AIR QUALITY IMPACT ASSESSMENT

52 Sinclair Street, Goulburn

Prepared for:

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with KDC Planning Development Property (the Client).   Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT REFERENCES

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1   Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by KDC Pty Ltd (KDC) to conduct an air quality impact assessment (AQIA) for the construction and operation of a proposed mixed use development including a poultry processing plant, child care facility and other associated infrastructure (combined 'the Development Site'), to be located 52 Sinclair St, Goulburn NSW.

This report has been prepared to inform a State Significant Development Application (SSDA) and focused on assessing potential air quality impacts from the construction of the Development Site, and operation of the proposed poultry processing plant.

This report addresses the Secretary's Environmental Assessment Requirements (SEARs) relevant to the Air Quality and Odour (SSD 9143) issued 25 July 2018, as reproduced below:

- A quantitative assessment of the potential air quality and odour impacts of the development in accordance with the relevant Environment Protection Authority (EPA) guidelines. This assessment must include:

  - an identification of existing and potential future sensitive receivers and consideration of approved and/or proposed development in the vicinity;

  - an investigation and assessment of odour impacts on all identified and potential receivers including, but not limited to, the adjacent rural residences;

  - an assessment of the cumulative air quality and odour impacts of the development;

  - evidence of appropriate meteorological data for use in air dispersion modelling, using real meteorological data where possible;

  - inclusion of 'worst case' emission scenarios and sensitivity analyses;

  - a contingency plan to address unpredicted operational odour impacts;

  - a description and appraisal of air quality and odour impact monitoring, emission control techniques and mitigation measures.

The assessment of air quality impacts during construction of the Development Site has been carried out based on a qualitative risk assessment method developed by the Institute of Air Quality Management (IAQM).

The assessment of air quality impacts during operation of the proposed poultry processing plant has been carried out in accordance with New South Wales (NSW) Office of Environment and Heritage (OEH) odour policy: *Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW* (hereafter 'the Odour Framework') (DEC 2006a) and supporting documentation: *Technical Notes: "Assessment and Management of Odour from Stationary Sources in NSW* (hereafter 'the Technical Notes') (DEC 2006b). To adequately assess odour impacts from the poultry processing plant, a Level 2 assessment is presented in this report. The Odour Framework outlines the parameters that need to be determined in a Level 2 assessment as follows:

- All nearby receptors potentially affected by the odour emissions (both current and future); this is particularly important where there is a potential for rezoning or subdivision (**Section 2.3**).

- Site features that may affect odour propagation and dispersion, including topography, vegetation, buildings and surrounding land uses (**Section 2.4**).

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- Operating hours and times when intermittent odour-generating activities are likely to occur (**Section 2.5**).

- All potential odour sources - materials, equipment or activities (including transport, waste management and maintenance) (**Section 3**).

- The odour assessment criteria that were used to assess the proposal under current and future circumstances (**Section 4.3**).

- Weather conditions particular to the site (**Section 5.2**).

- The location of the emission of each odour source as well as its characteristics and likely emission frequency, timing, duration, intensity, characteristics and chemical composition (**Section 8**).

- Likely odour impacts (predicted using the level 2 assessment approach) (**Section 9**).

The aim of this AQIA is to determine the potential air quality risks associated with the construction of the Development Site (including poultry processing plant, child care facility and other associated infrastructure) and the operation of the proposed poultry processing plant.

2   Project Overview

2.1   Location

The Development Site is located approximately 1.2 kilometres (km) southeast of Goulburn City Centre. The access to the Development Site is via Common Street and is 400 metres (m) from Sydney Road which provides a convenient linkage to Goulburn City Centre and the Hume Highway (Remembrance Drive).

The Development Site is legally described as Lot 22 in DP 750050 and is generally referred to as 52 Sinclair Street, Goulburn NSW 2580. The total area of the Site is approximately 82,606 m^2. It is located within the Goulburn Mulwaree Local Government Area (LGA) and zoned B6 Enterprise Corridor, RU6 Transition and E3 Environmental Management under the LEP 2009 (GMLEP 2009). The location of the Development Site is shown in **Figure 1**.

Figure 1   Location of the Project Site

2.2 Project Description

The Project involves the construction and operation of a mixed use development including a cold storage and distribution centre, poultry processing plant, child care facility and other associated infrastructure. A brief description of each of these project components is sourced from the KDC document '*Request for Secretary's Environmental Assessment Requirements* (KDC 2018), and is provided in the below sections. The proposed layout of the Development Site is shown in **Figure 2**.

Figure 2   Proposed Layout of the Development Site

Source: Combined Plans – compressed.pdf, 1 April 2019.

2.2.1 Cold Storage and Distribution Centre

The cold storage and distribution centre is proposed to be located in the north eastern corner of the Site and is planned to include a cold storage area of approximately 10,600 m^2, staff and visitor car parking, an attached corporate office, security office, despatch office, amenities and truck loading/unloading bays.

The cold storage area is intended to be leased to a number of tenants for the storage of refrigerated goods, including poultry from the poultry processing plant, for distribution to retailers and wholesalers. There will be no retail sales from the cold storage and distribution centre.

2.2.2 Poultry Processing Plant

2.2.2.1 Processing Plant

The poultry processing plant is proposed to be located in the western portion of the Development Site and is planned to include the processing plant (approximately 9,150 m^2), office, amenities, truck loading and unloading bay and a by-products processing plant. Poultry, including chicken, duck, turkey, geese and quail, are proposed to be brought from broiler farms for onsite slaughter, processing and packaging. At maximum

capacity approximately 1,000,000 birds per week are intended to be processed and packaged for sale to local and international markets.

Poultry is trucked in crates from broiler farms. The crates are unloaded and placed onto conveyors for cleaning. Poultry is removed from the crates and transported inside the poultry processing building and into a quarantined area for slaughtering. During the slaughter process the poultry is washed, blood waste is drained to a blood storage tank and other waste generated is transported to the by-products processing plant.

Following slaughter, poultry is eviscerated and then send to the chilling room to lower the body temperature of the poultry prior to cutting and sizing. During both the evisceration and cutting process, waste generated is taken to the by-products processing plant.

Poultry is then packaged according to the size and cut which generally includes feet, giblets, chicken pieces and whole pieces. Packaged poultry is stored in the cold storage prior to transport and distribution.

It has been notified by KDC that the processing plant will be refrigerated and that there will be no odour from this process. Hence, the only odour is anticipated to be from the bird reception area within the processing plant.

2.2.2.2 By-products Processing Plant

Poultry waste is proposed to be sent to the by-products processing plant for the manufacture of recycled meat, bone meal and animal fat products. This process ensures that there is no poultry waste taken to nearby landfill reducing the potential for disease and odour. It also promotes the efficient reuse of poultry waste for other consumer markets.

The by-products processing plant is likely to produce odorous emissions during the rendering process. It has been proposed that odorous air from the by-products processing plant will be subject to a bio-filter, to be located adjacent to the by-products processing plant building.

2.2.2.3 Wastewater Treatment Plant

In addition to the poultry waste, the wastewater from poultry processing will be treated in an onsite wastewater treatment plant (WWTP). The general treatment process is pre-screening of effluent received from the process facility followed by collection within a balance tank, then treatment by coagulation, flocculation, primary Dissolved Air Flotation (DAF), biological treatment in a single stage Moving Bed Biological Reactor (MBBR), and final clarification in a secondary DAF prior to discharge to sewer. Both primary and secondary sludge will be produced which will be managed by collection in a conical bottom sludge tank and dewatering using an Inclined Sludge Press.

It has been notified by KDC that the WWTP is proposed to be a 'closed system' (22 February 2019), hence it is not considered to be an odorous source.

2.2.2.4 Live Bird Sheds

Under normal operating conditions, the trucks carrying the poultry will enter the Development Site and proceed directly to the 'bird reception' area of the processing plant for unloading. In the case of an unforeseen disruption to the normal operating conditions, such as a failure within the processing plant, the trucks will be directed to the live bird shed for temporary parking to await the schedule for unloading.

Following advice from the client, it is determined that the live bird shed will be constructed as an emergency measure only, to satisfy animal welfare requirements during unforeseen disruptions to normal operating conditions. Given that placement of birds in these sheds will be for a very limited period of time it can be assumed that odour emissions from these sheds will be much lower than those represented by literature surrounding odour emissions for 'standard' poultry sheds, which focuses on odour emissions from birds that are placed for extended periods on litter that absorbs high levels of faecal material (comparatively). Therefore, odour emissions from this source will be better managed through good odour management practices and minimising the time that birds stay in the sheds.

