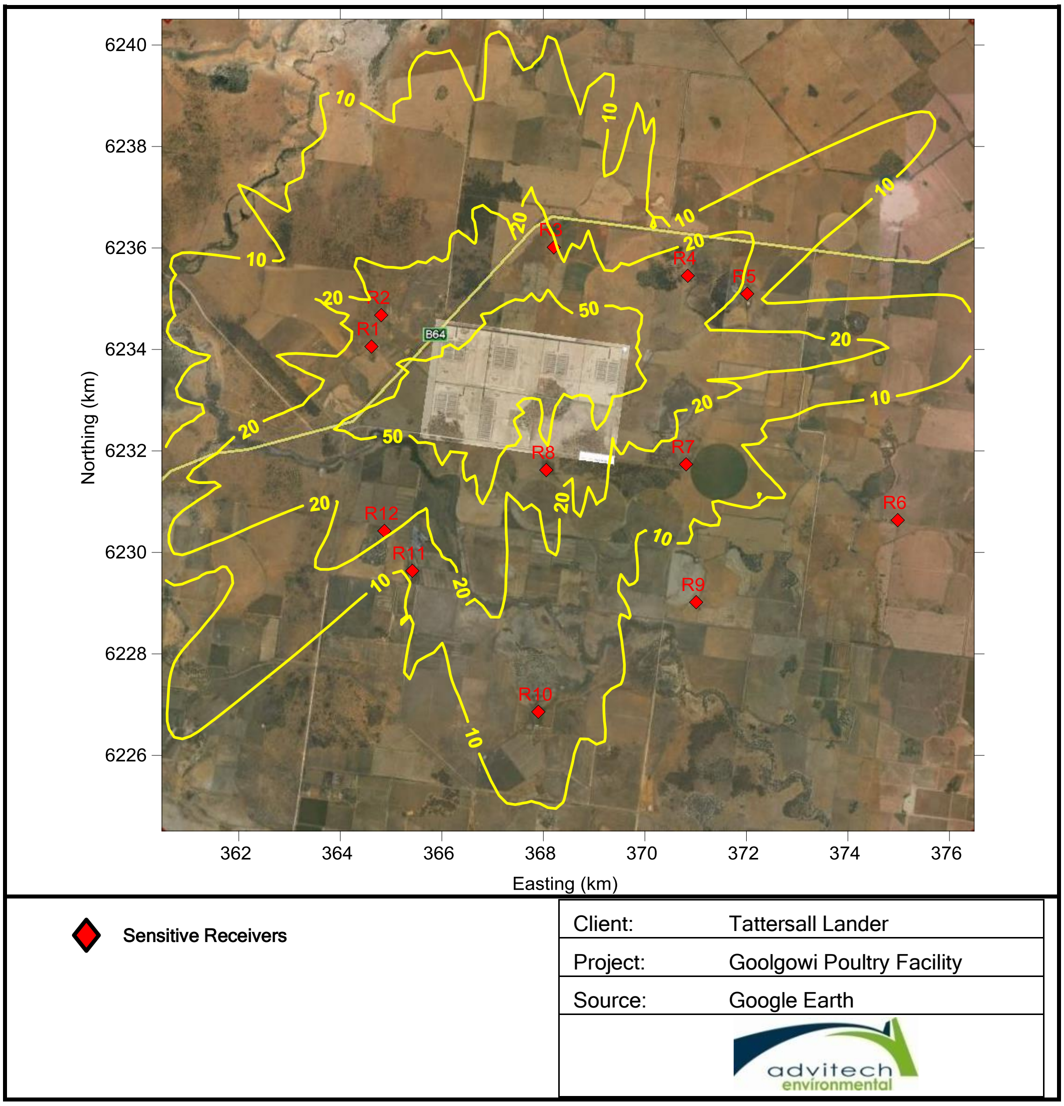


Figure 16: 100th Percentile 24 Hour Average PM_{10} Concentration

(Contour labels = 10, 20, 50 µg/m^3)

The predicted concentrations of the 24 hour average PM_{10} impact for the proposed operation are presented in **Table 12**.

Table 12: Maximum Impact of 24 Hour Average PM_{10}

Receiver	Predicted Increment ($\mu g/m^3$)	Maximum Background Concentration	Total ($\mu g/m^3$)	Impact Assessment Criteria
R1	25.0	39.2 $\mu g/m^3$	**64.2**	50 $\mu g/m^3$
R2	29.9		**69.1**	
R3	22.0		**61.2**	
R4	31.6		**70.8**	
R5	16.7		**55.9**	
R6	4.1		43.3	
R7	14.6		**53.8**	
R8	34.3		**73.5**	
R9	6.7		45.9	
R10	12.4		**51.6**	
R11	12.0		**51.2**	
R12	21.7		**60.9**	

[1] The background concentration of 56.3 $\mu g/m^3$ has been discounted as it is above the impact assessment criteria.
Bold and grey highlighted text indicates exceedances above the assessment criteria (i.e. 50 $\mu g/m^3$).

The exceedances at nearby sensitive receivers of the 24 hour average PM_{10} concentration presented in **Table 12** indicates that a Level 2 contemporaneous impact and background assessment is required to determine any additional exceedances as a result of the proposed operation. A summary of the 24 hour average PM_{10} contemporaneous impact and background assessment (Level 2 Assessment) for identified sensitive receivers are presented in **Table 13.** The detailed results of the contemporaneous impact and background assessment for each receiver are given in **Appendix II**.

Table 13: Summary of 24 Hour Average PM_{10} Contemporaneous Impact and Background

Date	PM_{10} 24-hour average (µg/m³)				Date	PM_{10} 24-hour average (µg/m³)			
	Highest Background	Predicted Increment	Receiver	Total		Background	Highest Predicted Increment	Receiver	Total
23/09/11	**56.3**	0.2	R3	**56.5**	26/06/2011	17.2	34.3	R8	**51.5**
24/10/2011	39.2	3.8	R8	43.0	5/02/2011	0.9	31.6	R4	32.5
19/09/2011	36.0	0.1	R8	36.1	5/11/2011	24.1	29.9	R2	**54.0**
15/11/2011	34.6	9.8	R1	44.4	23/08/2011	15.9	25.0	R1	40.9
31/05/2011	34.3	3.0	R2	37.3	1/09/2011	27.8	23.7	R2	**51.5**
19/05/2011	33.6	1.9	R2	35.5	29/04/2011	15.8	23.6	R1	39.4
1/02/2011	32.4	15.3	R8	47.7	30/08/2011	20.3	22.0	R3	42.3
16/09/2011	31.9	2.9	R4	34.8	24/06/2011	19.0	21.7	R12	40.7
3/06/2011	31.5	7.7	R8	39.2	6/05/2011	23.1	21.2	R1	44.3
8/03/2011	31.3	0.2	R8	31.5	13/04/2011	8.5	19.2	R8	27.7
6/11/2011	31.1	8.1	R3	39.2	22/08/2011	15.9	18.9	R2	34.8
14/11/2011	30.5	13.2	R3	43.7	11/04/2011	6.9	18.1	R8	25.0

[1]No predicted 24 hour average PM_{10} recorded at any sensitive receiver.

The detailed results of the contemporaneous impact and background assessment for each highlighted receiver as shown in **Table 13** are given in **Appendix II**. There are three additional exceedances of the 24 hour PM_{10} impact assessment criteria at nearby sensitive receivers. According to the NSW OEH guidance, mitigation measures or emission controls that reduce emissions are required.

The exceedances of the criteria are a result of the combination of the ambient dust concentration, poultry shed emissions and wheel generated emissions. It is recommended that particulate emissions be managed by the implementation of an air quality management plan which details best management practices.

11.2.3 Annual Average TSP

The predicted concentrations of annual average TSP for the proposed operation are presented in **Figure 17** and **Table 14**.

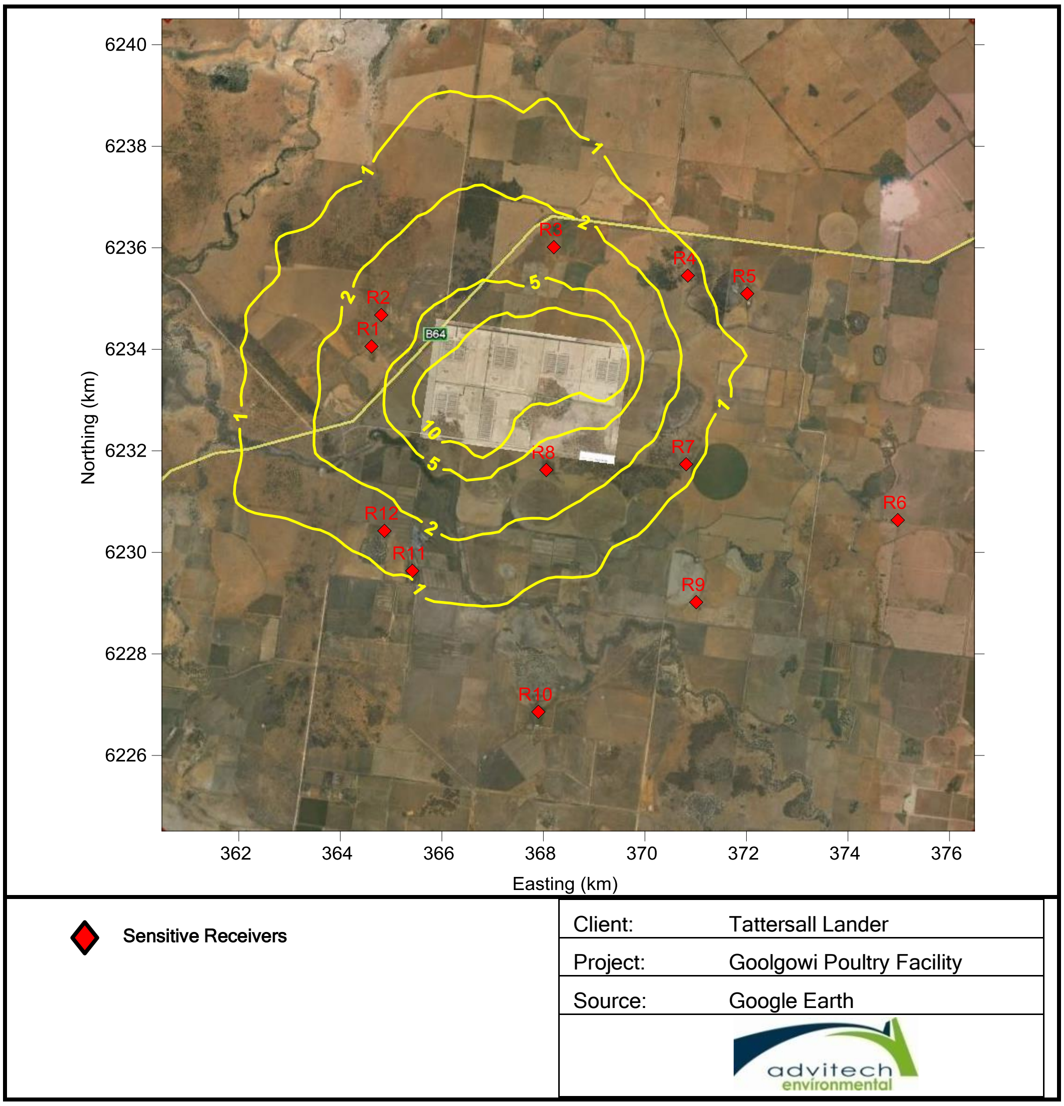


Figure 17: 100th Percentile Annual Average TSP Concentration

(Contour labels = 1, 2, 5, 10 µg/m³)

Table 14: Predicted Annual Average TSP at Sensitive Receivers

Receiver	Predicted Increment ($\mu g/m^3$)	Background Concentration[1]	Total ($\mu g/m^3$)	Impact Assessment Criteria
R1	3.1	26.4 $\mu g/m^3$	29.5	90 $\mu g/m^3$
R2	3.0		29.4	
R3	3.0		29.4	
R4	1.2		27.6	
R5	0.7		27.1	
R6	0.2		26.6	
R7	1.2		27.6	
R8	3.4		29.8	
R9	0.4		26.8	
R10	0.4		26.8	
R11	1.1		27.5	
R12	1.4		27.8	

[1]Considered to be twice the annual average PM_{10} value (refer to **Table 5**)

The modelling results for the proposed operation indicate that the predicted GLCs for annual average TSP at all receivers surrounding the facility will not exceed the impact assessment criteria of 90 $\mu g/m^3$.

11.2.4 Annual Average $PM_{2.5}$

The predicted concentrations of annual average $PM_{2.5}$ for the proposed operation are presented in **Figure 18** and **Table 15**.

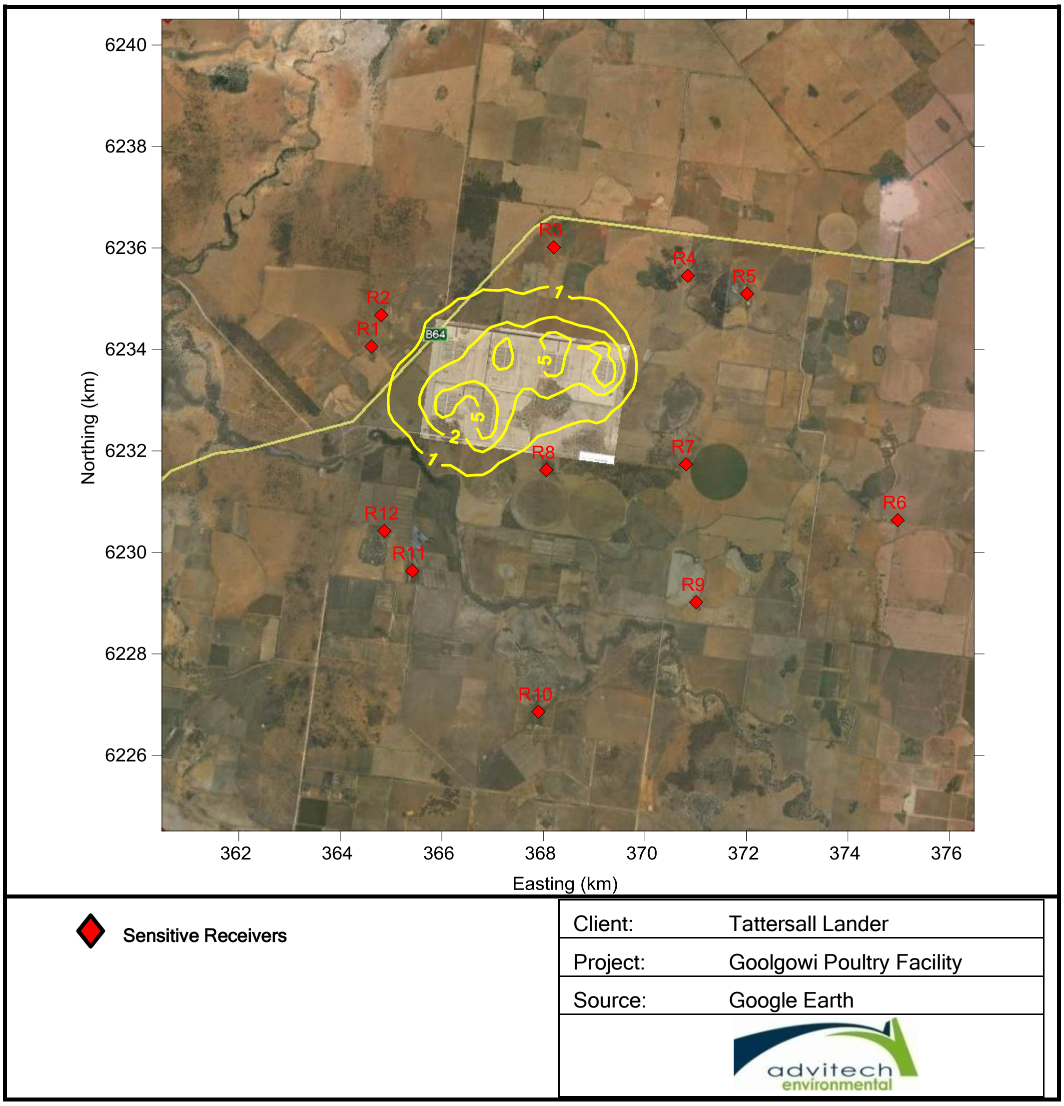


Figure 18: 100th Percentile Annual Average $PM_{2.5}$ Concentration

(Contour labels = 1, 2, 5 µg/m³)

Table 15 presents the predicted cumulative 100th percentile annual average $PM_{2.5}$ for sensitive receivers respectively. An annual average $PM_{2.5}$ background concentration of 5.94 µg/m³ has been applied (refer to **Table 6**) to determine if further assessment is required.

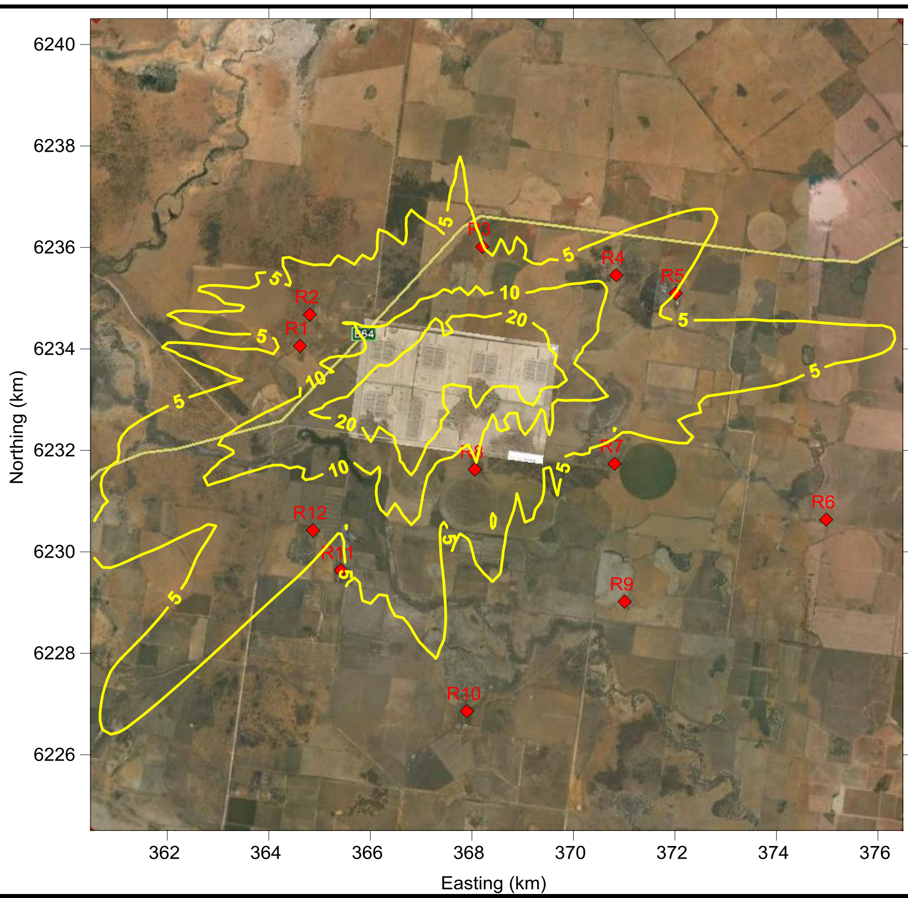
Table 15: Predicted Annual Average $PM_{2.5}$ at Sensitive Receivers

Receiver	Predicted Increment (µg/m³)	Background Concentration	Total (µg/m³)	Impact Assessment Criteria
R1	0.62	5.94 µg/m³	6.56	8 µg/m³
R2	0.60		6.54	
R3	0.55		6.49	
R4	0.25		6.19	
R5	0.15		6.09	
R6	0.06		6.00	
R7	0.23		6.17	
R8	0.65		6.59	
R9	0.10		6.04	
R10	0.12		6.06	
R11	0.27		6.21	
R12	0.33		6.27	

The annual $PM_{2.5}$ impact assessment criteria are not exceeded at any sensitive receivers. According to the NSW OEH guidance, no additional contemporaneous assessment of annual average $PM_{2.5}$ is required.

11.2.5 24 Hour Average $PM_{2.5}$

The predicted concentrations of 24 hour average $PM_{2.5}$ for the proposed operation are presented in **Figure 19** and **Table 16**.



Sensitive Receivers

Client:	Tattersall Lander
Project:	Goolgowi Poultry Facility
Source:	Google Earth

Figure 19: 100th Percentile 24 Hour Average $PM_{2.5}$ Concentration

(Contour labels = 5, 10, 20 µg/m^3)

Table 16 presents the predicted cumulative 100th percentile 24 hour average $PM_{2.5}$ for sensitive receivers respectively. A maximum 24 hour $PM_{2.5}$ background concentration of 17.6 µg/m^3 has been applied (refer to **Table 6**) to determine if further assessment is required.

Table 16: Predicted Maximum 24 Hour Average $PM_{2.5}$ at Sensitive Receivers

Receiver	Predicted Increment ($\mu g/m^3$)	Background Concentration[1]	Total ($\mu g/m^3$)	Impact Assessment Criteria
R1	6.8	17.6 $\mu g/m^3$	24.4	25 $\mu g/m^3$
R2	8.9		**26.5**	
R3	5.2		22.8	
R4	9.1		**26.7**	
R5	5.0		22.6	
R6	2.1		19.7	
R7	4.1		21.7	
R8	8.5		**26.1**	
R9	2.2		19.8	
R10	3.6		21.2	
R11	4.2		21.8	
R12	7.3		24.9	

[1] The background concentration of 25.3 $\mu g/m^3$ has been discounted as it is above the impact assessment criteria.

The exceedances at nearby sensitive receivers of the 24 hour average $PM_{2.5}$ concentration presented in **Table 16** indicates that a Level 2 contemporaneous impact and background assessment was required to determine any additional exceedances as a result of the proposed operation. A summary of the 24 hour average $PM_{2.5}$ contemporaneous impact and background assessment (Level 2 Assessment) for identified sensitive receivers are presented in **Table 17.** The detailed results of the contemporaneous impact and background assessment for each highlighted receiver are given in **Appendix III**.

.

Table 17: Summary of 24 Hour Average $PM_{2.5}$ Contemporaneous Impact and Background

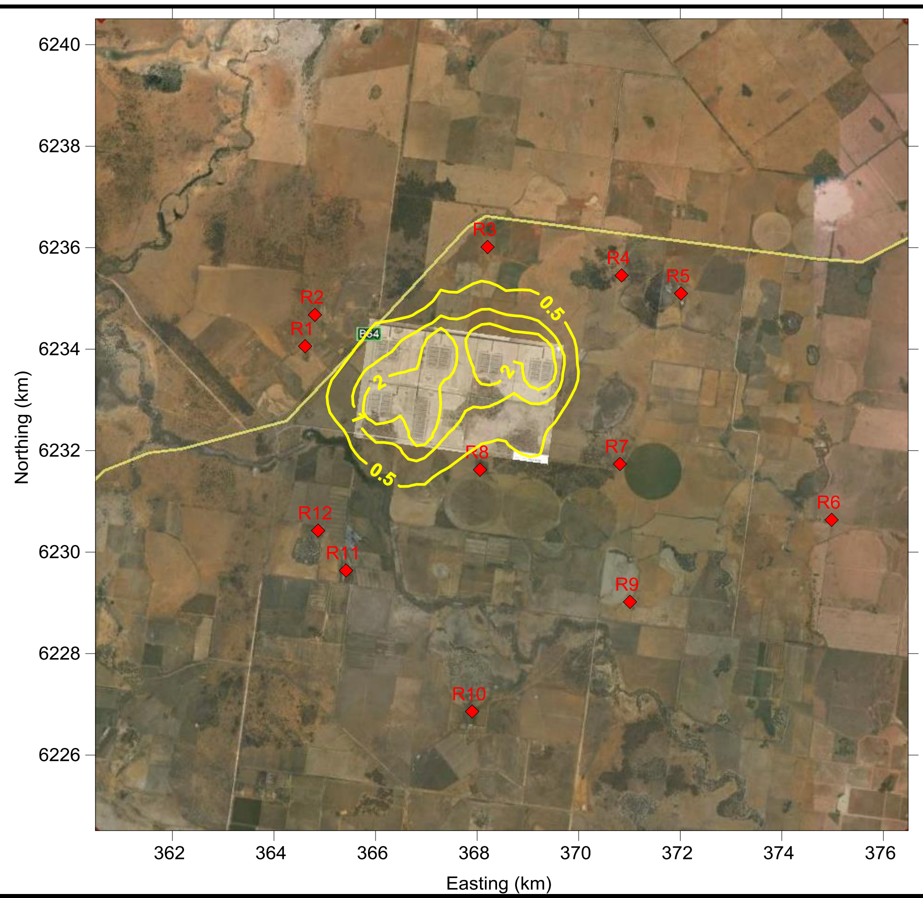
Date	$PM_{2.5}$ 24-hour average (µg/m³)				Date	$PM_{2.5}$ 24-hour average (µg/m³)			
	Highest Background	Predicted Increment	Receiver	Total		Background	Highest Predicted Increment	Receiver	Total
23/09/2011	25.3	0.1	R3	25.4	5/02/2011	0.4	9.1	R4	9.5
24/10/2011	17.6	1.5	R8	19.2	5/11/2011	10.8	8.9	R2	19.7
19/09/2011	16.2	0.0[1]	R8	16.2	26/06/2011	7.7	8.5	R8	16.3
15/11/2011	15.6	2.8	R1	18.4	24/06/2011	8.6	7.3	R12	15.8
31/05/2011	15.4	1.0	R2	16.5	23/08/2011	7.2	6.8	R1	14.0
19/05/2011	15.1	0.6	R2	15.7	1/09/2011	12.5	6.1	R2	18.6
1/02/2011	14.6	5.2	R8	19.8	22/08/2011	7.2	5.9	R2	13.1
16/09/2011	14.4	1.0	R1	15.3	10/02/2011	6.6	5.7	R8	12.4
3/06/2011	14.2	2.5	R8	16.7	12/09/2011	6.1	5.7	R8	11.8
8/03/2011	14.1	0.0[1]	R8	14.1	15/06/2011	10.4	5.6	R1	16.1
6/11/2011	14.0	2.2	R3	16.2	8/11/2011	11.2	5.3	R8	16.5
14/11/2011	13.7	3.6	R3	17.3	4/11/2011	11.9	5.3	R2	17.2

[1]No predicted 24 hour average $PM_{2.5}$ recorded at any sensitive receiver.

There are no additional exceedances of the 24 hour $PM_{2.5}$ impact assessment criteria at nearby sensitive receivers. According to the NSW OEH guidance, no additional assessment of 24 hour average $PM_{2.5}$ is required.

11.2.6 Dust Deposition

The predicted concentrations of annual average deposited dust for the proposed operation are presented in **Figure 20**.



Sensitive Receivers

Client:	Tattersall Lander
Project:	Goolgowi Poultry Facility
Source:	Google Earth

Figure 20: Annual Average Deposited Dust

(Contour labels = 0.5, 1, 2 g/m^2/month)

The modelling results for the proposed operation predict the dust deposition rate to be low. The maximum incremental deposited dust level predicted at a sensitive receiver is 0.35 g/m^2/month. The impact is not expected to exceed the maximum increase in deposited dust level criteria of 2 g/m^2/month.

12. DISCUSSION

12.1 Stage 1 Development

It is understood that the poultry development will be constructed in two stages over an extended period. An analysis has been undertaken to determine the maximum number of sheds that can be constructed without the addition of emission stacks whilst complying with the impact assessment criteria.

It has been determined that 40 conventional tunnel ventilated poultry sheds (20 sheds each at Farm 3 and Farm 4) will not exceed that air quality impact assessment criteria. These analysis results have been provided in detail in **Appendix IV**. If any additional sheds (other than the 40 sheds specified) are to be constructed on the project site, 10 m stacks must be retrofitted to each existing shed to maintain air quality compliance.

12.2 Stage 2 Development

The air quality impact assessment indicates that odour GLCs at sensitive receivers will not exceed the impact assessment criteria. Based on the assessment bases outlined in **Section 9.4**, it is a requirement that the ultimate development of the poultry farms be constructed with 10 m stacks to achieve air quality compliance.

The particulate dispersion modelling indicates that there may be additional exceedances of the 24 hour average PM_{10} impact assessment criteria at nearby sensitive receivers. The exceedances of the criteria are a result of the combination of the ambient dust concentration, poultry shed emissions and wheel generated emissions.

Particulate exceedances during periods of high background concentrations can be minimised by the implementation of best management practices such as:

- Moderate driving speeds (<40 km/h) are maintained on unsealed internal roads;
- Loads are securely covered for transport;
- Farm operations are planned and performed by taking into account weather conditions and forecasts (e.g. wind direction and strength) to minimise the impact of windblown dust on nearby sensitive land uses;
- Roads are wetted as a contingency action if unacceptable dust impacts on neighbours during peak periods of truck movement are likely during pick-up (e.g. in particularly dry and windy conditions); and
- Vegetative screens, impact walls, earthen mounds or enclosures at the end of tunnel ventilated sheds are installed as control measures against unacceptable dust impact.

It is recommended that particulate emissions be managed by the implementation of an air quality management plan which details best management practices. To assist with the management of air quality impacts from the poultry facility, it is recommended that a weather monitoring station is installed on-site.

13. CONCLUSIONS

CALPUFF modelling for odour and particulates for the proposed poultry facility was undertaken to enable assessment of air quality impacts. Odour impacts from the nearby Jeanella poultry facility were also included in the CALPUFF model to determine the predicted cumulative odour impacts.

A population dependent complex odour criterion of 5 OU (99th percentile nose response time) was applied to modelled odour emissions from the poultry facility. Based on the assessment bases outlined in this report, the result of CALPUFF modelling suggests that predicted cumulative odour GLCs above the 5 OU criterion will not be encountered at any identified sensitive receivers. The highest predicted off-site odour concentration of 4.9 OU is at sensitive receiver R8.

Modelling results suggest that particulate GLCs may cause additional exceedances of the impact assessment criteria at off-site discrete receivers. It is recommended that particulate emissions be managed by the implementation of an air quality management plan which details best management practices. To assist with the management of air quality impacts from the poultry facility, it is recommended that a weather monitoring station is installed on-site.

It should be noted that air dispersion models such as CALPUFF are predictive models. CALPUFF is dependent upon the accuracy of emission locations and inventories, local meteorology and the representativeness of background concentrations. As such there is always a degree of uncertainty in the predicted air quality impact.