For these reasons and acknowledging that the frequency of occurrence of these emergency events is anticipated to be low, the operation of the live bird shed has been excluded from the remainder of this assessment.

2.2.3   Childcare Facility

A childcare facility is proposed in the south east corner of the Development Site. It is intended primarily to accommodate children of staff working at the Development Site, however if capacity exists, will accept children from families not associated with this Project. The proposed childcare facility is approximately 665 m^2 in size, includes an outdoor play ground and is proposed to provide 21 car parking spaces for child care staff and visitors.

2.2.4   Other Associated Infrastructure

Other proposed associated infrastructure within the Development Site includes:

- Visitor and staff car parking (approximately 350 car parking spaces in total across the site);
- Truck and trailer parking (approximately 25 truck parking spaces);
- Truck maintenance and workshop area;
- Office buildings and amenities;
- Internal roads and services;
- Walkways and awnings; and
- Weighbridge and guard house.

2.3   Sensitive Receptors

Sensitive receptors are locations where the general population can be adversely impacted by exposure to pollution from the atmospheric emissions. These locations include hospitals, schools, day care facilities, aged care facilities and residential housing.

The area surrounding the Development Site include rural residential lots and other commercial and industrial uses including a sand and soil supplier, café, motel and a resource recovery facility. The nearest residential and commercial receptors are located approximately 60 m and 75 m from the closest Development Site boundary. The locations of the identified closest sensitive receptors are listed in **Table 1** and shown in **Figure 3**.

Table 1   Locations of the Identified Nearest Sensitive Receptors

Location	Easting (m)	Northing (m)
R1	751,567	6,151,302
R2	751,723	6,151,023
R3	751,701	6,150,879
R4	751,408	6,150,955
R5	751,075	6,150,791
R6	751,131	6,151,285
R7	751,386	6,151,409
R8	751,500	6,151,358
C1	751,636	6,151,266
C2	750,897	6,151,126
C3	751,288	6,151,459
CCC	751,526	6,151,081

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Figure 3   Locations of the Identified Sensitive Receptors
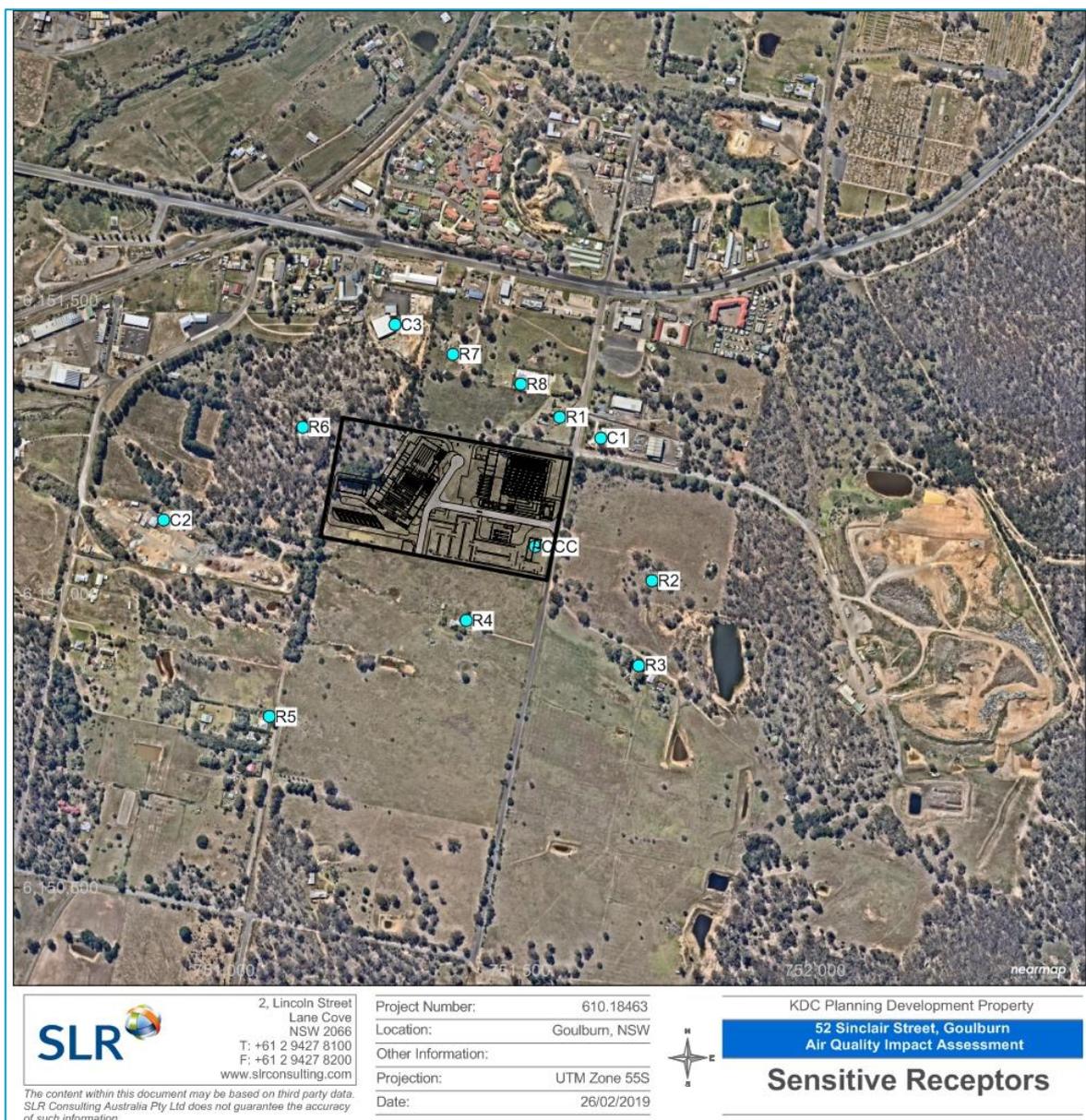
2.4   Local Topography

Local topography is important in air quality studies as local atmospheric dispersion can be influenced by night-time katabatic (downhill) drainage flows from elevated terrain or channelling effects in valleys or gullies.

A three dimensional representation of the topography surrounding the Development Site is shown in **Figure 4**. The ground elevation within the area illustrated in **Figure 4** ranges from approximately 600 m to 850 m Australian Height Datum (AHD). There are a number of significant topographical features in the surrounding area that are expected to influence local wind patterns and affect the dispersion of air emissions from the Development Site. This has been taken into consideration in the selection of the model and modelling grid resolution used for the study.