14. REFERENCES

The following information was used in the preparation of this report:

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13. Ormerod, R.J., Turatti F and D'Abreton, P.C., 2003. Variations in community responses to odour: implications for policy and management. Proc. CASN03 Clean Air Conference, Newcastle, November 2003. Clean Air Society of Australia & New Zealand

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Appendix I

Example CALMET and CALPUFF Input Files

```
CALPUFF.INP     2.0            File version record
Goolgowi Multiple shed model Run 24 with 40 sheds from Farm 4+5


---------------- Run title (3 lines) ------------------------------------------

                    CALPUFF MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    ! METDAT = J:\14275\CALMET\CALMET.DAT !
ISCMET.DAT    input    * ISCDAT =             *
    or
PLMMET.DAT    input    * PLMDAT =             *
    or
PROFILE.DAT   input    * PRFDAT =             *
SURFACE.DAT   input    * SFCDAT =             *
RESTARTB.DAT  input    * RSTARTB=             *
--------------------------------------------------------------------------------
CALPUFF.LST   output   ! PUFLST = C:\14275\2_Model Environment\Preliminary Model
Testing\p_CALPUFF\run24\CALPUFFrun24b.lst !
CONC.DAT      output   ! CONDAT = C:\14275\2_Model Environment\Preliminary Model
Testing\p_CALPUFF\run24\CONCrun24b.con !
DFLX.DAT      output   * DFDAT = *
WFLX.DAT      output   * WFDAT = *

VISB.DAT      output   * VISDAT = *
TK2D.DAT      output   * T2DDAT = *
RHO2D.DAT     output   * RHODAT = *
RESTARTE.DAT  output   * RSTARTE=             *
--------------------------------------------------------------------------------
Emission Files
--------------
PTEMARB.DAT   input    ! PTDAT  = C:\14275\2_Model Environment\Preliminary Model
Testing\p_CALPUFF\run24\PTEMARB_Rev24.DAT  !
VOLEMARB.DAT  input    * VOLDAT =             *
BAEMARB.DAT   input    * ARDAT  =             *
LNEMARB.DAT   input    * LNDAT  =             *
--------------------------------------------------------------------------------
Other Files
-----------
OZONE.DAT     input    * OZDAT  =             *
VD.DAT        input    * VDDAT  =             *
CHEM.DAT      input    * CHEMDAT=             *
AUX           input    ! AUXEXT =AUX     !
(Extension added to METDAT filename(s) for files
 with auxiliary 2D and 3D data)
H2O2.DAT      input    * H2O2DAT=             *
NH3Z.DAT      input    * NH3ZDAT=             *
HILL.DAT      input    * HILDAT=             *
HILLRCT.DAT   input    * RCTDAT=             *
COASTLN.DAT   input    * CSTDAT=             *
FLUXBDY.DAT   input    * BDYDAT=             *
BCON.DAT      input    * BCNDAT=             *
DEBUG.DAT     output   * DEBUG =             *
MASSFLX.DAT   output   * FLXDAT=             *
MASSBAL.DAT   output   * BALDAT=             *
FOG.DAT       output   * FOGDAT=             *
RISE.DAT      output   * RISDAT=             *
--------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
```

```
         T = lower case      ! LCFILES = F !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 132 characters in length


Provision for multiple input files
----------------------------------

     Number of Modeling Domains (NMETDOM)
                                Default: 1       ! NMETDOM =   1   !

     Number of CALMET.DAT files for run (NMETDAT)
                                Default: 1       ! NMETDAT = 1 !

     Number of PTEMARB.DAT files for run (NPTDAT)
                                Default: 0       ! NPTDAT =   0   !

     Number of BAEMARB.DAT files for run (NARDAT)
                                Default: 0       ! NARDAT =   0   !

     Number of VOLEMARB.DAT files for run (NVOLDAT)
                                Default: 0       ! NVOLDAT =   0   !

!END!

-------------
Subgroup (0a)
-------------

  Provide a name for each CALMET domain if NMETDOM > 1
  Enter NMETDOM lines.
                                    a,b
Default Name             Domain Name
------------             ------------
 none                  * DOMAIN1=     *   *END*
 none                  * DOMAIN2=     *   *END*
 none                  * DOMAIN3=     *   *END*


  The following CALMET.DAT filenames are processed in sequence
  if NMETDAT > 1

  Enter NMETDAT lines, 1 line for each file name.

                                     a,c,d
Default Name  Type          File Name
------------  ----          ---------
 none         input    * METDAT=  *    *END*
-------------
    a
     The name for each CALMET domain and each CALMET.DAT file is treated
     as a separate input subgroup and therefore must end with an input
                group(terminator.
    b
     Use DOMAIN1= to assign the name for the outermost CALMET domain.
     Use DOMAIN2= to assign the name for the next inner CALMET domain.
     Use DOMAIN3= to assign the name for the next inner CALMET domain, etc.
      --------------------------------------------------------------------
      |   When inner domains with equal resolution (grid-cell size)      |
      |   overlap, the data from the FIRST such domain in the list will  |
      |   be used if all other criteria for choosing the controlling     |
      |   grid domain are inconclusive.                                  |
      --------------------------------------------------------------------
    c
     Use METDAT1= to assign the file names for the outermost CALMET domain.
     Use METDAT2= to assign the file names for the next inner CALMET domain.
     Use METDAT3= to assign the file names for the next inner CALMET domain,
etc.
```

```
    d
     The filenames for each domain must be provided in sequential order

-------------
Subgroup (0b)
-------------

  The following PTEMARB.DAT filenames are processed if NPTDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * PTDAT=     *   *END*


-------------
Subgroup (0c)
-------------

  The following BAEMARB.DAT filenames are processed if NARDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * ARDAT=     *   *END*


-------------
Subgroup (0d)
-------------

  The following VOLEMARB.DAT filenames are processed if NVOLDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * VOLDAT=     *   *END*


--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Option to run all periods found
    in the met. file     (METRUN)   Default: 0       ! METRUN = 0 !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

     Starting date:    Year   (IBYR)  --    No default   ! IBYR = 2011 !
                       Month  (IBMO)  --    No default   ! IBMO = 1 !
                       Day    (IBDY)  --    No default   ! IBDY = 1 !
     Starting time:    Hour   (IBHR)  --    No default   ! IBHR = 1 !
                       Minute (IBMIN) --    No default   ! IBMIN = 0 !
                       Second (IBSEC) --    No default   ! IBSEC = 0 !

     Ending date:      Year   (IEYR)  --    No default   ! IEYR = 2011 !
                       Month  (IEMO)  --    No default   ! IEMO = 12 !
                       Day    (IEDY)  --    No default   ! IEDY = 31 !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR = 23 !
                       Minute (IEMIN) --    No default   ! IEMIN = 0 !
                       Second (IESEC) --    No default   ! IESEC = 0 !

     (These are only used if METRUN = 0)

     Base time zone:          (ABTZ)  --    No default   ! ABTZ = UTC+1000 !
      (character*8)
```

```
The modeling domain may span multiple time zones.  ABTZ defines the
base time zone used for the entire simulation.  This must match the
base time zone of the meteorological data.
Examples:
    Los Angeles, USA          = UTC-0800
    New York, USA             = UTC-0500
    Santiago, Chile           = UTC-0400
    Greenwich Mean Time (GMT) = UTC+0000
    Rome, Italy               = UTC+0100
    Cape Town, S.Africa       = UTC+0200
    Sydney, Australia         = UTC+1000

Length of modeling time-step (seconds)
Equal to update period in the primary
meteorological data files, or an
integer fraction of it (1/2, 1/3 ...)
Must be no larger than 1 hour
(NSECDT)                        Default:3600     ! NSECDT =  3600  !
                                Units: seconds

Number of chemical species (NSPEC)
                                Default: 5       ! NSPEC = 1 !

Number of chemical species
to be emitted  (NSE)            Default: 3       ! NSE = 0 !

Flag to stop run after
SETUP phase (ITEST)             Default: 2       ! ITEST =  2   !
(Used to allow checking
of the model inputs, files, etc.)
      ITEST = 1 - STOPS program after SETUP phase
      ITEST = 2 - Continues with execution of program
                  after SETUP

Restart Configuration:

   Control flag (MRESTART)      Default: 0       ! MRESTART =  0   !

      0 = Do not read or write a restart file
      1 = Read a restart file at the beginning of
          the run
      2 = Write a restart file during run
      3 = Read a restart file at beginning of run
          and write a restart file during run

   Number of periods in Restart
   output cycle (NRESPD)        Default: 0       ! NRESPD =  0   !

      0 = File written only at last period
     >0 = File updated every NRESPD periods

Meteorological Data Format (METFM)
                                Default: 1       ! METFM =  1   !

      METFM = 1 - CALMET binary file (CALMET.MET)
      METFM = 2 - ISC ASCII file (ISCMET.MET)
      METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
      METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                  surface parameters file (SURFACE.DAT)
      METFM = 5 - AERMET tower file (PROFILE.DAT) and
                  surface parameters file (SURFACE.DAT)

Meteorological Profile Data Format (MPRFFM)
       (used only for METFM = 1, 2, 3)
                                Default: 1       ! MPRFFM =  1   !

      MPRFFM = 1 - CTDM plus tower file (PROFILE.DAT)
      MPRFFM = 2 - AERMET tower file (PROFILE.DAT)
```

```
     PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
     Averaging Time (minutes) (AVET)
                                Default: 60.0    ! AVET = 60. !
     PG Averaging Time (minutes) (PGTIME)
                                Default: 60.0    ! PGTIME = 60. !


     Output units for binary concentration and flux files
     written in Dataset v2.2 or later formats
     (IOUTU)                    Default: 1       ! IOUTU =  2   !
         1 = mass      -  g/m3 (conc) or g/m2/s (dep)
         2 = odour     -  odour_units (conc)
         3 = radiation -  Bq/m3 (conc) or Bq/m2/s (dep)


     Output Dataset format for binary concentration
     and flux files (e.g., CONC.DAT)
     (IOVERS)                   Default: 2       ! IOVERS =  2   !
         1 = Dataset Version 2.1
         2 = Dataset Version 2.2


!END!


-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Technical options
--------------


     Vertical distribution used in the
     near field (MGAUSS)              Default: 1     ! MGAUSS =  1   !
        0 = uniform
        1 = Gaussian

     Terrain adjustment method
     (MCTADJ)                         Default: 3     ! MCTADJ =  3   !
        0 = no adjustment
        1 = ISC-type of terrain adjustment
        2 = simple, CALPUFF-type of terrain
            adjustment
        3 = partial plume path adjustment

     Subgrid-scale complex terrain
     flag (MCTSG)                     Default: 0     ! MCTSG =  0   !
        0 = not modeled
        1 = modeled

     Near-field puffs modeled as
     elongated slugs? (MSLUG)         Default: 0     ! MSLUG =  0   !
        0 = no
        1 = yes (slug model used)

     Transitional plume rise modeled?
     (MTRANS)                         Default: 1     ! MTRANS =  1   !
        0 = no  (i.e., final rise only)
        1 = yes (i.e., transitional rise computed)

     Stack tip downwash? (MTIP)       Default: 1     ! MTIP =  1  !
        0 = no  (i.e., no stack tip downwash)
        1 = yes (i.e., use stack tip downwash)

     Method used to compute plume rise for
     point sources not subject to building
     downwash? (MRISE)                Default: 1     ! MRISE =  1  !
        1 = Briggs plume rise
```

```
   2 = Numerical plume rise

Method used to simulate building
downwash? (MBDW)                      Default: 1     ! MBDW = 1 !
   1 = ISC method
   2 = PRIME method

Vertical wind shear modeled above
stack top (modified Briggs plume rise)?
(MSHEAR)                              Default: 0     ! MSHEAR =  0  !
   0 = no  (i.e., vertical wind shear not modeled)
   1 = yes (i.e., vertical wind shear modeled)

Puff splitting allowed? (MSPLIT)      Default: 0     ! MSPLIT =  0  !
   0 = no (i.e., puffs not split)
   1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM)       Default: 1     ! MCHEM = 0 !
   0 = chemical transformation not
       modeled
   1 = transformation rates computed
       internally (MESOPUFF II scheme)
   2 = user-specified transformation
       rates used
   3 = transformation rates computed
       internally (RIVAD/ARM3 scheme)
   4 = secondary organic aerosol formation
       computed (MESOPUFF II scheme for OH)
   5 = user-specified half-life with or
       without transfer to child species
   6 = transformation rates computed
       internally (Updated RIVAD scheme with
       ISORROPIA equilibrium)
   7 = transformation rates computed
       internally (Updated RIVAD scheme with
       ISORROPIA equilibrium and CalTech SOA)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 6, or 7)        Default: 0     ! MAQCHEM = 0 !
   0 = aqueous phase transformation
       not modeled
   1 = transformation rates and wet
       scavenging coefficients adjusted
       for in-cloud aqueous phase reactions
       (adapted from RADM cloud model
        implementation in CMAQ/SCICHEM)

Liquid Water Content flag (MLWC)
(Used only if MAQCHEM = 1)            Default: 1     ! MLWC =  1   !
   0 = water content estimated from cloud cover
       and presence of precipitation
   1 = gridded cloud water data read from CALMET
       water content output files (filenames are
       the CALMET.DAT names PLUS the extension
       AUXEXT provided in Input Group 0)

Wet removal modeled ? (MWET)          Default: 1     ! MWET = 0 !
   0 = no
   1 = yes

Dry deposition modeled ? (MDRY)       Default: 1     ! MDRY = 0 !
   0 = no
   1 = yes
   (dry deposition method specified
    for each species in Input Group 3)


Gravitational settling (plume tilt)
```

```
modeled ? (MTILT)                      Default: 0     ! MTILT =  0   !
   0 = no
   1 = yes
   (puff center falls at the gravitational
    settling velocity for 1 particle species)

Restrictions:
    - MDRY  = 1
    - NSPEC = 1  (must be particle species as well)
    - sg    = 0  GEOMETRIC STANDARD DEVIATION in Group 8 is
                 set to zero for a single particle diameter

Method used to compute dispersion
coefficients (MDISP)                   Default: 3     ! MDISP =  3   !

   1 = dispersion coefficients computed from measured values
       of turbulence, sigma v, sigma w
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.
   5 = CTDM sigmas used for stable and neutral conditions.
       For unstable conditions, sigmas are computed as in
       MDISP = 3, described above.  MDISP = 5 assumes that
       measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
(Used only if MDISP = 1 or 5)          Default: 3     ! MTURBVW =  3  !
   1 = use sigma-v or sigma-theta measurements
       from PROFILE.DAT to compute sigma-y
       (valid for METFM = 1, 2, 3, 4, 5)
   2 = use sigma-w measurements
       from PROFILE.DAT to compute sigma-z
       (valid for METFM = 1, 2, 3, 4, 5)
   3 = use both sigma-(v/theta) and sigma-w
       from PROFILE.DAT to compute sigma-y and sigma-z
       (valid for METFM = 1, 2, 3, 4, 5)
   4 = use sigma-theta measurements
       from PLMMET.DAT to compute sigma-y
       (valid only if METFM = 3)

Back-up method used to compute dispersion
when measured turbulence data are
missing (MDISP2)                       Default: 3     ! MDISP2 =  3  !
(used only if MDISP = 1 or 5)
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.

[DIAGNOSTIC FEATURE]
Method used for Lagrangian timescale for Sigma-y
(used only if MDISP=1,2 or MDISP2=1,2)
(MTAULY)                               Default: 0     ! MTAULY =  0  !
   0 = Draxler default 617.284 (s)
   1 = Computed as Lag. Length / (.75 q) -- after SCIPUFF
  10 < Direct user input (s)             -- e.g., 306.9


[DIAGNOSTIC FEATURE]
```

```
Method used for Advective-Decay timescale for Turbulence
(used only if MDISP=2 or MDISP2=2)
(MTAUADV)                              Default: 0     ! MTAUADV =  0  !
   0 = No turbulence advection
   1 = Computed (OPTION NOT IMPLEMENTED)
  10 < Direct user input (s)   -- e.g., 800


Method used to compute turbulence sigma-v &
sigma-w using micrometeorological variables
(Used only if MDISP = 2 or MDISP2 = 2)
(MCTURB)                               Default: 1     ! MCTURB =  1  !
   1 = Standard CALPUFF subroutines
   2 = AERMOD subroutines

PG sigma-y,z adj. for roughness?      Default: 0     ! MROUGH =  0  !
(MROUGH)
   0 = no
   1 = yes

Partial plume penetration of          Default: 1     ! MPARTL =  1  !
elevated inversion modeled for
point sources?
(MPARTL)
   0 = no
   1 = yes

Partial plume penetration of          Default: 1     ! MPARTLBA =  1  !
elevated inversion modeled for
buoyant area sources?
(MPARTLBA)
   0 = no
   1 = yes

Strength of temperature inversion     Default: 0     ! MTINV =  0  !
provided in PROFILE.DAT extended records?
(MTINV)
   0 = no (computed from measured/default gradients)
   1 = yes

PDF used for dispersion under convective conditions?
                                       Default: 0     ! MPDF =  0  !
(MPDF)
   0 = no
   1 = yes

Sub-Grid TIBL module used for shore line?
                                       Default: 0     ! MSGTIBL = 0  !
(MSGTIBL)
   0 = no
   1 = yes

Boundary conditions (concentration) modeled?
                                       Default: 0     ! MBCON = 0  !
(MBCON)
   0 = no
   1 = yes, using formatted BCON.DAT file
   2 = yes, using unformatted CONC.DAT file

Note:  MBCON > 0 requires that the last species modeled
       be 'BCON'.  Mass is placed in species BCON when
       generating boundary condition puffs so that clean
       air entering the modeling domain can be simulated
       in the same way as polluted air.  Specify zero
       emission of species BCON for all regular sources.

Individual source contributions saved?
                                       Default: 0     ! MSOURCE = 0  !
```

```
     (MSOURCE)
        0 = no
        1 = yes


     Analyses of fogging and icing impacts due to emissions from
     arrays of mechanically-forced cooling towers can be performed
     using CALPUFF in conjunction with a cooling tower emissions
     processor (CTEMISS) and its associated postprocessors.  Hourly
     emissions of water vapor and temperature from each cooling tower
     cell are computed for the current cell configuration and ambient
     conditions by CTEMISS. CALPUFF models the dispersion of these
     emissions and provides cloud information in a specialized format
     for further analysis. Output to FOG.DAT is provided in either
     'plume mode' or 'receptor mode' format.

     Configure for FOG Model output?
                                       Default: 0     ! MFOG =  0   !
     (MFOG)
        0 = no
        1 = yes  - report results in PLUME Mode format
        2 = yes  - report results in RECEPTOR Mode format


     Test options specified to see if
     they conform to regulatory
     values? (MREG)                    Default: 1     ! MREG =  0   !

        0 = NO checks are made
        1 = Technical options must conform to USEPA
            Long Range Transport (LRT) guidance
                       METFM    1 or 2
                       AVET     60. (min)
                       PGTIME   60. (min)
                       MGAUSS   1
                       MCTADJ   3
                       MTRANS   1
                       MTIP     1
                       MRISE    1
                       MCHEM    1 or 3 (if modeling SOx, NOx)
                       MWET     1
                       MDRY     1
                       MDISP    2 or 3
                       MPDF     0 if MDISP=3
                                1 if MDISP=2
                       MROUGH   0
                       MPARTL   1
                       MPARTLBA 0
                       SYTDEP   550. (m)
                       MHFTSZ   0
                       SVMIN    0.5 (m/s)


!END!


--------------------------------------------------------------------------------

INPUT GROUP: 3a, 3b -- Species list
-------------------

------------
Subgroup (3a)
------------

  The following species are modeled:
! CSPEC = ODOR !         !END!
```

```
                                                               Dry                 OUTPUT
GROUP
    SPECIES          MODELED          EMITTED       DEPOSITED
NUMBER
     NAME         (0=NO, 1=YES)    (0=NO, 1=YES)    (0=NO,
(0=NONE,
   (Limit: 12                                        1=COMPUTED-GAS        1=1st
CGRUP,
    Characters                                       2=COMPUTED-PARTICLE   2=2nd
CGRUP,
    in length)                                       3=USER-SPECIFIED)     3=
etc.)
!        ODOR=       1,               0,           0,                  0   !

!END!

  Note:  The last species in (3a) must be 'BCON' when using the
         boundary condition option (MBCON > 0).  Species BCON should
         typically be modeled as inert (no chem transformation or
         removal).


-------------
Subgroup (3b)
-------------
  The following names are used for Species-Groups in which results
  for certain species are combined (added) prior to output.  The
  CGRUP name will be used as the species name in output files.
  Use this feature to model specific particle-size distributions
  by treating each size-range as a separate species.
  Order must be consistent with 3(a) above.



-------------------------------------------------------------------------------


INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = UTM !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                    Default=0.0     ! FEAST  = 0.000  !
     (FNORTH)                   Default=0.0     ! FNORTH = 0.000  !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default      ! IUTMZN = 55 !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                   Default: N      ! UTMHEM = S !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection
```

```
     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                    No Default      ! RLAT0 =  0N  !
     (RLON0)                    No Default      ! RLON0 =  0E  !

         TTM :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         LCC :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         PS  :  RLON0 identifies central (grid N/S) meridian of projection
                RLAT0 selected for convenience
         EM  :  RLON0 identifies central meridian of projection
                RLAT0 is REPLACED by 0.0N (Equator)
         LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
                RLAT0 identifies latitude of tangent-point of mapping plane

     Matching parallel(s) of latitude (decimal degrees) for projection
     (Used only if PMAP= LCC or PS)
     (XLAT1)                    No Default      ! XLAT1 =  0N  !
     (XLAT2)                    No Default      ! XLAT2 =  0N  !

         LCC :  Projection cone slices through Earth's surface at XLAT1 and
XLAT2
         PS  :  Projection plane slices through Earth at XLAT1
                (XLAT2 is not used)

     ----------
     Note:  Latitudes and longitudes should be positive, and include a
            letter N,S,E, or W indicating north or south latitude, and
            east or west longitude.  For example,
            35.9  N Latitude  =  35.9N
            118.7 E Longitude = 118.7E


     Datum-region
     ------------

     The Datum-Region for the coordinates is identified by a character
     string.  Many mapping products currently available use the model of the
     Earth known as the World Geodetic System 1984 (WGS-84).  Other local
     models may be in use, and their selection in CALMET will make its output
     consistent with local mapping products.  The list of Datum-Regions with
     official transformation parameters is provided by the National Imagery and
     Mapping Agency (NIMA).

     NIMA Datum - Regions(Examples)
------------------------------------------------------------------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

     Datum-region for output coordinates
     (DATUM)                    Default: WGS-84    ! DATUM = WGS-84 !


METEOROLOGICAL Grid:

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX = 100 !
            No. Y grid cells (NY)      No default     ! NY = 100 !
        No. vertical layers (NZ)       No default     ! NZ = 10 !

           Grid spacing (DGRIDKM)      No default     ! DGRIDKM = .16 !
```

```
                           Units: km

           Cell face heights
               (ZFACE(nz+1))      No defaults
                                  Units: m
   ! ZFACE = 0,20,40,80,160,320,700,1300,1700,2300,3000 !

           Reference Coordinates
          of SOUTHWEST corner of
                grid cell(1, 1):

           X coordinate (XORIGKM)     No default     ! XORIGKM = 360.487 !
           Y coordinate (YORIGKM)     No default     ! YORIGKM = 6224.511 !
                                     Units: km


COMPUTATIONAL Grid:

     The computational grid is identical to or a subset of the MET. grid.
     The lower left (LL) corner of the computational grid is at grid point
     (IBCOMP, JBCOMP) of the MET. grid.  The upper right (UR) corner of the
     computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.
     The grid spacing of the computational grid is the same as the MET. grid.

        X index of LL corner (IBCOMP)      No default     ! IBCOMP = 1 !
                  (1 <= IBCOMP <= NX)

        Y index of LL corner (JBCOMP)      No default     ! JBCOMP = 1 !
                  (1 <= JBCOMP <= NY)


        X index of UR corner (IECOMP)      No default     ! IECOMP = 100 !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP = 100 !
                  (1 <= JECOMP <= NY)



SAMPLING Grid (GRIDDED RECEPTORS):

     The lower left (LL) corner of the sampling grid is at grid point
     (IBSAMP, JBSAMP) of the MET. grid.  The upper right (UR) corner of the
     sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
     The sampling grid must be identical to or a subset of the computational
     grid.  It may be a nested grid inside the computational grid.
     The grid spacing of the sampling grid is DGRIDKM/MESHDN.

        Logical flag indicating if gridded
        receptors are used (LSAMP)         Default: T     ! LSAMP = F !
        (T=yes, F=no)

        X index of LL corner (IBSAMP)      No default     ! IBSAMP = 1 !
         (IBCOMP <= IBSAMP <= IECOMP)

        Y index of LL corner (JBSAMP)      No default     ! JBSAMP = 1 !
         (JBCOMP <= JBSAMP <= JECOMP)


        X index of UR corner (IESAMP)      No default     ! IESAMP = 100 !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP = 100 !
         (JBCOMP <= JESAMP <= JECOMP)


       Nesting factor of the sampling
        grid (MESHDN)                      Default: 1     ! MESHDN = 1 !
```

```
        (MESHDN is an integer >= 1)

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 5 -- Output Options
--------------
                                             *                       *
     FILE                       DEFAULT VALUE             VALUE THIS RUN
     ----                       -------------             --------------

   Concentrations (ICON)              1                   ! ICON = 1 !
   Dry Fluxes (IDRY)                  1                   ! IDRY = 0 !
   Wet Fluxes (IWET)                  1                   ! IWET = 0 !
   2D Temperature (IT2D)              0                   ! IT2D = 0 !
   2D Density (IRHO)                  0                   ! IRHO = 0 !
   Relative Humidity (IVIS)           1                   ! IVIS = 0 !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                           Default: T         ! LCOMPRS = T !

   *
    0 = Do not create file, 1 = create file


    QA PLOT FILE OUTPUT OPTION:

       Create a standard series of output files (e.g.
       locations of sources, receptors, grids ...)
       suitable for plotting?
       (IQAPLOT)                       Default: 1         ! IQAPLOT = 1 !
         0 = no
         1 = yes

    DIAGNOSTIC PUFF-TRACKING OUTPUT OPTION:

       Puff locations and properties reported to
       PFTRAK.DAT file for postprocessing?
       (IPFTRAK)                       Default: 0         ! IPFTRAK =  0   !
         0 = no
         1 = yes, update puff output at end of each timestep
         2 = yes, update puff output at end of each sampling step

    DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

       Mass flux across specified boundaries
       for selected species reported?
       (IMFLX)                         Default: 0         ! IMFLX =  0  !
         0 = no
         1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
                  are specified in Input Group 0)

       Mass balance for each species
       reported?
       (IMBAL)                         Default: 0         ! IMBAL =  0  !
         0 = no
         1 = yes (MASSBAL.DAT filename is
              specified in Input Group 0)


    NUMERICAL RISE OUTPUT OPTION:

       Create a file with plume properties for each rise
```

```
       increment, for each model timestep?
       This applies to sources modeled with numerical rise
       and is limited to ONE source in the run.
       (INRISE)                        Default: 0         ! INRISE =  0  !
         0 = no
         1 = yes (RISE.DAT filename is
                  specified in Input Group 0)


    LINE PRINTER OUTPUT OPTIONS:

       Print concentrations (ICPRT)    Default: 0         ! ICPRT =  0   !
       Print dry fluxes (IDPRT)        Default: 0         ! IDPRT =  0   !
       Print wet fluxes (IWPRT)        Default: 0         ! IWPRT =  0   !
       (0 = Do not print, 1 = Print)

       Concentration print interval
       (ICFRQ) in timesteps            Default: 1         ! ICFRQ =  1   !
       Dry flux print interval
       (IDFRQ) in timesteps            Default: 1         ! IDFRQ =  1   !
       Wet flux print interval
       (IWFRQ) in timesteps            Default: 1         ! IWFRQ =  1   !

       Units for Line Printer Output
       (IPRTU)                         Default: 1         ! IPRTU =  5   !
                        for             for
                  Concentration    Deposition
           1 =       g/m**3         g/m**2/s
           2 =      mg/m**3        mg/m**2/s
           3 =      ug/m**3        ug/m**2/s
           4 =      ng/m**3        ng/m**2/s
           5 =     Odour Units

       Messages tracking progress of run
       written to the screen ?
       (IMESG)                         Default: 2         ! IMESG =  2   !
         0 = no
         1 = yes (advection step, puff ID)
         2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)


     SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

                 ---- CONCENTRATIONS ----   ------ DRY FLUXES ------   ------
WET FLUXES ------   -- MASS FLUX --
   SPECIES
   /GROUP        PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   PRINTED?
SAVED ON DISK?   SAVED ON DISK?
   -------       ------------------------   ------------------------
------------------------   ---------------
!        ODOR=   0,           1,           0,           0,           0,
  0,          0   !
  Note:  Species BCON (for MBCON > 0) does not need to be saved on disk.


     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                                 Default: F     ! LDEBUG = F !

       First puff to track
       (IPFDEB)                                 Default: 1     ! IPFDEB =  1  !

       Number of puffs to track
       (NPFDEB)                                 Default: 1     ! NPFDEB =  1  !

       Met. period to start output
       (NN1)                                    Default: 1     ! NN1 =  1   !
```

```
       Met. period to end output
       (NN2)                               Default: 10    ! NN2 =  10  !

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs
-------------------------

---------------
Subgroup (6a)
---------------
       Number of terrain features (NHILL)       Default: 0     ! NHILL =  0   !

       Number of special complex terrain
       receptors  (NCTREC)                      Default: 0     ! NCTREC =  0   !

       Terrain and CTSG Receptor data for
       CTSG hills input in CTDM format ?
       (MHILL)                                  No Default     ! MHILL =  0   !
       1 = Hill and Receptor data created
           by CTDM processors & read from
           HILL.DAT and HILLRCT.DAT files
       2 = Hill data created by OPTHILL &
           input below in Subgroup (6b);
           Receptor data in Subgroup (6c)

       Factor to convert horizontal dimensions  Default: 1.0   ! XHILL2M = 1.0 !
       to meters (MHILL=1)

       Factor to convert vertical dimensions    Default: 1.0   ! ZHILL2M = 1.0 !
       to meters (MHILL=1)

       X-origin of CTDM system relative to      No Default     ! XCTDMKM = 0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

       Y-origin of CTDM system relative to      No Default     ! YCTDMKM = 0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

---------------
Subgroup (6b)
---------------

                      1 **
     HILL information


HILL           XC        YC       THETAH  ZGRID  RELIEF    EXPO 1    EXPO 2
SCALE 1    SCALE 2    AMAX1     AMAX2
 NO.          (km)      (km)      (deg.)   (m)     (m)       (m)       (m)
(m)         (m)        (m)       (m)
----          ----      ----      ------  -----  ------    ------    ------
-------    -------    -----     -----

---------------
Subgroup (6c)
---------------

    COMPLEX TERRAIN RECEPTOR INFORMATION

                      XRCT         YRCT        ZRCT          XHH
                      (km)         (km)         (m)
```

```
                                 ------        -----      ------        ----


-------------------
1
     Description of Complex Terrain Variables:
          XC, YC  = Coordinates of center of hill
          THETAH  = Orientation of major axis of hill (clockwise from
                    North)
          ZGRID   = Height of the  0  of the grid above mean sea
                    level
          RELIEF  = Height of the crest of the hill above the grid elevation
          EXPO 1  = Hill-shape exponent for the major axis
          EXPO 2  = Hill-shape exponent for the major axis
          SCALE 1 = Horizontal length scale along the major axis
          SCALE 2 = Horizontal length scale along the minor axis
          AMAX    = Maximum allowed axis length for the major axis
          BMAX    = Maximum allowed axis length for the major axis

          XRCT, YRCT = Coordinates of the complex terrain receptors
          ZRCT    = Height of the ground (MSL) at the complex terrain
                    Receptor
          XHH     = Hill number associated with each complex terrain receptor
                    (NOTE: MUST BE ENTERED AS A REAL NUMBER)

   **
     NOTE: DATA for each hill and CTSG receptor are treated as a separate
           input subgroup and therefore must end with an input group terminator.

-------------------------------------------------------------------------------


INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases
--------------

      SPECIES     DIFFUSIVITY      ALPHA STAR      REACTIVITY    MESOPHYLL
RESISTANCE     HENRY'S LAW COEFFICIENT
       NAME         (cm**2/s)                                                (s/cm)
             (dimensionless)
     -------     -----------     ----------      ----------
--------------------     -----------------------



!END!


-------------------------------------------------------------------------------


INPUT GROUP: 8 -- Size parameters for dry deposition of particles
--------------

     For SINGLE SPECIES, the mean and standard deviation are used to
     compute a deposition velocity for NINT (see group 9) size-ranges,
     and these are then averaged to obtain a mean deposition velocity.

     For GROUPED SPECIES, the size distribution should be explicitly
     specified (by the 'species' in the group), and the standard deviation
     for each should be entered as 0.  The model will then use the
     deposition velocity for the stated mean diameter.

      SPECIES      GEOMETRIC MASS MEAN        GEOMETRIC STANDARD
       NAME             DIAMETER                   DEVIATION
                        (microns)                  (microns)
      -------      -------------------        ------------------
```

```
!END!

-------------------------------------------------------------------------------

INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------

     Reference cuticle resistance (s/cm)
     (RCUTR)                           Default: 30    !  RCUTR = 30.0 !
     Reference ground resistance  (s/cm)
     (RGR)                             Default: 10    !    RGR = 10.0 !
     Reference pollutant reactivity
     (REACTR)                          Default: 8     ! REACTR = 8.0 !

     Number of particle-size intervals used to
     evaluate effective particle deposition velocity
     (NINT)                            Default: 9     !   NINT =  9  !

     Vegetation state in unirrigated areas
     (IVEG)                            Default: 1     !   IVEG =  1   !
        IVEG=1 for active and unstressed vegetation
        IVEG=2 for active and stressed vegetation
        IVEG=3 for inactive vegetation

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 10 -- Wet Deposition Parameters
---------------

                      Scavenging Coefficient -- Units: (sec)**(-1)

       Pollutant      Liquid Precip.       Frozen Precip.
       ---------      --------------       --------------

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 11a, 11b -- Chemistry Parameters
---------------------

---------------
Subgroup (11a)
---------------

     Several parameters are needed for one or more of the chemical
transformation
     mechanisms.  Those used for each mechanism are:
                                         M                 B
                                         A  B  R  R  R     C  B           N
                                   B     V  C  N  N  N  M  K  C  O        D
                                   C  M  G  K  I  I  I  H  H  K  F  V  E
                                M  K  N  N  N  T  T  T  2  2  P  R  C  C
                                O  O  H  H  H  E  E  E  O  O  M  A  N  A
     Mechanism (MCHEM)          Z  3  3  3  3  1  2  3  2  2  F  C  X  Y
     --------------------    ------------------------------------------
     0 None                     .  .  .  .  .  .  .  .  .  .  .  .  .  .
     1 MESOPUFF II              X  X  .  .  X  X  X  X  .  .  .  .  .  .
```

```
     2 User Rates              .  .  .  .  .  .  .  .  .  .  .  .  .  .
     3 RIVAD                   X  X  .  .  X  .  .  .  .  .  .  .  .  .
     4 SOA                     X  X  .  .  .  .  .  .  .  .  X  X  X  .
     5 Radioactive Decay       .  .  .  .  .  .  .  .  .  .  .  .  .  X
     6 RIVAD/ISORRPIA          X  X  X  X  X  X  .  .  X  X  .  .  .  .
     7 RIVAD/ISORRPIA/SOA      X  X  X  X  X  X  .  .  X  X  X  X  .  .


     Ozone data input option (MOZ)     Default: 1            ! MOZ =  0   !
     (Used only if MCHEM = 1, 3, 4, 6, or 7)
        0 = use a monthly background ozone value
        1 = read hourly ozone concentrations from
            the OZONE.DAT data file

     Monthly ozone concentrations in ppb (BCKO3)
     (Used only if MCHEM = 1,3,4,6, or 7 and either
        MOZ = 0, or
        MOZ = 1 and all hourly O3 data missing)
                                       Default: 12*80.
     !  BCKO3 = 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00,
80.00, 80.00, 80.00 !

     Ammonia data option (MNH3)        Default: 0            ! MNH3 =  0   !
     (Used only if MCHEM = 6 or 7)
        0 = use monthly background ammonia values (BCKNH3) - no vertical
variation
        1 = read monthly background ammonia values for each layer from
            the NH3Z.DAT data file

     Ammonia vertical averaging option (MAVGNH3)
     (Used only if MCHEM = 6 or 7, and MNH3 = 1)
        0 = use NH3 at puff center height (no averaging is done)
        1 = average NH3 values over vertical extent of puff
                                       Default: 1            ! MAVGNH3 =  1   !

     Monthly ammonia concentrations in ppb (BCKNH3)
     (Used only if MCHEM = 1 or 3, or
               if MCHEM = 6 or 7, and MNH3 = 0)
                                       Default: 12*10.
     !  BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00,
10.00, 10.00, 10.00 !

     Nighttime SO2 loss rate in %/hour (RNITE1)
     (Used only if MCHEM = 1, 6 or 7)
     This rate is used only at night for MCHEM=1
     and is added to the computed rate both day
     and night for MCHEM=6,7 (heterogeneous reactions)
                                       Default: 0.2          ! RNITE1 = .2 !

     Nighttime NOx loss rate in %/hour (RNITE2)
     (Used only if MCHEM = 1)
                                       Default: 2.0          ! RNITE2 = 2.0 !

     Nighttime HNO3 formation rate in %/hour (RNITE3)
     (Used only if MCHEM = 1)
                                       Default: 2.0          ! RNITE3 = 2.0 !

     H2O2 data input option (MH2O2)    Default: 1            ! MH2O2 =  1   !
     (Used only if MCHEM = 6 or 7, and MAQCHEM = 1)
        0 = use a monthly background H2O2 value
        1 = read hourly H2O2 concentrations from
            the H2O2.DAT data file

     Monthly H2O2 concentrations in ppb (BCKH2O2)
     (Used only if MQACHEM = 1 and either
        MH2O2 = 0 or
        MH2O2 = 1 and all hourly H2O2 data missing)
                                       Default: 12*1.
```

```
     !  BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00,
1.00, 1.00 !


 --- Data for SECONDARY ORGANIC AEROSOL (SOA) Options
     (used only if MCHEM = 4 or 7)

     The MCHEM = 4 SOA module uses monthly values of:
          Fine particulate concentration in ug/m^3 (BCKPMF)
          Organic fraction of fine particulate     (OFRAC)
          VOC / NOX ratio (after reaction)         (VCNX)

     The MCHEM = 7 SOA module uses monthly values of:
          Fine particulate concentration in ug/m^3 (BCKPMF)
          Organic fraction of fine particulate     (OFRAC)

     These characterize the air mass when computing
     the formation of SOA from VOC emissions.
     Typical values for several distinct air mass types are:

        Month    1    2    3    4    5    6    7    8    9   10   11   12
                Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

     Clean Continental
        BCKPMF   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.
        OFRAC  .15  .15  .20  .20  .20  .20  .20  .20  .20  .20  .20  .15
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

     Clean Marine (surface)
        BCKPMF  .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5
        OFRAC  .25  .25  .30  .30  .30  .30  .30  .30  .30  .30  .30  .25
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

     Urban - low biogenic (controls present)
        BCKPMF  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.
        OFRAC  .20  .20  .25  .25  .25  .25  .25  .25  .20  .20  .20  .20
        VCNX     4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.

     Urban - high biogenic (controls present)
        BCKPMF  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.
        OFRAC  .25  .25  .30  .30  .30  .55  .55  .55  .35  .35  .35  .25
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

     Regional Plume
        BCKPMF  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.
        OFRAC  .20  .20  .25  .35  .25  .40  .40  .40  .30  .30  .30  .20
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

     Urban - no controls present
        BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100.
        OFRAC  .30  .30  .35  .35  .35  .55  .55  .55  .35  .35  .35  .30
        VCNX     2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.

     Default: Clean Continental
     !  BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00,
1.00, 1.00 !
     !  OFRAC  = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20,
0.20, 0.15 !
     !  VCNX   = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00,
50.00, 50.00, 50.00 !

 --- End Data for SECONDARY ORGANIC AEROSOL (SOA) Option


     Number of half-life decay specification blocks provided in Subgroup 11b
     (Used only if MCHEM = 5)
     (NDECAY)                                 Default: 0      ! NDECAY =  0
!
```

```
!END!


--------------
Subgroup (11b)
--------------

     Each species modeled may be assigned a decay half-life (sec), and the
associated
     mass lost may be assigned to one or more other modeled species using a mass
yield
     factor. This information is used only for MCHEM=5.

     Provide NDECAY blocks assigning the half-life for a parent species and mass
yield
     factors for each child species (if any) produced by the decay.
     Set HALF_LIFE=0.0 for NO decay (infinite half-life).


                              a            b
        SPECIES       Half-Life   Mass Yield
         NAME           (sec)       Factor
        -------       ---------   ----------

     *   SPEC1   =    3600.,         -1.0   *    (Parent)
     *   SPEC2   =     -1.0,          0.0   *    (Child)
   *END*

--------
    a
     Specify a half life that is greater than or equal to zero for 1 parent
species
     in each block, and set the yield factor for this species to -1
    b
     Specify a yield factor that is greater than or equal to zero for 1 or more
child
     species in each block, and set the half-life for each of these species to
-1

     NOTE: Assignments in each block are treated as a separate input
           subgroup and therefore must end with an input group terminator.
           If NDECAY=0, no assignments and input group terminators should
appear.

-------------------------------------------------------------------------------


INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters
---------------

     Horizontal size of puff (m) beyond which
     time-dependent dispersion equations (Heffter)
     are used to determine sigma-y and
     sigma-z (SYTDEP)                           Default: 550.   ! SYTDEP =
5.5E02 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                   Default: 0      ! MHFTSZ =  0
!

     Stability class used to determine plume
     growth rates for puffs above the boundary
     layer (JSUP)                               Default: 5      ! JSUP =  5   !

     Vertical dispersion constant for stable
     conditions (k1 in Eqn. 2.7-3)  (CONK1)     Default: 0.01   ! CONK1 = .01 !
```

```
     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
     (CONK2)                                    Default: 0.1     ! CONK2 = .1 !

     Factor for determining Transition-point from
     Schulman-Scire to Huber-Snyder Building Downwash
     scheme (SS used for Hs < Hb + TBD * HL)
     (TBD)                                      Default: 0.5     ! TBD = .5 !
        TBD < 0   ==> always use Huber-Snyder
        TBD = 1.5 ==> always use Schulman-Scire
        TBD = 0.5 ==> ISC Transition-point

     Range of land use categories for which
     urban dispersion is assumed
     (IURB1, IURB2)                             Default: 10      ! IURB1 =  10  !
                                                         19      ! IURB2 =  19  !

     Site characterization parameters for single-point Met data files ---------
     (needed for METFM = 2,3,4,5)