Figure 4   Local Topography Surrounding the Development Site
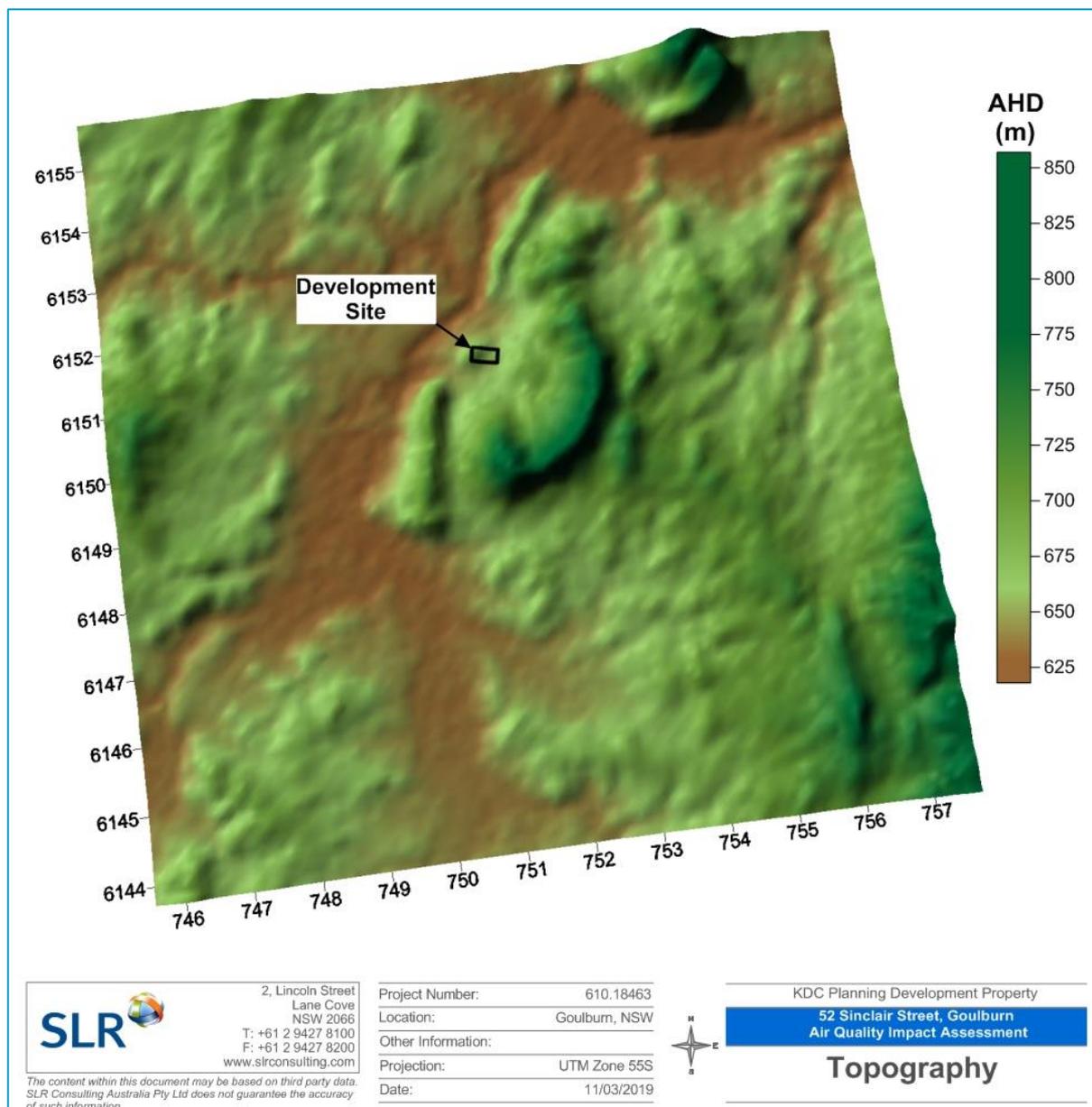
2.5   Hours of Operation

The Development Site is proposed to be constructed and operated in stages. Stage 1 involves construction and operation of the processing plant, cold storage and distribution centre. Stage 2 involves construction and operation of the bird reception area and the kill plant.

The childcare facility will be constructed and operated concurrently with Stage 1 and 2 to meet the demands of local workers and the broader community.

For the purpose of operational assessment, it is assumed that the Development Site is fully operational (including Stages 1 and 2), and that the poultry processing plant and the cold storage and distribution centre will operate 24 hours per day, 7 days per week.

For the purpose of construction assessment, it is assumed that the construction will typically be undertaken during standard construction hours, between 7:00 am and 6:00 pm Monday to Friday and, 8:00 am and 1:00 pm Saturday, with no works conducted on Sundays or public holidays.

3   Potential Sources of Air Emissions

3.1   Potential Sources of Dust Emissions During Construction

The potential for dust to be emitted during the construction phase will be directly influenced by the nature of the activities being performed at any given time. As the Development Site is a green field site, the activities that are most likely to lead to short-term emissions of dust, include:

- Earthworks;

- Grading;

- Loading and unloading of materials;

- Wheel-generated dust and combustion emissions from construction equipment;

- Wheel-generated dust from trucks travelling on unpaved surfaces; and

- Wind erosion of exposed surfaces.

Temporary elevations in local dust levels are most likely to occur when construction activities are undertaken during periods of low rainfall and/or windy conditions. The impact of elevated dust emissions is dependent upon the potential for particulates to become and remain airborne prior to being deposited as dust or experienced as an ambient particulate concentration.

A number of environmental factors may affect the generation and dispersion of dust emissions, including:

- Wind direction - determines whether dust and suspended particles are transported in the direction of the sensitive receptors;

- Wind speed - determines the potential suspension and drift resistance of particles;

- Surface type - more erodible surface material types have an increased soil or dust erosion potential;

- Surface material moisture - increased surface material moisture reduces soil or dust erosion potential; and

- Rainfall or dew - rainfall or heavy dew that wets the surface of the soil reduces the risk of dust generation.

Where diesel-powered mobile machinery and vehicles are being used, localised elevations in ambient concentrations of combustion-related pollutants may occur, however the potential for relevant impact assessment criteria for these pollutants to be exceeded at surrounding sensitive areas will be minimal. Fugitive dust emissions are generally considered to have the greatest potential to give rise to downwind air quality impacts at construction sites and combustion emissions during construction have not been considered further.

Potential air quality impacts associated with fugitive dust emissions from the construction phase of the project have been addressed in **Section 7**.

3.2   Potential Sources of Emissions During Operations

The main sources of air pollutants associated with the Development Site are identified to be:

- Odour emissions from the bird reception area within the processing plant; and

- Odour emissions from the by-products processing plant (bio-filter and fugitive).

It has been notified by KDC that the WWTP is proposed to be a 'closed system' (22 February 2019), hence it is not considered to be an odorous source.

Exhaust emissions associated with the proposed truck movements (see **Section 2.2.2**) would be minimal in the context of other vehicle movements in the area and are unlikely to have potential for off-site air quality impacts and have therefore not been considered further.

3.3 Identified Pollutants

3.3.1 Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms "dust" and "particulates" are often used interchangeably. The health effects of particulate matter are strongly influenced by the size of the airborne particles. Smaller particles can penetrate further into the respiratory tract, with the smallest particles having a greater impact on human health as they can penetrate to the gas exchange areas of the lungs.

The term "suspended particulate matter" refers to a category of airborne particles, typically less than 30 microns (μm) in diameter and ranging down to 0.1 microns and is termed total suspended particulate (TSP).

Particulate matter with an aerodynamic diameter of 10 microns or less is referred to as PM_{10} and with an aerodynamic diameter of 2.5 microns or less is referred to as $PM_{2.5}$. The PM_{10} size fraction is sufficiently small to penetrate the large airways of the lungs, while $PM_{2.5}$ is generally small enough to be drawn in and deposited into the deepest portions of the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

3.3.2 Odour

Emissions associated with the poultry processing plant will include odour emissions from bird reception area and the by-product processing plant. Nuisance odour may be defined as an odour which is perceived to be offensive by an individual. A nuisance odour is largely dependent on an individual's sensitivity to a particular odour as everyone experiences odour differently.

The odour detection threshold of an odour is the minimum concentration of a particular substance in air which can be detected by a sense of smell by an individual with normal olfactory activity. The strength and intensity of an odour experienced in an environmental setting depends heavily on the type and throughput of contributing sources, the prevailing weather conditions and will vary with small changes in wind speed and direction.

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4   Air Quality Policy and Guidance

The following air quality policy and guidance documents have been referenced within this assessment and have been used to identify the relevant air quality criteria (see **Section 4.3**).

4.1   Approved Methods for Modelling and Assessment

State air quality guidelines adopted by the NSW EPA are published in the NSW EPA's *Approved Methods for Modelling and Assessment of Air Pollutants in NSW* (EPA 2017) publication, hereafter referred as the 'Approved Methods'.

The Approved Methods lists the statutory methods for modelling and assessing air pollutants (including odour) from stationary sources and specifies criteria which reflect the environmental outcomes adopted by the EPA. The Approved Methods are referred to in the *POEO (Clean Air) Regulation 2002* for assessment of impacts of air pollutants.

The odour impact assessment criteria set out in the Approved Methods relevant to the Development Site are reproduced and discussed in **Section 4.3.2**.

4.2   Odour Technical Framework and Notes

The EPA's *Assessment and Management of Odour from Stationary Sources in NSW (Technical Framework and Technical Notes)* publications provide a policy framework for assessing and managing activities that emit odour and offer guidance on dealing with odour issues. These documents are required to be referenced when assessing any odour issue in NSW.

4.3   Air Quality Criteria

4.3.1   Odour Concentration and Emission Rate Definitions

Odour concentration is measured in terms of odour units (ou). 1 ou is the concentration of odour-containing air that can just be detected by 50% of members of an odour panel (persons chosen as representative of the average population sensitivity to odour). This process is defined within Australian Standard AS4323.3: *Stationary Source Emissions – Part 3: Determination of Odour Concentration by Dynamic Olfactometry (Standards Australia 2001).*

The Specific Odour Emission Rate (SOER) is a measure of odour released from an area source and is expressed in odour units emitted per surface and time unit (ou.m^3/m^2/s or ou.m^3/m^2/min).