        Land use category for modeling domain
        (ILANDUIN)                              Default: 20      ! ILANDUIN =  20
 !

        Roughness length (m) for modeling domain
        (Z0IN)                                  Default: 0.25    ! Z0IN = .25 !

        Leaf area index for modeling domain
        (XLAIIN)                                Default: 3.0     ! XLAIIN = 3.0 !

        Elevation above sea level (m)
        (ELEVIN)                                Default: 0.0     ! ELEVIN = .0 !

        Latitude (degrees) for met location
        (XLATIN)                                Default: -999.  ! XLATIN =
-999.0 !

        Longitude (degrees) for met location
        (XLONIN)                                Default: -999.  ! XLONIN =
-999.0 !

     Specialized information for interpreting single-point Met data files -----

        Anemometer height (m) (Used only if METFM = 2,3)
        (ANEMHT)                                Default: 10.     ! ANEMHT = 10.0
!

        Form of lateral turbulance data in PROFILE.DAT file
        (Used only if METFM = 4,5 or MTURBVW = 1 or 3)
        (ISIGMAV)                               Default: 1       ! ISIGMAV =  1
!
            0 = read sigma-theta
            1 = read sigma-v

        Choice of mixing heights (Used only if METFM = 4)
        (IMIXCTDM)                              Default: 0       ! IMIXCTDM =  0
!
            0 = read PREDICTED mixing heights
            1 = read OBSERVED mixing heights

     Maximum length of a slug (met. grid units)
     (XMXLEN)                                   Default: 1.0     ! XMXLEN = 1.0 !

     Maximum travel distance of a puff/slug (in
     grid units) during one sampling step
     (XSAMLEN)                                  Default: 1.0     ! XSAMLEN = 1.0
!
```

```
     Maximum Number of slugs/puffs release from
     one source during one time step
     (MXNEW)                                    Default: 99     ! MXNEW =  99
!

     Maximum Number of sampling steps for
     one puff/slug during one time step
     (MXSAM)                                    Default: 99     ! MXSAM =  99
!

     Number of iterations used when computing
     the transport wind for a sampling step
     that includes gradual rise (for CALMET
     and PROFILE winds)
     (NCOUNT)                                   Default: 2      ! NCOUNT =  2
!

     Minimum sigma y for a new puff/slug (m)
     (SYMIN)                                    Default: 1.0    ! SYMIN = 1.0  !

     Minimum sigma z for a new puff/slug (m)
     (SZMIN)                                    Default: 1.0    ! SZMIN = 1.0  !

     Maximum sigma z (m) allowed to avoid
     numerical problem in calculating virtual
     time or distance.  Cap should be large
     enough to have no influence on normal events.
     Enter a negative cap to disable.
     (SZCAP_M)                                  Default: 5.0e06 ! SZCAP_M =
5.0E06 !

     Default minimum turbulence velocities sigma-v and sigma-w
     for each stability class over land and over water (m/s)
     (SVMIN(12) and SWMIN(12))

                     ----------  LAND  ----------       ---------  WATER
----------
        Stab Class :  A    B    C    D    E    F         A    B    C    D    E
 F
                     ---  ---  ---  ---  ---  ---       ---  ---  ---  ---  ---
---
     Default SVMIN : .50, .50, .50, .50, .50, .50,      .37, .37, .37, .37, .37,
.37
     Default SWMIN : .20, .12, .08, .06, .03, .016,     .20, .12, .08, .06, .03,
.016

           ! SVMIN = 0.200, 0.200, 0.200, 0.200, 0.200, 0.200, 0.200, 0.200,
0.200, 0.200, 0.200, 0.200!
           ! SWMIN = 0.200, 0.120, 0.080, 0.060, 0.030, 0.016, 0.200, 0.120,
0.080, 0.060, 0.030, 0.016!

     Divergence criterion for dw/dz across puff
     used to initiate adjustment for horizontal
     convergence (1/s)
     Partial adjustment starts at CDIV(1), and
     full adjustment is reached at CDIV(2)
     (CDIV(2))                                  Default: 0.0,0.0  ! CDIV = .0,
.0 !

     Search radius (number of cells) for nearest
     land and water cells used in the subgrid
     TIBL module
     (NLUTIBL)                                  Default: 4      ! NLUTIBL =  4
!

     Minimum wind speed (m/s) allowed for
     non-calm conditions. Also used as minimum
```

```
     speed returned when using power-law
     extrapolation toward surface
     (WSCALM)                                   Default: 0.5    ! WSCALM = .5 !

     Maximum mixing height (m)
     (XMAXZI)                                   Default: 3000.  ! XMAXZI =
3000.0 !

     Minimum mixing height (m)
     (XMINZI)                                   Default: 50.    ! XMINZI = 50.0
!

     Default wind speed classes --
     5 upper bounds (m/s) are entered;
     the 6th class has no upper limit
     (WSCAT(5))                      Default   :
                                     ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8
(10.8+)

                              Wind Speed Class :  1     2     3     4     5
                                                 ---   ---   ---   ---   ---
                                       ! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80 !

     Default wind speed profile power-law
     exponents for stabilities 1-6
     (PLX0(6))                       Default   : ISC RURAL values
                                     ISC RURAL : .07, .07, .10, .15, .35, .55
                                     ISC URBAN : .15, .15, .20, .25, .30, .30

                               Stability Class :  A     B     C     D     E
F
                                                 ---   ---   ---   ---   ---
---
                                        ! PLX0 = 0.07, 0.07, 0.10, 0.15, 0.35,
0.55 !

     Default potential temperature gradient
     for stable classes E, F (degK/m)
     (PTG0(2))                       Default: 0.020, 0.035
                                        ! PTG0 = 0.020,   0.035 !

     Default plume path coefficients for
     each stability class (used when option
     for partial plume height terrain adjustment
     is selected -- MCTADJ=3)
     (PPC(6))                  Stability Class :  A     B     C     D     E
F
                                  Default  PPC : .50,  .50,  .50,  .50,  .35,
.35
                                                 ---   ---   ---   ---   ---
---
                                        !  PPC = 0.50, 0.50, 0.50, 0.50, 0.35,
0.35 !

     Slug-to-puff transition criterion factor
     equal to sigma-y/length of slug
     (SL2PF)                                 Default: 10.       ! SL2PF = 10.0 !

     Puff-splitting control variables ------------------------

       VERTICAL SPLIT
       --------------

       Number of puffs that result every time a puff
       is split - nsplit=2 means that 1 puff splits
       into 2
       (NSPLIT)                              Default:   3       ! NSPLIT =  3  !
```

```
       Time(s) of a day when split puffs are eligible to
       be split once again; this is typically set once
       per day, around sunset before nocturnal shear develops.
       24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
       0=do not re-split    1=eligible for re-split
       (IRESPLIT(24))                    Default:  Hour 17 = 1
       !  IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

       Split is allowed only if last hour's mixing
       height (m) exceeds a minimum value
       (ZISPLIT)                         Default: 100.       ! ZISPLIT = 100.0
!

       Split is allowed only if ratio of last hour's
       mixing ht to the maximum mixing ht experienced
       by the puff is less than a maximum value (this
       postpones a split until a nocturnal layer develops)
       (ROLDMAX)                         Default: 0.25       ! ROLDMAX = 0.25
!


       HORIZONTAL SPLIT
       ----------------

       Number of puffs that result every time a puff
       is split - nsplith=5 means that 1 puff splits
       into 5
       (NSPLITH)                         Default:   5        ! NSPLITH =  5  !

       Minimum sigma-y (Grid Cells Units) of puff
       before it may be split
       (SYSPLITH)                        Default:  1.0       ! SYSPLITH = 1.0
!

       Minimum puff elongation rate (SYSPLITH/hr) due to
       wind shear, before it may be split
       (SHSPLITH)                        Default:  2.        ! SHSPLITH = 2.0
!

       Minimum concentration (g/m^3) of each
       species in puff before it may be split
       Enter array of NSPEC values; if a single value is
       entered, it will be used for ALL species
       (CNSPLITH)                        Default:  1.0E-07   ! CNSPLITH =
1.0E-07 !

     Integration control variables ------------------------

       Fractional convergence criterion for numerical SLUG
       sampling integration
       (EPSSLUG)                         Default:   1.0e-04  ! EPSSLUG =
1.0E-04 !

       Fractional convergence criterion for numerical AREA
       source integration
       (EPSAREA)                         Default:   1.0e-06  ! EPSAREA =
1.0E-06 !

       Trajectory step-length (m) used for numerical rise
       integration
       (DSRISE)                          Default:   1.0      ! DSRISE = 1.0 !

       Boundary Condition (BC) Puff control variables ------------------------

       Minimum height (m) to which BC puffs are mixed as they are emitted
       (MBCON=2 ONLY).  Actual height is reset to the current mixing height
       at the release point if greater than this minimum.
       (HTMINBC)                         Default:   500.     ! HTMINBC = 500.0
```

```
!

       Search radius (km) about a receptor for sampling nearest BC puff.
       BC puffs are typically emitted with a spacing of one grid cell
       length, so the search radius should be greater than DGRIDKM.
       (RSAMPBC)                          Default:   10.      ! RSAMPBC = 10.0
!

       Near-Surface depletion adjustment to concentration profile used when
       sampling BC puffs?
       (MDEPBC)                           Default:   1        ! MDEPBC =  1  !
          0 = Concentration is NOT adjusted for depletion
          1 = Adjust Concentration for depletion

!END!

-------------------------------------------------------------------------------


INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------

---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  ! NPT1 = 0 !

     Units used for point source
     emissions below                (IPTU)  Default: 1  !  IPTU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !  NSPT1 =  0  !

     Number of point sources with
     variable emission parameters
     provided in external file      (NPT2)  No default  !  NPT2 =  120  !

     (If NPT2 > 0, these point
     source emissions are read from
     the file: PTEMARB.DAT)

!END!

---------------
Subgroup (13b)
---------------
                                              a
          POINT SOURCE: CONSTANT DATA
          -----------------------------
                                                                                b
        c
  Source       X           Y        Stack     Base      Stack     Exit   Exit    Bldg.
Emission
   No.     Coordinate Coordinate Height Elevation Diameter  Vel.  Temp.   Dwash
```

```
 Rates
             (km)      (km)       (m)      (m)       (m)  (m/s) (deg. K)

  ------   ---------- ---------- ------  ------   -------- ----- -------- -----
--------

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

     SRCNAM  is a 12-character name for a source
             (No default)
     X       is an array holding the source data listed by the column headings
             (No default)
     SIGYZI  is an array holding the initial sigma-y and sigma-z (m)
             (Default: 0.,0.)
     FMFAC   is a vertical momentum flux factor (0. or 1.0) used to represent
             the effect of rain-caps or other physical configurations that
             reduce momentum rise associated with the actual exit velocity.
             (Default: 1.0  -- full momentum used)
     ZPLTFM  is the platform height (m) for sources influenced by an isolated
             structure that has a significant open area between the surface
             and the bulk of the structure, such as an offshore oil platform.
             The Base Elevation is that of the surface (ground or ocean),
             and the Stack Height is the release height above the Base (not
             above the platform).  Building heights entered in Subgroup 13c
             must be those of the buildings on the platform, measured from
             the platform deck.  ZPLTFM is used only with MBDW=1 (ISC
             downwash method) for sources with building downwash.
             (Default: 0.0)

    b
     0. = No building downwash modeled
     1. = Downwash modeled for buildings resting on the surface
     2. = Downwash modeled for buildings raised above the surface (ZPLTFM > 0.)
     NOTE: must be entered as a REAL number (i.e., with decimal point)

    c
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IPTU
     (e.g. 1 for g/s).

---------------
Subgroup (13c)
---------------

           BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH
           -------------------------------------------------------
Source                                                                a
 No.       Effective building height, width, length and X/Y offset (in meters)
           every 10 degrees.  LENGTH, XBADJ, and YBADJ are only needed for
           MBDW=2 (PRIME downwash option)
------     --------------------------------------------------------------------


--------

    a
     Building height, width, length, and X/Y offset from the source are treated
     as a separate input subgroup for each source and therefore must end with
     an input group terminator.  The X/Y offset is the position, relative to the
     stack, of the center of the upwind face of the projected building, with the
     x-axis pointing along the flow direction.
```

```
---------------
Subgroup (13d)
---------------
                                                      a
          POINT SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 13b.  Factors entered multiply the rates in 13b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
```

```
                               and the speed classes have upper
                               bounds (m/s) defined in Group 12
          5 =       Temperature   (12 scaling factors, where temperature
                               classes have upper bounds (C) of:
                               0, 5, 10, 15, 20, 25, 30, 35, 40,
                               45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------


INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters
--------------------------------

---------------
Subgroup (14a)
---------------

     Number of polygon area sources with
     parameters specified below (NAR1)       No default  ! NAR1 = 0 !

     Units used for area source
     emissions below            (IARU)       Default: 1  !  IARU =   1  !
           1 =        g/m**2/s
           2 =       kg/m**2/hr
           3 =       lb/m**2/hr
           4 =     tons/m**2/yr
           5 =     Odour Unit * m/s  (vol. flux/m**2 of odour compound)
           6 =     Odour Unit * m/min
           7 =     metric tons/m**2/yr
           8 =     Bq/m**2/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !  NSAR1 =  0  !

     Number of buoyant polygon area sources
     with variable location and emission
     parameters (NAR2)                      No default  !  NAR2 =  0   !
     (If NAR2 > 0, ALL parameter data for
     these sources are read from the file: BAEMARB.DAT)

!END!

---------------
Subgroup (14b)
---------------
                                          a
          AREA SOURCE: CONSTANT DATA
          ----------------------------
                                                                  b
Source           Effect.    Base      Initial    Emission
 No.             Height   Elevation   Sigma z     Rates
                   (m)       (m)        (m)
-------          ------    ------     --------   ---------

--------
    a
     Data for each source are treated as a separate input subgroup
```

```
     and therefore must end with an input group terminator.
    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IARU
     (e.g. 1 for g/m**2/s).

---------------
Subgroup (14c)
---------------

           COORDINATES (km) FOR EACH VERTEX(4) OF EACH POLYGON
           --------------------------------------------------------
Source                                                               a
 No.       Ordered list of X followed by list of Y, grouped by source
------     ------------------------------------------------------------

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.


---------------
Subgroup (14d)
---------------
                                                 a
          AREA SOURCE: VARIABLE EMISSIONS DATA
          --------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 14b.  Factors entered multiply the rates in 14b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


--------------------------------------------------------------------------------

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters
---------------------------

---------------
Subgroup (15a)
---------------
```

```
     Number of buoyant line sources
     with variable location and emission
     parameters (NLN2)                               No default  !  NLN2 =  0   !

     (If NLN2 > 0, ALL parameter data for
      these sources are read from the file: LNEMARB.DAT)

     Number of buoyant line sources (NLINES)         No default   ! NLINES = 0 !

     Units used for line source
     emissions below               (ILNU)            Default: 1  !  ILNU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)       (NSLN1) Default: 0  !  NSLN1 =  0  !

     Maximum number of segments used to model
     each line (MXNSEG)                              Default: 7   ! MXNSEG = 7 !

     The following variables are required only if NLINES > 0.  They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which                 Default: 6   ! NLRISE = 6 !
        transitional rise is computed

        Average building length (XL)                 No default   ! XL = .0 !
                                                     (in meters)

        Average building height (HBL)                No default   ! HBL = .0 !
                                                     (in meters)

        Average building width (WBL)                 No default   ! WBL = .0 !
                                                     (in meters)

        Average line source width (WML)              No default   ! WML = .0 !
                                                     (in meters)

        Average separation between buildings (DXL)  No default   ! DXL = .0 !
                                                     (in meters)

        Average buoyancy parameter (FPRIMEL)         No default   ! FPRIMEL = .0
!
                                                     (in m**4/s**3)

!END!

---------------
Subgroup (15b)
---------------

          BUOYANT LINE SOURCE: CONSTANT DATA
          ----------------------------------

         a
Source     Beg. X      Beg. Y      End. X     End. Y     Release    Base
Emission
 No.     Coordinate  Coordinate  Coordinate Coordinate  Height    Elevation
Rates
```

```
          (km)         (km)         (km)        (km)        (m)        (m)

------   ----------  ----------  ---------  ----------  -------   ---------
---------

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by ILNTU
     (e.g. 1 for g/s).

---------------
Subgroup (15c)
---------------
                                                                 a
          BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA
          ----------------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 15b.  Factors entered multiply the rates in 15b.
     Skip sources here that have constant emissions.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


--------------------------------------------------------------------------------


INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters
---------------------------

---------------
Subgroup (16a)
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  ! NVL1 = 0 !

     Units used for volume source
     emissions below in 16b       (IVLU)     Default: 1  !  IVLU =   1  !
           1 =        g/s
```

```
        2 =       kg/hr
        3 =       lb/hr
        4 =     tons/yr
        5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
        6 =     Odour Unit * m**3/min
        7 =     metric tons/yr
        8 =     Bq/s  (Bq = becquerel = disintegrations/s)
        9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (16c)      (NSVL1)    Default: 0  !  NSVL1 =  0  !

     Number of volume sources with
     variable location and emission
     parameters                   (NVL2)     No default  !  NVL2 =   0   !

     (If NVL2 > 0, ALL parameter data for
      these sources are read from the VOLEMARB.DAT file(s) )

!END!

---------------
Subgroup (16b)
---------------
                                                a
           VOLUME SOURCE: CONSTANT DATA
           ------------------------------
                                                                                  b
         X           Y          Effect.    Base     Initial    Initial    Emission
     Coordinate  Coordinate    Height   Elevation  Sigma y    Sigma z     Rates
        (km)        (km)         (m)       (m)        (m)        (m)
     ----------  ----------    ------    ------    --------   --------   --------

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IVLU
     (e.g. 1 for g/s).

---------------
Subgroup (16c)
---------------
                                                         a
          VOLUME SOURCE: VARIABLE EMISSIONS DATA
          ----------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 16b.  Factors entered multiply the rates in 16b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                   Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
```

```
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)


--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information
-----------------------

---------------
Subgroup (17a)
---------------

     Number of non-gridded receptors (NREC)  No default  ! NREC = 12 !

!END!

---------------
Subgroup (17b)
---------------
                                               a
           NON-GRIDDED (DISCRETE) RECEPTOR DATA
           ------------------------------------

                    X            Y          Ground       Height   b
Receptor       Coordinate   Coordinate    Elevation   Above Ground
  No.             (km)         (km)          (m)          (m)
--------       ----------   ----------    ---------   ------------
     1 ! X =     364.614,    6234.057,         104,         1.5!   !END!
     2 ! X =     364.806,    6234.676,         109,         1.5!   !END!
     3 ! X =     368.206,    6236.013,         106,         1.5!   !END!
     4 ! X =     370.845,    6235.452,         107,         1.5!   !END!
     5 ! X =     372.015,    6235.097,         105,         1.5!   !END!
     6 ! X =     374.981,    6230.636,         104,         1.5!   !END!
     7 ! X =     370.812,    6231.736,         106,         1.5!   !END!
     8 ! X =     368.057,    6231.623,         105,         1.5!   !END!
     9 ! X =     371.011,    6229.019,         106,         1.5!   !END!
    10 ! X =     367.901,    6226.858,         109,         1.5!   !END!
    11 ! X =     365.419,    6229.637,         105,         1.5!   !END!
    12 ! X =     364.869,    6230.424,         106,         1.5!   !END!
-------------
    a
     Data for each receptor are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     Receptor height above ground is optional.  If no value is entered,
     the receptor is placed on the ground.
```

Appendix II

24 Hour Average PM_{10} - Level 2 Contemporaneous Impact and Background Assessments

Table A1: Receiver 1 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	23/08/2011	15.9	25.0	40.9
24/10/2011	39.2	0.0	39.2	29/04/2011	15.8	23.6	39.4
19/09/2011	36	0.0	36.0	6/05/2011	23.1	21.2	44.3
15/11/2011	34.6	9.8	44.4	15/06/2011	23.2	17.1	40.3
31/05/2011	34.3	1.6	35.9	21/08/2011	16.3	15.7	32.0
19/05/2011	33.6	1.1	34.7	20/08/2011	15.5	15.1	30.6
1/02/2011	32.4	0.0	32.4	27/04/2011	11.4	14.7	26.1
16/09/2011	31.9	2.8	34.7	12/11/2011	22.8	14.4	37.2
3/06/2011	31.5	0.0	31.5	25/06/2011	14.8	13.8	28.6
8/03/2011	31.3	0.0	31.3	27/08/2011	16.1	12.9	29.0
6/11/2011	31.1	0.0	31.1	28/06/2011	15.9	12.8	28.7
14/11/2011	30.5	7.0	37.5	8/09/2011	13.4	12.4	25.8

Table A2: Receiver 2 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	5/11/2011	24.1	29.9	**54.0**
24/10/2011	39.2	0.0	39.2	1/09/2011	27.8	23.7	**51.5**
19/09/2011	36	0.0	36.0	22/08/2011	15.9	18.9	34.8
15/11/2011	34.6	4.0	38.6	4/11/2011	26.4	17.6	44.0
31/05/2011	34.3	3.0	37.3	8/09/2011	13.4	17.2	30.6
19/05/2011	33.6	1.9	35.5	6/05/2011	23.1	16.5	39.6
1/02/2011	32.4	0.0	32.4	29/01/2011	19.3	12.8	32.1
16/09/2011	31.9	1.8	33.7	23/08/2011	15.9	12.1	28.0
3/06/2011	31.5	0.0	31.5	3/02/2011	7.5	12.1	19.6
8/03/2011	31.3	0.0	31.3	2/09/2011	18.9	12.1	31.0
6/11/2011	31.1	0.0	31.1	12/11/2011	22.8	11.8	34.6
14/11/2011	30.5	5.8	36.3	13/10/2011	16.7	10.9	27.6