An Odour Emission Rate (OER) is the product of the odour concentration (ou) and the volumetric flow rate (eg m^3/s or m^3/min), and is often annotated as ou.m^3/s, or ou.m^3/min. For area sources, the SOER is multiplied by the area of the source to obtain the OER.

4.3.2   Odour Impact Assessment Criteria

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management, but are generally not intended to achieve "no odour".

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The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the *odour threshold* and defines 1 ou. An odour goal of less than 1 ou would theoretically result in no odour impact being experienced.

In practice, the character of a particular odour can only be judged by the receiver's reaction to it, and preferably only compared to another odour under similar social and regional conditions. Based on the literature available, the level at which an odour is perceived to be a nuisance can range significantly depending on a combination of the following factors:

- *Odour Quality*: whether an odour results from a pure compound or from a mixture of compounds. Pure compounds tend to have a higher threshold (lower offensiveness) than a mixture of compounds.

- *Population sensitivity:* any given population contains individuals with a range of sensitivities to odour. The larger a population, the greater the number of sensitive individuals it may contain.

- *Background level:* whether a given odour source, because of its location, is likely to contribute to a cumulative odour impact. In areas with more closely-located sources, particularly sources emitting odours of a similar character, it may be necessary to apply a lower threshold to prevent offensive odour.

- *Public expectation:* whether a given community is tolerant of a particular type of odour and does not find it offensive, even at relatively high concentrations. For example, background agricultural odours may not be considered offensive, particularly in a rural or semi-rural environment, until a higher threshold is reached than for odours from a landfill facility.

- *Source characteristics:* whether the odour is emitted from a stack (point source) or from an area (diffuse source). Generally, the components of point source emissions can be identified and treated more easily than diffuse sources. Emissions from point sources can be more easily controlled using control equipment.

- *Health Effects:* whether a particular odour is likely to be associated with adverse health effects. In general, odours from agricultural activities are less likely to present a health risk than emissions from industrial facilities.

Experience gained through odour assessments from proposed and existing facilities in NSW indicates that an odour performance goal of 7 ou is likely to represent the level below which "offensive" odours should not occur (for an individual with a 'standard sensitivity' to odours). The OEH recommends within the Odour Framework that, as a design goal, no individual be exposed to ambient odour levels of greater than 7 ou. This is expressed as the 99th percentile value, as a nose response time average (approximately one second).

Odour performance goals need to be designed to take into account the range in sensitivities to odours within the community, and provide additional protection for individuals with a heightened response to odours. In NSW this is done using a statistical approach which depends on the size of the affected population. As the affected population size increases, the number of sensitive individuals is also likely to increase, which suggests that more stringent goals are necessary in these situations. In addition, the potential for cumulative odour impacts in relatively sparsely populated areas can be more easily defined and assessed than in highly populated urban areas. It is often not possible or practical to determine and assess the cumulative odour impacts of all odour sources that may impact on a receptor in an urban environment. Therefore, the proposed odour performance goals allow for population density, cumulative impacts, anticipated odour levels during adverse meteorological conditions and community expectations of amenity.

The equation used by the OEH to determine the appropriate impact assessment criteria for complex mixtures of odorous air pollutants, as specified in the Approved Methods, is expressed as follows:

$$\text{Impact assessment criterion (ou)} = (\log_{10}(\text{population})-4.5)/-0.6$$

A summary of the impact assessment criteria given for various population densities, as drawn from the Approved Methods, is shown in **Table 2**. This factor has been used to derive a project specific odour criterion.

Table 2   OEH Impact Assessment Criteria for Complex Mixtures of Odorous Air Pollutants

Population of Affected Community	Impact Assessment Criteria for Complex Mixtures of Odours (ou) (nose-response-time average, 99th percentile)
Urban area ($\geq$ 2000)	2.0
~300	3.0
~125	4.0
~30	5.0
~10	6.0
Single residence ($\leq$ 2)	7.0

Source: The Approved Methods (EPA 2017)

The Approved Methods states that the impact assessment criteria for complex mixtures of odorous air pollutants must be applied at the nearest existing or likely future off-site sensitive receptor(s).

The incremental impact (predicted impact due to the pollutant source alone) must be reported in units consistent with the impact assessment criteria (ou), as peak concentrations (i.e. approximately 1 second average) and as the:

- 100th percentile of dispersion model predictions for Level 1 impact assessments; or
- 99th percentile of dispersion model predictions for Level 2 impact assessments.

It is noted that a Level 2 odour impact assessment as defined by the Approved Methods is equivalent to a Level 3 odour impact assessment as defined by the Technical Framework.

Based on previous discussions with the NSW EPA for similar facilities, the odour impact assessment criterion was determined by identifying the area within the 2 ou contour for the worst case scenario and multiplying this area by the relevant average population density obtained from the Australian Bureau of Statistics (2016 Census data). Refer to **Section 9** for details on the odour impact assessment criterion adopted for the Development Site.

4.3.3   Peak to Mean Ratios

It is a common practice to use dispersion models to determine compliance with odour goals. This introduces a complication because dispersion models are typically restricted by the meteorological data inputs to predicting concentrations over an averaging period of 1-hour or greater. The human nose, however, can respond to odours over periods of the order of one second. During longer periods, odour levels can fluctuate significantly above and below the mean depending on the nature of the source.

To determine the ratio between the 1-second peak concentrations and longer period average concentrations (referred to as the peak to mean ratio) that might be predicted by a dispersion model, the EPA commissioned a study by Katestone Scientific Pty Ltd (Katestone 1995). This study recommended peak to mean ratios for a range of circumstances. The findings of these studies have been adopted in the Approved Methods and Technical Framework.

For wake-affected point and volume sources, a peak to mean ratio of 2.3 is recommended by the Approved Methods.

The estimated odour emission rates used in the modelling study have accounted for the above peak to mean ratio to enable direct comparison of the results against the goals shown in **Section 4.3.2**, which are based on nose-response time.

5 Atmospheric Dispersion Modelling

Odour emissions from the proposed poultry processing plant have been modelled using a combination of the TAPM, CALMET and CALPUFF models. CALPUFF is a transport and dispersion model that ejects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so, it typically uses the fields generated by a meteorological pre-processor CALMET, discussed further in **Section 5.1.4**. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either hourly concentration fluxes evaluated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

5.1 Meteorological Modelling

5.1.1 Regional Meteorological Data

To adequately characterise the dispersion meteorology of the Development Site, information is needed on the prevailing wind regime, atmospheric stability, mixing depth and other meteorological parameters.

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station recording wind speed and wind direction data is the Goulburn Airport Automatic Weather Station (AWS), located approximately 6 kilometres (km) south of the Development Site (Station ID 66037). Considering the relatively flat terrain between Development Site and Goulburn Airport AWS, it may be assumed that the wind conditions recorded at the Goulburn Airport AWS are a reasonable representation of the wind conditions experienced at the Development Site.

5.1.2 Selection of Representative Year for Meteorological Modelling

In order to determine a representative meteorological year for use in dispersion modelling, five years of meteorological data (2013-2017) from the closest meteorological monitoring station (ie Goulburn Airport AWS) were analysed against the five year average meteorological conditions. Specifically, the following parameters were analysed:

- Frequency and distribution of the predominant wind directions;
- Monthly average wind speeds observed; and
- Monthly average temperatures.

Based on this analysis, it was concluded that the year 2015 was representative of the last five years of meteorological conditions experienced at the Goulburn Airport AWS and hence the 2015 calendar year was adopted for use in this AQIA. A summary of the analysis is presented in **Appendix B**.

5.1.3 TAPM

The TAPM prognostic model, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), was used to generate the upper air data required for CALMET modelling.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate one full year of hourly meteorological observations at user-defined levels within the atmosphere.

Additionally, the TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to realign the predicted solution towards the observation values. In this study, data from the BoM's Goulburn Airport AWS has been used to nudge (ie influence) the TAPM predictions. **Table 3** details the parameters used in the TAPM meteorological modelling for this assessment.