Table A3: Receiver 3 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.2	**56.5**	30/08/2011	20.3	22.0	42.3
24/10/2011	39.2	1.2	40.4	3/02/2011	7.5	17.7	25.2
19/09/2011	36	0.0	36.0	31/08/2011	22	17.1	39.1
15/11/2011	34.6	5.4	40.0	14/11/2011	30.5	13.2	43.7
31/05/2011	34.3	1.9	36.2	27/01/2011	15.6	12.4	28.0
19/05/2011	33.6	0.0	33.6	31/10/2011	12	11.8	23.8
1/02/2011	32.4	0.0	32.4	19/02/2011	14.5	11.7	26.2
16/09/2011	31.9	1.4	33.3	8/09/2011	13.4	11.7	25.1
3/06/2011	31.5	0.0	31.5	30/10/2011	7.8	11.1	18.9
8/03/2011	31.3	0.0	31.3	21/11/2011	14.8	10.6	25.4
6/11/2011	31.1	8.1	39.2	21/02/2011	14.2	10.5	24.7
14/11/2011	30.5	13.2	43.7	20/02/2011	8	10.2	18.2

Table A4: Receiver 4 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	5/02/2011	0.9	31.6	32.5
24/10/2011	39.2	1.1	40.3	10/09/2011	14.2	9.3	23.5
19/09/2011	36	0.0	36.0	17/06/2011	13.8	8.7	22.5
15/11/2011	34.6	0.0	34.6	29/10/2011	10.7	8.2	18.9
31/05/2011	34.3	0.0	34.3	8/06/2011	9.4	8.2	17.6
19/05/2011	33.6	0.0	33.6	22/04/2011	11.9	8.1	20.0
1/02/2011	32.4	0.0	32.4	8/07/2011	11.7	8.0	19.7
16/09/2011	31.9	2.9	34.8	9/06/2011	13	7.4	20.4
3/06/2011	31.5	0.0	31.5	6/11/2011	31.1	7.3	38.4
8/03/2011	31.3	0.0	31.3	11/07/2011	10.7	6.8	17.5
6/11/2011	31.1	7.3	38.4	11/09/2011	7.6	6.8	14.4
14/11/2011	30.5	3.5	34.0	3/02/2011	7.5	6.7	14.2

Table A5: Receiver 5 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	5/02/2011	0.9	16.7	17.6
24/10/2011	39.2	0.1	39.3	17/06/2011	13.8	11.5	25.3
19/09/2011	36	0.0	36.0	18/06/2011	11.5	9.9	21.4
15/11/2011	34.6	0.1	34.7	10/04/2011	8.8	7.5	16.3
31/05/2011	34.3	0.0	34.3	23/06/2011	8.5	6.9	15.4
19/05/2011	33.6	0.0	33.6	11/04/2011	6.9	6.6	13.5
1/02/2011	32.4	0.0	32.4	28/02/2011	14	5.2	19.2
16/09/2011	31.9	1.2	33.1	8/07/2011	11.7	4.6	16.3
3/06/2011	31.5	0.0	31.5	17/02/2011	9.5	4.5	14.0
8/03/2011	31.3	0.0	31.3	11/10/2011	14.7	4.3	19.0
6/11/2011	31.1	2.4	33.5	6/08/2011	10.3	3.3	13.6
14/11/2011	30.5	2.8	33.3	8/06/2011	9.4	3.2	12.6

Table A6: Receiver 6 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	12/04/2011	6.9	4.1	11.0
24/10/2011	39.2	0.7	39.9	8/07/2011	11.7	3.7	15.4
19/09/2011	36	0.0	36.0	12/07/2011	13.9	3.1	17.0
15/11/2011	34.6	0.0	34.6	11/04/2011	6.9	2.7	9.6
31/05/2011	34.3	0.0	34.3	16/06/2011	21.7	2.7	24.4
19/05/2011	33.6	0.0	33.6	4/02/2011	0	2.5	2.5
1/02/2011	32.4	0.0	32.4	11/08/2011	8.9	2.3	11.2
16/09/2011	31.9	0.2	32.1	29/08/2011	18.4	2.2	20.6
3/06/2011	31.5	0.0	31.5	4/06/2011	13.2	2.0	15.2
8/03/2011	31.3	0.0	31.3	8/08/2011	8.8	1.3	10.1
6/11/2011	31.1	0.1	31.2	10/04/2011	8.8	1.3	10.1
14/11/2011	30.5	0.1	30.6	18/06/2011	11.5	1.2	12.7

Table A7: Receiver 7 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	12/04/2011	6.9	14.6	21.5
24/10/2011	39.2	1.9	41.1	4/02/2011	0	13.5	13.5
19/09/2011	36	0.0	36.0	13/04/2011	8.5	12.2	20.7
15/11/2011	34.6	0.2	34.8	11/04/2011	6.9	10.4	17.3
31/05/2011	34.3	0.0	34.3	8/07/2011	11.7	9.3	21.0
19/05/2011	33.6	0.0	33.6	16/02/2011	4.8	9.0	13.8
1/02/2011	32.4	3.5	35.9	29/08/2011	18.4	8.5	26.9
16/09/2011	31.9	0.5	32.4	16/06/2011	21.7	7.4	29.1
3/06/2011	31.5	1.1	32.6	4/06/2011	13.2	7.2	20.4
8/03/2011	31.3	0.0	31.3	25/08/2011	24	7.0	31.0
6/11/2011	31.1	2.0	33.1	24/06/2011	19	6.7	25.7
14/11/2011	30.5	0.2	30.7	12/07/2011	13.9	6.5	20.4

Table A8: Receiver 8 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	26/06/2011	17.2	34.3	**51.5**
24/10/2011	39.2	3.8	43.0	13/04/2011	8.5	19.2	27.7
19/09/2011	36	0.1	36.1	11/04/2011	6.9	18.1	25.0
15/11/2011	34.6	0.4	35.0	10/02/2011	14.7	17.4	32.1
31/05/2011	34.3	0.0	34.3	12/04/2011	6.9	16.1	23.0
19/05/2011	33.6	0.3	33.9	8/11/2011	24.8	15.7	40.5
1/02/2011	32.4	15.3	47.7	1/02/2011	32.4	15.3	47.7
16/09/2011	31.9	2.9	34.8	2/02/2011	9.2	14.8	24.0
3/06/2011	31.5	7.7	39.2	25/08/2011	24	14.7	38.7
8/03/2011	31.3	0.2	31.5	5/06/2011	4.6	14.0	18.6
6/11/2011	31.1	6.1	37.2	19/04/2011	25.1	13.2	38.3
14/11/2011	30.5	2.7	33.2	7/08/2011	7.5	11.9	19.4

Table A9: Receiver 9 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	16/02/2011	4.8	6.7	11.5
24/10/2011	39.2	0.5	39.7	19/06/2011	9.9	5.8	15.7
19/09/2011	36	0.0	36.0	12/04/2011	6.9	5.0	11.9
15/11/2011	34.6	0.0	34.6	13/04/2011	8.5	4.3	12.8
31/05/2011	34.3	0.0	34.3	24/06/2011	19	4.2	23.2
19/05/2011	33.6	0.0	33.6	16/06/2011	21.7	4.0	25.7
1/02/2011	32.4	2.0	34.4	10/08/2011	9	3.9	12.9
16/09/2011	31.9	0.1	32.0	4/02/2011	0	3.6	3.6
3/06/2011	31.5	1.4	32.9	2/02/2011	9.2	3.4	12.6
8/03/2011	31.3	0.0	31.3	8/07/2011	11.7	2.8	14.5
6/11/2011	31.1	1.1	32.2	29/08/2011	18.4	2.5	20.9
14/11/2011	30.5	0.3	30.8	9/08/2011	11.6	2.3	13.9

Table A10: Receiver 10 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	26/06/2011	17.2	12.4	29.6
24/10/2011	39.2	0.4	39.6	2/02/2011	9.2	5.7	14.9
19/09/2011	36	0.0	36.0	1/02/2011	32.4	5.4	37.8
15/11/2011	34.6	0.0	34.6	27/06/2011	21.3	5.0	26.3
31/05/2011	34.3	0.0	34.3	14/04/2011	11.1	4.6	15.7
19/05/2011	33.6	0.1	33.7	10/02/2011	14.7	4.3	19.0
1/02/2011	32.4	5.4	37.8	20/04/2011	19.7	3.4	23.1
16/09/2011	31.9	0.5	32.4	28/10/2011	16.2	3.3	19.5
3/06/2011	31.5	1.2	32.7	21/04/2011	13.6	3.1	16.7
8/03/2011	31.3	0.0	31.3	25/02/2011	21.8	2.4	24.2
6/11/2011	31.1	1.3	32.4	9/04/2011	20.9	2.4	23.3
14/11/2011	30.5	0.5	31.0	5/09/2011	17.8	2.3	20.1

Table A11: Receiver 11 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	10/02/2011	14.7	12.0	26.7
24/10/2011	39.2	0.1	39.3	31/01/2011	27.5	11.0	38.5
19/09/2011	36	0.1	36.1	5/06/2011	4.6	9.5	14.1
15/11/2011	34.6	0.2	34.8	8/11/2011	24.8	8.7	33.5
31/05/2011	34.3	0.0	34.3	19/04/2011	25.1	8.6	33.7
19/05/2011	33.6	0.1	33.7	24/06/2011	19	8.1	27.1
1/02/2011	32.4	3.2	35.6	23/08/2011	15.9	7.7	23.6
16/09/2011	31.9	0.8	32.7	2/07/2011	17.3	7.6	24.9
3/06/2011	31.5	2.0	33.5	18/02/2011	12.7	6.3	19.0
8/03/2011	31.3	0.1	31.4	25/01/2011	14.7	5.8	20.5
6/11/2011	31.1	0.4	31.5	8/04/2011	16	5.6	21.6
14/11/2011	30.5	0.8	31.3	20/04/2011	19.7	5.4	25.1

Table A12: Receiver 12 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	56.3	0.0	**56.3**	24/06/2011	19	21.7	40.7
24/10/2011	39.2	0.0	39.2	31/01/2011	27.5	16.3	43.8
19/09/2011	36	0.1	36.1	19/04/2011	25.1	14.0	39.1
15/11/2011	34.6	0.9	35.5	8/11/2011	24.8	13.6	38.4
31/05/2011	34.3	0.0	34.3	8/04/2011	16	13.1	29.1
19/05/2011	33.6	0.2	33.8	5/06/2011	4.6	8.8	13.4
1/02/2011	32.4	0.3	32.7	1/07/2011	14.5	8.5	23.0
16/09/2011	31.9	1.0	32.9	23/10/2011	19	8.3	27.3
3/06/2011	31.5	1.1	32.6	22/01/2011	14	7.9	21.9
8/03/2011	31.3	0.1	31.4	25/06/2011	14.8	7.9	22.7
6/11/2011	31.1	0.0	31.1	9/11/2011	15.6	7.4	23.0
14/11/2011	30.5	0.1	30.6	18/02/2011	12.7	7.2	19.9

Appendix III

24 Hour Average $PM_{2.5}$ - Level 2 Contemporaneous Impact and Background Assessments

Table A1: Receiver 1 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	23/08/2011	7.2	6.8	14.0
24/10/2011	17.6	0.0	17.6	15/06/2011	10.4	5.6	16.1
19/09/2011	16.2	0.0	16.2	29/04/2011	7.1	5.1	12.2
15/11/2011	15.6	2.8	18.4	20/08/2011	7.0	4.9	11.9
31/05/2011	15.4	0.6	16.1	6/05/2011	10.4	4.9	15.3
19/05/2011	15.1	0.3	15.4	21/08/2011	7.3	4.9	12.2
1/02/2011	14.6	0.0	14.6	12/11/2011	10.3	4.3	14.6
16/09/2011	14.4	1.0	15.3	28/06/2011	7.2	4.2	11.3
3/06/2011	14.2	0.0	14.2	27/04/2011	5.1	4.0	9.1
8/03/2011	14.1	0.0	14.1	14/02/2011	4.1	3.9	8.0
6/11/2011	14.0	0.0	14.0	27/08/2011	7.2	3.9	11.1
14/11/2011	13.7	1.9	15.6	24/12/2011	5.9	3.6	9.5

Table A2: Receiver 2 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	5/11/2011	10.8	8.9	19.7
24/10/2011	17.6	0.0	17.6	1/09/2011	12.5	6.1	18.6
19/09/2011	16.2	0.0	16.2	22/08/2011	7.2	5.9	13.1
15/11/2011	15.6	1.2	16.8	4/11/2011	11.9	5.3	17.2
31/05/2011	15.4	1.0	16.5	8/09/2011	6.0	4.3	10.4
19/05/2011	15.1	0.6	15.7	6/05/2011	10.4	4.1	14.5
1/02/2011	14.6	0.0	14.6	29/01/2011	8.7	3.9	12.6
16/09/2011	14.4	0.8	15.1	3/02/2011	3.4	3.8	7.1
3/06/2011	14.2	0.0	14.2	2/09/2011	8.5	3.7	12.2
8/03/2011	14.1	0.0	14.1	13/10/2011	7.5	3.6	11.1
6/11/2011	14.0	0.0	14.0	12/11/2011	10.3	3.6	13.8
14/11/2011	13.7	1.6	15.3	14/06/2011	10.6	3.3	13.9

Table A3: Receiver 3 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m^3) Highest Background	Predicted Increment	Total	Date	PM10 24-hour average (µg/m^3) Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.4**	30/08/2011	9.1	5.2	14.3
24/10/2011	17.6	0.4	18.0	3/02/2011	3.4	4.7	8.1
19/09/2011	16.2	0.0	16.2	27/01/2011	7.0	4.0	11.0
15/11/2011	15.6	1.3	16.9	26/02/2011	11.8	3.8	15.6
31/05/2011	15.4	0.6	16.0	30/10/2011	3.5	3.8	7.3
19/05/2011	15.1	0.0	15.1	31/08/2011	9.9	3.7	13.6
1/02/2011	14.6	0.0	14.6	14/11/2011	13.7	3.6	17.3
16/09/2011	14.4	0.7	15.1	12/09/2011	6.1	3.6	9.6
3/06/2011	14.2	0.0	14.2	15/09/2011	10.4	3.5	13.9
8/03/2011	14.1	0.0	14.1	19/02/2011	6.5	3.4	10.0
6/11/2011	14.0	2.2	16.2	31/10/2011	5.4	3.4	8.8
14/11/2011	13.7	3.6	17.3	12/02/2011	2.6	3.1	5.7

Table A4: Receiver 4 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m^3) Highest Background	Predicted Increment	Total	Date	PM10 24-hour average (µg/m^3) Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	5/02/2011	0.4	9.1	9.5
24/10/2011	17.6	0.4	18.0	17/06/2011	6.2	3.4	9.6
19/09/2011	16.2	0.0	16.2	29/10/2011	4.8	3.2	8.0
15/11/2011	15.6	0.0	15.6	8/06/2011	4.2	2.8	7.0
31/05/2011	15.4	0.0	15.4	10/09/2011	6.4	2.8	9.2
19/05/2011	15.1	0.0	15.1	9/06/2011	5.9	2.5	8.4
1/02/2011	14.6	0.0	14.6	26/02/2011	11.8	2.5	14.4
16/09/2011	14.4	0.8	15.1	22/04/2011	5.4	2.5	7.8
3/06/2011	14.2	0.0	14.2	6/11/2011	14.0	2.1	16.1
8/03/2011	14.1	0.0	14.1	8/10/2011	5.7	2.0	7.7
6/11/2011	14.0	2.1	16.1	3/02/2011	3.4	2.0	5.4
14/11/2011	13.7	1.3	15.0	11/09/2011	3.4	1.9	5.3