Table 3   Meteorological Parameters Used for this Study - TAPM

TAPM (v 4.0)	
Number of Grids (spacing)	5 (30 km, 10 km, 3 km and 1 km, 300 m)
Number of Grid Points	25 x 25 x 25
Year of Analysis	2015
Centre of Analysis	751,384 m E 6,151,054 m S
Data Assimilation	Goulburn Airport AWS

5.1.4   CALMET

In the simplest terms, CALMET is a meteorological model that develops hourly wind and other meteorological fields on a three-dimensional gridded modelling domain that are required as inputs to the CALPUFF dispersion model. Associated two dimensional fields such as mixing height, surface characteristics and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, sea breeze, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final hourly varying wind field thus reflects the influences of local topography and land uses.

The CALMET domain was modelled with a resolution of 100 m. The TAPM-generated 3-dimensional meteorological data (1 km resolution) was used as the 'initial guess' wind field and the local topography and available surface weather observations in the area were used to refine the wind field predetermined by TAPM. **Table 4** details the parameters used in the meteorological modelling to drive the CALMET model.

Table 4   Meteorological Parameters Used for this Study – CALMET (V 6.1)

CALMET Domain	
Meteorological Grid	12 km × 12 km
Meteorological Grid Resolution	100 m
Initial Guess Filed	3D output from TAPM modelling
Topography	SRTM-derived 3-second (90 m) data sourced from Geosciences Australia
Surface station data	Goulburn Airport AWS

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5.2   Meteorological Data Used In Modelling

To provide a summary of the meteorological conditions predicted at the Development Site using the methodology described in **Section 5.1**, a single-point, ground-level meteorological dataset was 'extracted' from the 3-dimensional modelled dataset at the Development Site and is presented in this section.

5.2.1   Wind Speed and Direction

A summary of the annual wind behaviour predicted by CALMET for 2015 (extracted at the Development Site) is presented as wind roses in **Figure 6** and as a wind speed distribution plot in **Figure 5**.

The wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from north). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus, it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day. The 'Beaufort Wind Scale' (consistent with terminology used by the BoM) was used to describe the wind speeds experienced at the Development site, outlined in **Table 5**.

Table 5   Beaufort Wind Scale

Beaufort Scale #	Description	m/s	Description on land
0	Calm	0-0.5	Smoke rises vertically
1	Light air	0.5-1.5	Smoke drift indicates wind direction
2-3	Light/gentle breeze	1.5-5.3	Wind felt on face, leaves rustle, light flags extended, ordinary vanes moved by wind
4	Moderate winds	5.3-8.0	Raises dust and loose paper, small branches are moved
5	Fresh winds	8.0-10.8	Small trees in leaf begin to sway, crested wavelets form on inland waters
6	Strong winds	>10.8	Large branches in motion, whistling heard in telephone wires; umbrellas used with difficulty

Source: http://www.bom.gov.au/lam/glossary/beaufort.shtml

The predicted wind roses show that winds at the Development Site were predicted to be predominantly of gentle breeze to moderate strength (between 3 m/s and 8 m/s) during 2015. Calm wind conditions were predicted to occur approximately 4.5% of the time throughout the modelling period. It is noted that the moderate winds and low percentage of calm wind conditions will assist pollutant dispersion, resulting in lower odour concentrations at the surrounding receptors.

The seasonal wind roses indicate that typically:

- In summer, winds predominantly blow from between the east-northeast and southeast with very low frequency of winds from the northern and southern quadrants. On average, calm winds are experienced 2.3% of the time during summer.

- In autumn, winds predominantly blow from the west and west-northwest, with very low frequency of winds from the northern and south-southwest directions. On average, calm winds are experienced 4.9% of the time during autumn.

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- In winter, winds predominantly blow from the west and west-northwest, with very low frequency of winds from the northern directions. On average, calm winds are experienced 6.4% of the time during winter.

- In spring, winds predominantly blow from between the west and west-northwest, and from between east-northeast and east directions. On average, calm winds were experienced 4.3% of the time during spring.

Figure 5   CALMET-Predicted Annual Wind Speed Frequencies at the Development Site - 2015

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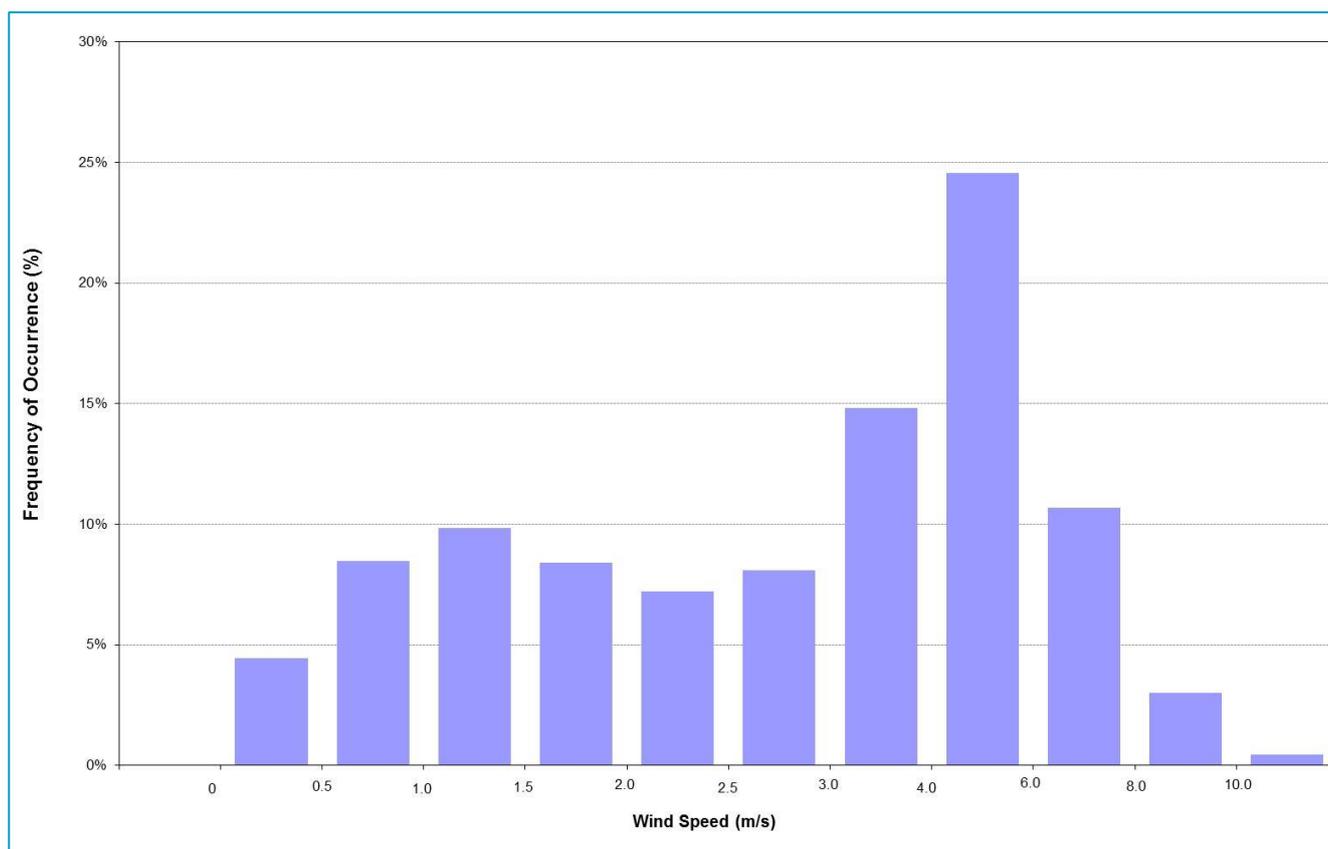
Figure 6   CALMET-Predicted Seasonal Wind Roses for the Development Site – 2015
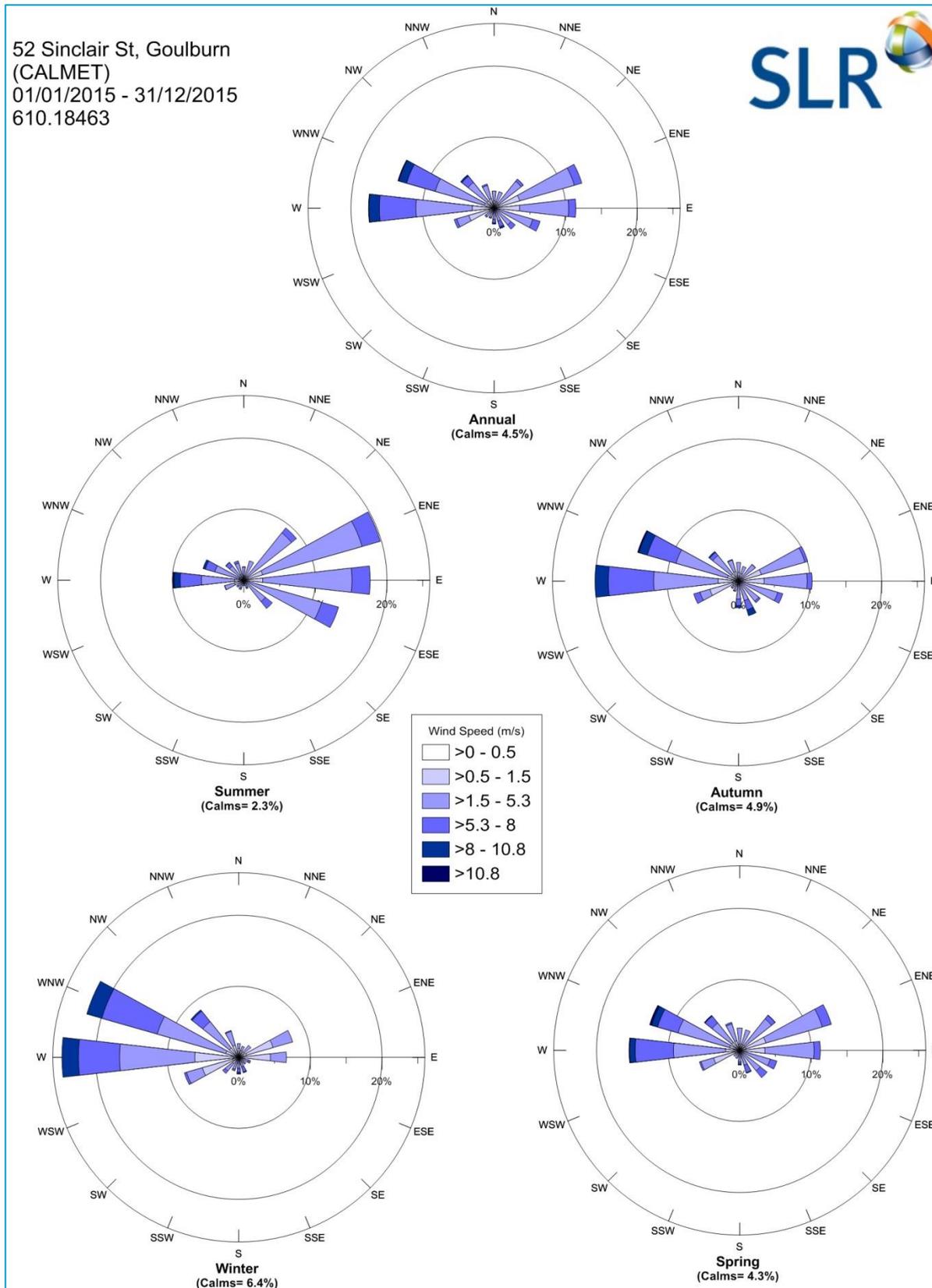
5.2.2 Atmospheric Stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Gifford-Turner (PGT) assignment scheme identifies six stability classes, A to F, to categorise the degree of atmospheric stability as follows:

- A = Extremely unstable conditions
- B = Moderately unstable conditions
- C = Slightly unstable conditions
- D = Neutral conditions
- E = Slightly stable conditions
- F = Moderately stable conditions

The meteorological conditions defining each PGT stability class are shown in **Table 6**.

Table 6   Meteorological Conditions Defining PGT Stability Classes

Surface Wind Speed (m/s)	Daytime Insolation			Night-Time Conditions	
	Strong	**Moderate**	**Slight**	**Thin overcast or > 4/8 low cloud**	**<= 4/8 cloudiness**
< 2	A	A - B	B	E	F
2 - 3	A - B	B	C	E	F
3 - 5	B	B - C	C	D	E
5 - 6	C	C - D	D	D	D
> 6	C	D	D	D	D

Source: NOAA 2018

Notes:

1. Strong insolation corresponds to sunny midday in midsummer in England; slight insolation to similar conditions in midwinter.

2. Night refers to the period from 1 hour before sunset to 1 hour after sunrise.

3. The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

The frequency of each stability class predicted by CALMET at the Development Site during the modelling period is presented in **Figure 7**. The results indicate a high frequency of conditions typical to Stability Class D and F. Stability Class D is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing. Stability Class F is indicative of night time conditions, conducive to a low level of pollutant dispersion resulting in higher downwind concentrations.

Figure 7   CALMET-Predicted Stability Class Frequencies at the Development Site - 2015
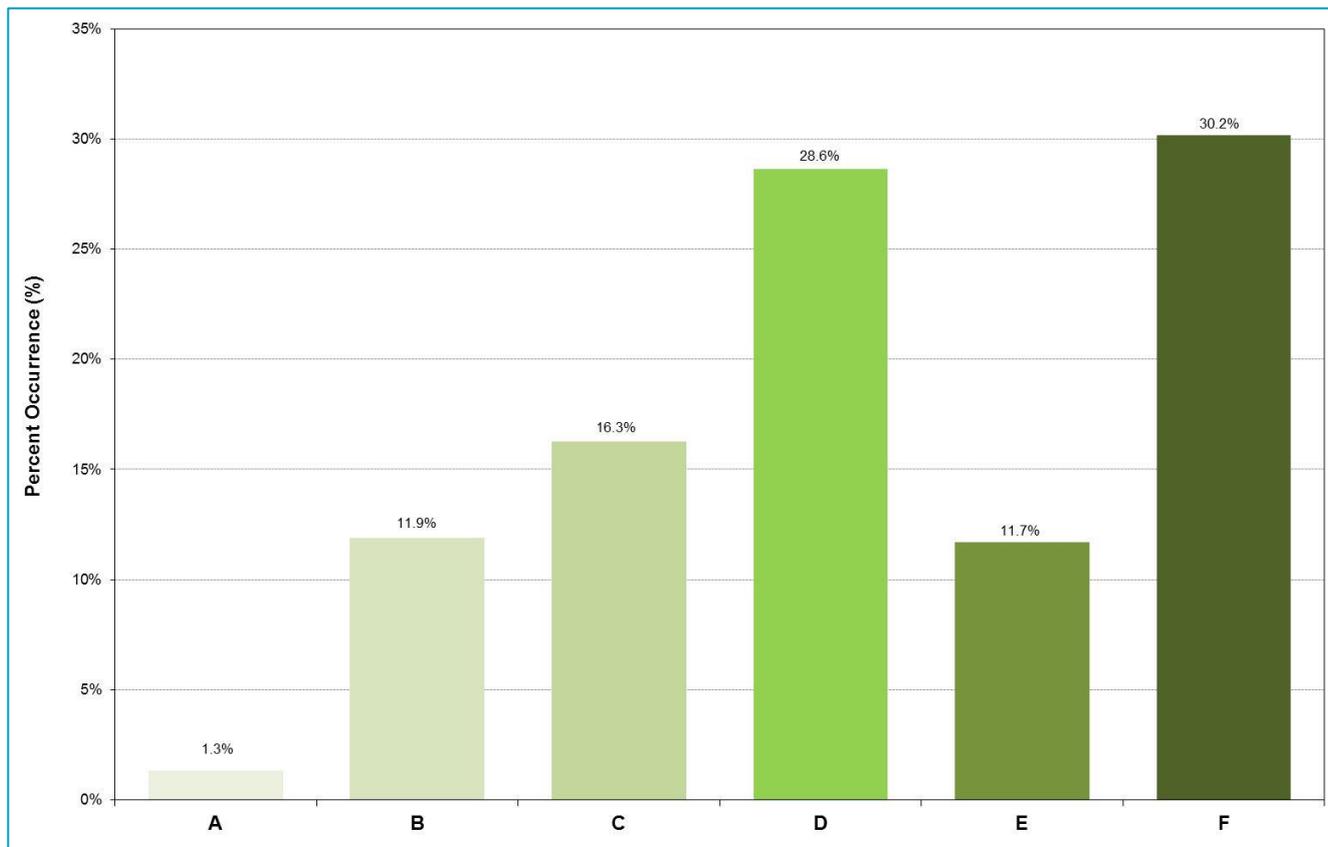
5.2.3   Mixing Heights

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Development Site during the 2015 modelling period are illustrated in **Figure 8**.

As would be expected, an increase in mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground based temperature inversions and growth of the convective mixing layer.