Table A5: Receiver 5 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	5/02/2011	0.4	5.0	5.4
24/10/2011	17.6	0.0	17.7	18/06/2011	5.2	4.1	9.2
19/09/2011	16.2	0.0	16.2	17/06/2011	6.2	3.9	10.1
15/11/2011	15.6	0.0	15.6	23/06/2011	3.8	2.7	6.5
31/05/2011	15.4	0.0	15.4	10/04/2011	4.0	2.6	6.6
19/05/2011	15.1	0.0	15.1	11/04/2011	3.1	1.7	4.8
1/02/2011	14.6	0.0	14.6	17/02/2011	4.3	1.4	5.7
16/09/2011	14.4	0.3	14.6	11/10/2011	6.6	1.3	7.9
3/06/2011	14.2	0.0	14.2	26/02/2011	11.8	1.3	13.1
8/03/2011	14.1	0.0	14.1	28/02/2011	6.3	1.2	7.5
6/11/2011	14.0	0.7	14.7	11/08/2011	4.0	1.2	5.2
14/11/2011	13.7	1.1	14.9	29/10/2011	4.8	1.2	6.0

Table A6: Receiver 6 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	11/08/2011	4.0	2.1	6.1
24/10/2011	17.6	0.3	17.9	12/04/2011	3.1	1.3	4.4
19/09/2011	16.2	0.0	16.2	8/07/2011	5.3	1.0	6.2
15/11/2011	15.6	0.0	15.6	11/04/2011	3.1	0.9	4.0
31/05/2011	15.4	0.0	15.4	16/06/2011	9.8	0.8	10.6
19/05/2011	15.1	0.0	15.1	12/07/2011	6.3	0.8	7.1
1/02/2011	14.6	0.0	14.6	4/06/2011	5.9	0.8	6.7
16/09/2011	14.4	0.1	14.5	4/02/2011	0.0	0.8	0.8
3/06/2011	14.2	0.0	14.2	29/08/2011	8.3	0.7	9.0
8/03/2011	14.1	0.0	14.1	8/08/2011	4.0	0.5	4.4
6/11/2011	14.0	0.0	14.0	22/06/2011	4.4	0.4	4.8
14/11/2011	13.7	0.0	13.8	18/06/2011	5.2	0.4	5.6

Table A7: Receiver 7 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	4/02/2011	0.0	4.1	4.1
24/10/2011	17.6	0.8	18.4	12/04/2011	3.1	4.0	7.1
19/09/2011	16.2	0.0	16.2	13/04/2011	3.8	3.2	7.1
15/11/2011	15.6	0.0	15.6	11/04/2011	3.1	3.2	6.3
31/05/2011	15.4	0.0	15.4	16/02/2011	2.2	2.8	4.9
19/05/2011	15.1	0.0	15.1	11/08/2011	4.0	2.6	6.6
1/02/2011	14.6	1.2	15.8	29/08/2011	8.3	2.6	10.9
16/09/2011	14.4	0.2	14.6	4/06/2011	5.9	2.5	8.5
3/06/2011	14.2	0.4	14.6	8/07/2011	5.3	2.3	7.5
8/03/2011	14.1	0.0	14.1	16/06/2011	9.8	2.3	12.0
6/11/2011	14.0	0.8	14.7	25/08/2011	10.8	2.1	12.9
14/11/2011	13.7	0.1	13.8	12/09/2011	6.1	1.9	8.0

Table A8: Receiver 8 - Contemporaneous Impact and Background Assessment

Date	PM_{10} 24-hour average (µg/m^3)			Date	PM_{10} 24-hour average (µg/m^3)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	26/06/2011	7.7	8.5	16.3
24/10/2011	17.6	1.5	19.2	10/02/2011	6.6	5.7	12.4
19/09/2011	16.2	0.0	16.2	12/09/2011	6.1	5.7	11.8
15/11/2011	15.6	0.1	15.7	8/11/2011	11.2	5.3	16.5
31/05/2011	15.4	0.0	15.4	1/02/2011	14.6	5.2	19.8
19/05/2011	15.1	0.1	15.2	11/04/2011	3.1	5.1	8.2
1/02/2011	14.6	5.2	19.8	5/06/2011	2.1	4.8	6.9
16/09/2011	14.4	0.7	15.1	2/02/2011	4.1	4.7	8.9
3/06/2011	14.2	2.5	16.7	13/04/2011	3.8	4.6	8.4
8/03/2011	14.1	0.0	14.1	26/02/2011	11.8	4.5	16.3
6/11/2011	14.0	2.1	16.1	25/08/2011	10.8	4.3	15.1
14/11/2011	13.7	0.9	14.7	11/02/2011	5.4	4.2	9.6

Table A9: Receiver 9 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	16/02/2011	2.2	2.2	4.4
24/10/2011	17.6	0.3	17.9	19/06/2011	4.5	1.8	6.2
19/09/2011	16.2	0.0	16.2	10/08/2011	4.1	1.4	5.4
15/11/2011	15.6	0.0	15.6	12/04/2011	3.1	1.4	4.5
31/05/2011	15.4	0.0	15.4	16/06/2011	9.8	1.3	11.1
19/05/2011	15.1	0.0	15.1	2/02/2011	4.1	1.3	5.4
1/02/2011	14.6	0.9	15.5	13/04/2011	3.8	1.1	5.0
16/09/2011	14.4	0.0	14.4	4/02/2011	0.0	1.1	1.1
3/06/2011	14.2	0.5	14.7	24/06/2011	8.6	1.1	9.7
8/03/2011	14.1	0.0	14.1	9/11/2011	7.0	0.9	7.9
6/11/2011	14.0	0.5	14.5	1/02/2011	14.6	0.9	15.5
14/11/2011	13.7	0.1	13.8	9/08/2011	5.2	0.9	6.1

Table A10: Receiver 10 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	26/06/2011	7.7	3.6	11.4
24/10/2011	17.6	0.2	17.9	1/02/2011	14.6	2.0	16.6
19/09/2011	16.2	0.0	16.2	2/02/2011	4.1	2.0	6.2
15/11/2011	15.6	0.0	15.6	27/06/2011	9.6	1.8	11.3
31/05/2011	15.4	0.0	15.4	10/02/2011	6.6	1.8	8.4
19/05/2011	15.1	0.0	15.1	14/04/2011	5.0	1.4	6.4
1/02/2011	14.6	2.0	16.6	28/10/2011	7.3	1.2	8.5
16/09/2011	14.4	0.1	14.5	5/09/2011	8.0	1.1	9.1
3/06/2011	14.2	0.5	14.6	21/04/2011	6.1	1.0	7.1
8/03/2011	14.1	0.0	14.1	20/04/2011	8.9	1.0	9.8
6/11/2011	14.0	0.6	14.6	9/04/2011	9.4	1.0	10.4
14/11/2011	13.7	0.2	14.0	20/06/2011	4.1	0.9	5.0

Table A11: Receiver 11 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	10/02/2011	6.6	4.2	10.8
24/10/2011	17.6	0.0	17.7	31/01/2011	12.4	3.6	16.0
19/09/2011	16.2	0.0	16.2	5/06/2011	2.1	3.5	5.6
15/11/2011	15.6	0.0	15.6	24/06/2011	8.6	3.0	11.6
31/05/2011	15.4	0.0	15.4	8/11/2011	11.2	3.0	14.2
19/05/2011	15.1	0.1	15.2	2/07/2011	7.8	2.8	10.6
1/02/2011	14.6	1.1	15.7	23/08/2011	7.2	2.7	9.8
16/09/2011	14.4	0.2	14.5	19/04/2011	11.3	2.3	13.6
3/06/2011	14.2	0.7	14.9	18/02/2011	5.7	2.0	7.7
8/03/2011	14.1	0.0	14.1	25/01/2011	6.6	2.0	8.6
6/11/2011	14.0	0.2	14.1	22/01/2011	6.3	1.9	8.2
14/11/2011	13.7	0.3	14.0	27/06/2011	9.6	1.9	11.5

Table A12: Receiver 12 - Contemporaneous Impact and Background Assessment

Date	PM10 24-hour average (µg/m³)			Date	PM10 24-hour average (µg/m³)		
	Highest Background	Predicted Increment	Total		Background	Highest Predicted Increment	Total
23/09/2011	25.3	0.0	**25.3**	24/06/2011	8.6	7.3	15.8
24/10/2011	17.6	0.0	17.6	31/01/2011	12.4	5.1	17.5
19/09/2011	16.2	0.0	16.2	8/11/2011	11.2	4.4	15.5
15/11/2011	15.6	0.2	15.8	8/04/2011	7.2	4.2	11.4
31/05/2011	15.4	0.0	15.4	19/04/2011	11.3	3.8	15.1
19/05/2011	15.1	0.1	15.2	5/06/2011	2.1	3.1	5.2
1/02/2011	14.6	0.1	14.7	22/01/2011	6.3	2.9	9.2
16/09/2011	14.4	0.2	14.6	1/07/2011	6.5	2.7	9.2
3/06/2011	14.2	0.3	14.5	23/10/2011	8.6	2.6	11.2
8/03/2011	14.1	0.0	14.1	2/07/2011	7.8	2.3	10.1
6/11/2011	14.0	0.0	14.0	9/11/2011	7.0	2.3	9.3
14/11/2011	13.7	0.0	13.7	18/02/2011	5.7	2.3	8.0

Appendix IV

Scenario Analysis - Stage 1 Development

Assumptions

The following assumptions have been used in the CALPUFF model computation of odour and particulate GLCs.

General

- Default options within CALPUFF were used.
- The production cycle is 67 days and consists of three distinct phases. The first phase is the brooding phase and begins from day 1 to 22. During this phase the ventilation system is operated under minimum ventilation. The second phase is between day 23 and 50 where the ventilation system is operated under tunnel ventilation mode. After day 50, the sheds are cleaned and sterilized and remain ready for chick restocking. This period (phase 3) lasts for 17 days.
- The modelling assessment assumes the facility is fully stocked with poultry (2,400,000 birds) at the proposed facility and in operation for 365 days per annum.
- All sheds are mechanically ventilated. The sheds are not naturally ventilated.
- Shed emissions are effected by building downwash. Plumes are trapped in building wakes in the cavity region immediately downwind of a building or subjected to plume downwash and enhanced horizontal or vertical spreading due to the turbulent zone that exists further downwind. The ISC-method of building downwash has been applied in this report.
- In the event the outside ambient dry bulb temperature fell below 22 degrees Celsius, the tunnel ventilation system reduced to between 1% and 5% of full capacity flow (i.e. between 1% and 5% of 175 m^3/s).
- In the event the outside ambient dry bulb temperature fell below 20 degrees Celsius, the tunnel ventilation system reduced to a minimum ventilation rate (i.e. up to 70,000 m^3/h), as defined by the Ross Broiler Management Handbook 2014. Only Farm 3 and Farm 4 are constructed and operating. Each farm has 20 tunnel ventilated sheds (i.e. total of 40 sheds).
- The discharge for the tunnel ventilated fans that are located at the end of each shed is orientated so that all exhaust emissions are emitted as a horizontal discharge at a height of 1.5 m and constant velocity of 8 m/s.

Odour

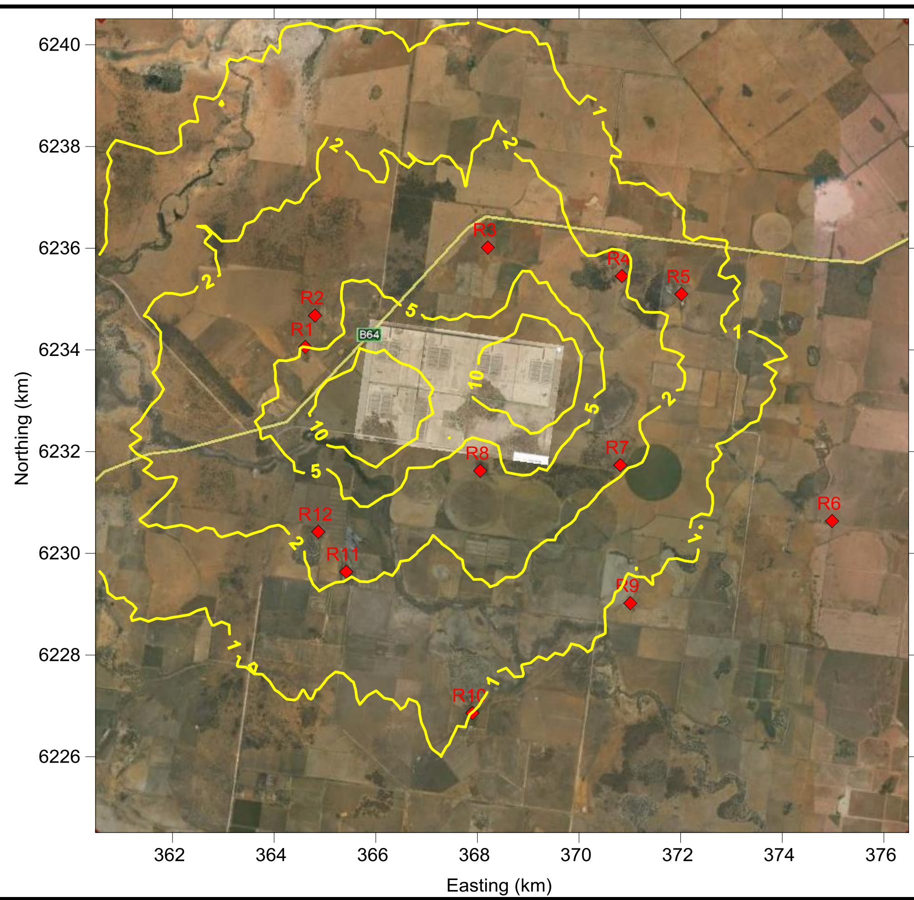
- Predicted odour GLCs are the one hour average 99th percentile dispersion model value and adjusted using a P/M 60 factor of 2.3 to represent the one second nose-response-time.
- Odour emissions from all tunnel fans on a shed are modelled as one shed specific stack source (e.g. eight sheds equating to eight stacks) and odour emissions from roof chimney fans are modelled as separate specific stack sources (e.g. eight roof fans on one shed equating to eight stacks).
- Odour emissions from the removal of shed litter are modelled as one specific volume source (i.e. large shed doors at eastern end of the shed).
- No odour is emitted from areas outside the sheds. Dead poultry is expected to be stored in an enclosed organic waste bin and transported off-site for rendering.
- No odours are generated from loading, storage and distribution of feed material into sheds.
- Poultry mortality losses have not been considered as a potential source of odour.

DISPERSION MODELLING RESULTS

The modelling was undertaken assuming the Goolgowi poultry facility operates with 40 sheds from Farm 3 and Farm 4 fully stocked with 60,000 birds per shed.

Odour

Figure A1 presents the cumulative 99th percentile one-second average GLC of odour at the surrounding sensitive receiver locations, as predicted by CALPUFF, for the proposed operation. The DECCW odour criterion as outlined in **Table 3** is 5 OU.



Sensitive Receivers

Client:	Tattersall Lander
Project:	Goolgowi Poultry Facility
Source:	Google Earth

Figure A1: 99th Percentile One-Second Average Odour Concentration

(Contour labels = 1, 2, 5, 10 OU)

Cumulative Impact

A Monte Carlo simulation was undertaken to assess the potential cumulative impacts of the existing poultry facility. The simulation involves the repeated random selection of data points from the model predictions of both the proposed project site and the existing Jeanella poultry facility to determine an odour GLC frequency distribution for each sensitive receiver.

The simulation in the assessment used 250,000 iterations to determine the distribution of odour GLCs at each sensitive receiver. **Table A1** presents the results of the Monte Carlo simulation for sensitive receivers.

Table A1: Predicted Cumulative Odour GLCs at Sensitive Receivers

Receiver	Predicted 99th Percentile Odour GLC from the Proposed Poultry Facility (OU)	Predicted 99th Percentile Cumulative Odour GLC by Monte Carlo Simulation (OU)	Impact assessment criteria (OU)
R1	4.77	4.83	5 OU
R2	4.23	4.31	
R3	3.04	3.33	
R4	2.31	3.62	
R5	1.46	3.27	
R6	0.44	1.53	
R7	2.23	3.22	
R8	3.84	4.33	
R9	0.87	1.40	
R10	1.00	1.32	
R11	2.26	2.42	
R12	2.65	2.83	

The results indicate the 99th percentile one second average odour GLC criteria is not exceeded at any sensitive receivers.