Figure 8   CALMET-Predicted Mixing Heights at the Development Site - 2015
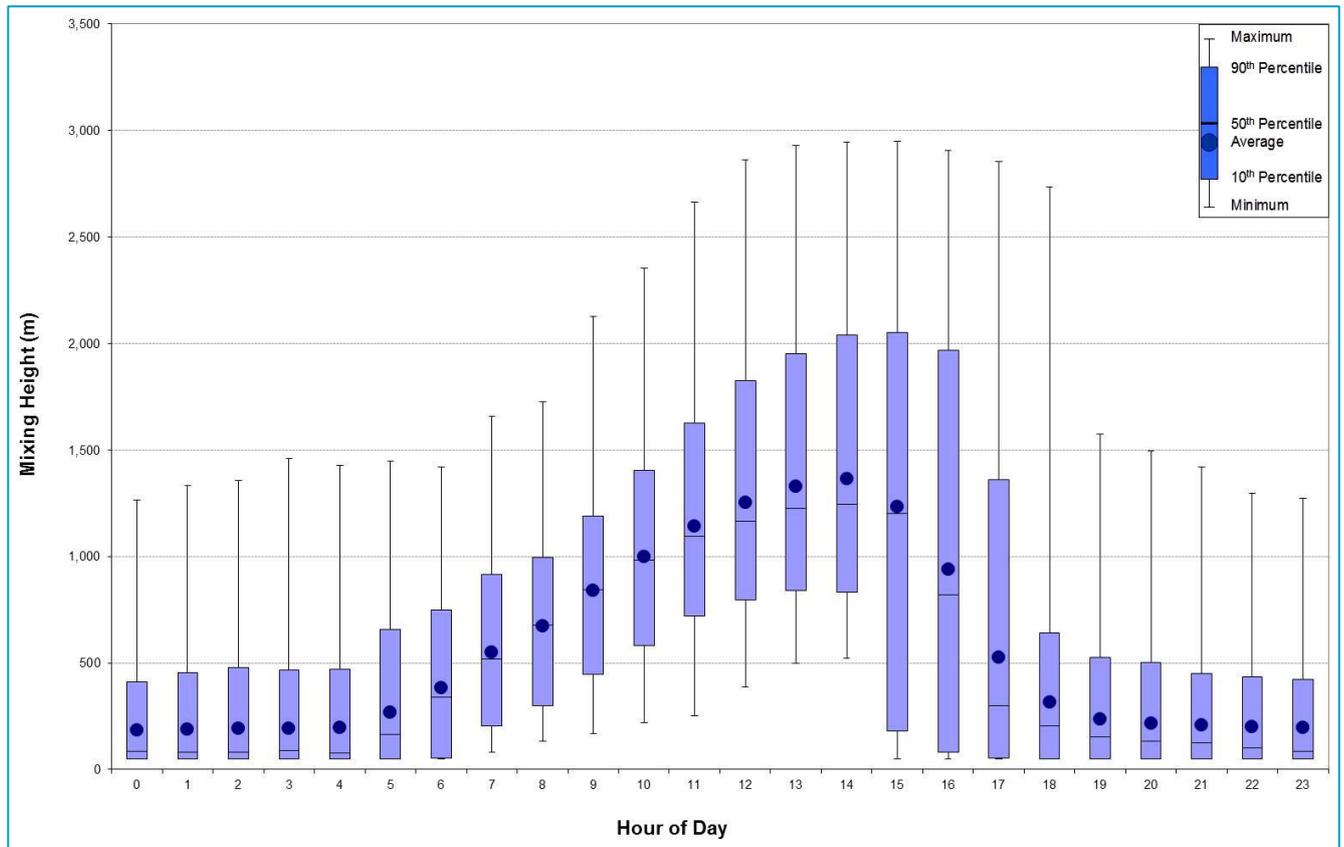
6 Background Air Quality

6.1 Particulates (as PM_{10})

Air quality monitoring is performed by the NSW Office of Environment and Heritage (OEH) at a number of monitoring stations across NSW. The closest such station is the Albion Park South Air Quality Monitoring Station (AQMS), located approximately 102 km northeast of the Development Site. However the Albion Park South AQMS is not considered to be reflective of the particulate levels at the Development Site due to the presence of mining activities (eg stone quarries in Albion Park). Instead, another regional AQMS located in Bathurst is considered appropriate based on similar inland location, regional industries and human population.

Air quality monitoring data recorded by the Bathurst AQMS were obtained for the calendar years 2013 - 2017 and are summarised in **Table 7**.

Table 7   Summary of Bathurst AQMS Data (2013 - 2017)

Pollutant	Averaging Period	Criteria	Year	Bathurst AQMS		Units
				Maximum Concentration	**Number of Exceedances**	
PM_{10}	24-hour	50 $\mu g/m^3$	2013	145.0	3	$\mu g/m^3$
			2014	42.8	0	$\mu g/m^3$
			2015	94.6	2	$\mu g/m^3$
			2016	34.1	0	$\mu g/m^3$
			2017	49.9	0	$\mu g/m^3$
	Annual	25 $\mu g/m^3$	2013	15.1	0	$\mu g/m^3$
			2014	14.6	0	$\mu g/m^3$
			2015	13.4	0	$\mu g/m^3$
			2016	13.3	0	$\mu g/m^3$
			2017	14.1	0	$\mu g/m^3$

Notes: The maximum 24-hour average PM_{10} concentrations were recorded on 10 May 2013, 18 October 2013, 19 October 2013, 6 May 2015 and 25 November 2015.

Exceedances of the 24-hour average PM_{10} criterion were recorded by the Bathurst AQMS in 2013 and 2015. A review of the exceedances recorded during 2013 (OEH 2014) and 2015 (OEH 2017) indicates that they were associated with natural events such as bushfires or dust storms, or hazard reduction burns.

6.2 Odour

As discussed in **Section 2.3**, other odour generating industries exist in the vicinity of the Development Site ie sand and soil supplier, café, motel and a resource recovery facility. Although these are existing odour generating activities in the area, the odours from the poultry processing plant have a different characteristic compared to odours from other operations and it is not appropriate to assume that the odours are directly additive. The *Technical Notes: Assessment and management of odour from stationary sources in NSW* (DEC 2006b) only requires:

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*"Where it is likely that two or more facilities with **similar odour character** will result in cumulative odour impacts, the combined odours due to emissions resulting from all nearby facilities should also be assessed against the odour assessment criteria."*

Similarly, the Queensland Department of Environment and Science Guideline *Odour Impact Assessment from Developments* (DEHP 2013) states:

One of the drawbacks of dispersion modelling with multiple sources of odour is that the model assumes that the odours are additive. While this is correct for single chemical contaminants, it is not correct for odour units because the actual downwind odour concentration will depend on the various concentrations of the chemical constituents in the odour mixture. If the two sources were of quite different make-up, then the combined, diluted mixture of these two odour sources can have quite a different cumulative impact on the receiving environment. In some cases the effects may be additive and in other cases it may be positively or negatively synergistic. The modelling of multiple odour sources is quite complex and a little is currently understood about the cumulative impacts of multiple odour sources. It is reasonable to expect multiple sources of the same type of odorant (eg. multiple sheds on a poultry farm) to be additive in nature. An example of different type of odorant would be the rendering plant cooking odour via a chimney and the diffuse source odour from a wastewater treatment system.

On this basis, it is considered that a cumulative odour assessment is not required for this Project.

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7 Assessment of Dust Emissions During Construction

7.1 Impact Assessment Methodology

For the assessment of construction phase impacts, the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (Holman *et al* 2014) has been used to provide a qualitative assessment method (see **Appendix A** for full methodology). The IAQM method uses a four-step process for assessing dust impacts from construction activities:

- **Step 1**: Screening based on distance to the nearest sensitive receptor; whereby the sensitivity to dust deposition and human health impacts of the identified sensitive receptors is determined.

- **Step 2**: Assess risk of dust effects from activities based on:

  - the scale and nature of the works, which determines the potential dust emission magnitude; and

  - the sensitivity of the area surrounding dust-generating activities.

- **Step 3**: Determine site-specific mitigation for remaining activities with greater than negligible effects.

- **Step 4**: Assess significance of remaining activities after management measures have been considered.

7.2 Step 1 – Screening Based on Separation Distance

As noted in **Section 2.3**, the nearest sensitive receptor (R6) is located approximately 60 m (adjacent plot) from the nearest Development Site boundary.

As sensitive receptors are located within 350 m from the boundary of the site, less than 50 m from the route to be used by construction vehicles on public roads and within 500 m from the site entrance, further assessment is required.

7.3 Step 2a – Assessment of Scale and Nature of the Works

Based upon the above assumptions and the IAQM definitions presented in **Appendix A**, the dust emission magnitudes for each phase of the construction works have been categorised as presented in **Table 8**.

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Table 8   Categorisation of Dust Emission Magnitude

Activity	Dust Emission Magnitude	Basis
Earthworks	Large	Total site area greater than 10,000 m^2, potentially dusty soil type (eg clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 8 m in height, total material moved more than 100,000 t. *Total area where the earthworks will be undertaken at the Development Site is estimated to be approximately 82,000 m^2.*
Construction	Large	Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting. *The total volume of new buildings is estimated to be approximately 280,150 m^3, including:* *~123,480 m^3 for the 'Process Facility' building (147m x 75m x 11.2m);* *~4,220 m^3 for the 'Live Bird Shed' building (27m x22mx7.1m):* *~9,800 m^3 for the 'By-products processing' building (44m x20m x11.1m):* *~124,800 m^3 for the 'Cold Storage' building (104m x 93m x 12.9m)* *~5,950 m^3 for the 'Childcare' building (70m x 10m x 6.9m) + (16.2m x 10m x 6.9)* *~11,900 m^3 for the 'Truck Maintenance' building (38m x33m x9.5m)*
Trackout	Medium	Between 10 and 50 heavy vehicle movements per day, surface materials with a moderate potential for dust generation, between 50 m and 100 m of unpaved road length.

7.4   Step 2b – Risk Assessment

7.4.1   Receptor Sensitivity

Based on the criteria listed in **Table A1** in **Appendix A**, the sensitivity of the identified receptors in this study is concluded to be *high* for health impacts and *high* for dust soiling, as they include residential areas where people may be reasonably expected to be present continuously as part of the normal pattern of land use.

7.4.2   Sensitivity of an Area

Based on the classifications shown in **Table A2** and **Table A3** in **Appendix A**, the sensitivity of the area to dust soiling and health effects may be classified as '*medium*' and '*low*' respectively. This categorisation has been made taking into account the individual receptor sensitivities derived above, the annual mean background PM$_{10}$ concentration of 14.1 µg/m^3 recorded at Bathurst AQMS (see **Section 6.1**) and the anticipated number of sensitive receptors present in the vicinity of the Development Site (a hotel is regarded as a '>100' receptor category).

7.4.3   Risk Assessment

Given the sensitivity of the general area is classified as '*medium*' for dust soiling and '*low*' for health effects, and the dust emission magnitudes for the various construction phase activities as shown in **Table 8**, the resulting risk of air quality impacts is as presented in **Table 9**.

Table 9   Preliminary Risk of Air Quality Impacts from Construction Activities (Uncontrolled)

Impact	Sensitivity of Area	Dust Emission Magnitude			Preliminary Risk		
		Earthworks	Construction	Trackout	Earthworks	Construction	Trackout
Dust Soiling	Medium	Large	Large	Medium	Medium Risk	Medium Risk	Low Risk
Human Health	Low				Medium Risk	Medium Risk	Low Risk

The results indicate that there is a *medium* risk of adverse dust soiling and human health impacts occurring at the off-site sensitive receptor locations if no mitigation measures were to be applied to control emissions during the earthworks and construction phases of the works. The trackout phase has a *low* risk of impacts.

7.5   Step 3 - Mitigation Measures

A reappraisal of the predicted unmitigated air quality impacts on sensitive receptors has been performed to demonstrate the opportunity for minimising risks associated with the use of mitigation strategies. These are termed 'residual impacts'.

Table 10 lists the relevant mitigation measures designated as *highly recommended* (H) or *desirable* (D) by the IAQM methodology for a development shown to have a high risk of adverse impacts. Not all these measures would be practical or relevant to the proposed Development Site, however they will be relevant for the initial stage of site clearing and stripping until the new capping layer is in place. This period of works will likely be relatively short and estimated at say 4 – 6 weeks. Piling for the new deck will therefore take place once the site has been capped. The capping layer should therefore minimise any dust impacts on neighbouring sites.

A detailed review of the recommendations should be performed as part of the development of the Construction Environmental Management Plan (CEMP) and the most appropriate measures adopted. For almost all construction activity, the IAQM Methods notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible.

Table 10   Site-Specific Management Measures Recommended by the IAQM

	Activity	
1	**Communications**	
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	H
1.2	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H
1.3	Display the head or regional office contact information.	H
1.4	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority.	H
2	**Site Management**	
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely	H

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	Activity	
	manner, and record the measures taken.	
2.2	Make the complaints log available to the local authority when asked.	H
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	H
3	**Monitoring**	
3.1	Perform daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary.	D
3.2	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.	H
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H
4	**Preparing and Maintaining the Site**	
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
4.2	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	H
4.3	Keep site fencing, barriers and scaffolding clean using wet methods.	H
4.4	Cover, seed or fence stockpiles to prevent wind erosion	H
5	**Operating Vehicle/Machinery and Sustainable Travel**	
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	H
5.3	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable	H
6	**Operations**	
6.1	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	H
6.2	Use enclosed chutes and conveyors and covered skips	H
6.3	Minimise drop heights from loading shovels and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	H
7	**Waste Management**	
7.1	Avoid bonfires and burning of waste materials.	H
7.2	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D
7.3	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	H
8	**Trackout**	
8.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	H
8.2	Avoid dry sweeping of large areas.	H
8.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	H
8.4	Record all inspections of haul routes and any subsequent action in a site log book.	H
8.5	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	H

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	Activity	
9	**Earthworks**	
9.1	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable	D
9.2	Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable	D
9.3	Only remove the cover in small areas during work and not all at once	D
10	**Construction**	
10.1	Avoid scabbling (roughening of concrete surfaces) if possible	D
10.2	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	H
10.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	D
10.4	For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust	D

H = Highly recommended; D = Desirable

7.6   Step 4 - Residual Impacts

A reappraisal of the predicted unmitigated air quality impacts on sensitive receptors has been performed to demonstrate the opportunity for minimising risks associated with the use of mitigation strategies. These are termed 'residual impacts'. The results of the reappraisal are presented below in **Table 11**.

Table 11   Residual Risk of Air Quality Impacts from Construction

Impact	Sensitivity of Area	Residual Risk		
		Earthworks	**Construction**	**Trackout**
Dust Soiling	High	Low Risk	Low Risk	Negligible Risk
Human Health	High	Low Risk	Low Risk	Negligible Risk

The mitigated dust soiling and human health impacts for trackout activities are anticipated to be *negligible,* whereas for earthworks and construction activities are anticipated to be *low*.

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8 Odour Source and Emission Data

As discussed in **Section 3.2**, the only sources of odour from the poultry processing plant are anticipated to be:

- bird reception area within the processing plant; and
- by-product processing plant.

8.1 Emissions Estimation Methodology

At the time of writing this report, the detailed ventilation design for the poultry processing plant has not been finalised. The ventilation requirements have been calculated using engineering design principles and best industry practice, which were discussed and agreed upon by KDC.

8.1.1 Bird Reception Area

The bird reception area within the processing plant will be a source of fugitive odour when the poultry loaded trucks enter and exit the processing plant building.

It is understood that a maximum of one (1) truck will be present within the bird reception area at any given time. The mean odour emission rate value of 0.35 ou.m^3/s/bird was adopted.

8.1.2 By-product Processing Plant

It is estimated that the by-product processing plant will be processing approximately 148 tonnes per day of waste. As discussed in **Section 2.2.2.2**, the odorous air from the by-product processing plant will be subjected to treatment through a bio-filter.

The preliminary design (email advice received on 27 February 2019) for the bio-filter suggests the following in regards to the bio-filter:

- total exhaust flowrate of up to 30,000 m^3/hour;
- odour concentration of 13,800 ou at the bio-filter inlet; and
- odour concentration of 100 ou at the bio-filter outlet.

The size of the bio-filter was estimated based on previously completed assessment of bio-filters by TOU. The bio-filter for Oakburn Protein Recovery Plant (PRP) was estimated to be of approximately 598 m^2 for a total throughput of 150 tonnes per day (TOU 2013b). Based on this, a bio-filter area of approximately 590 m^2 will be needed for the current Project.

In addition, it assumed that 2% of the total emissions will be released as fugitive emissions from the by-product processing plant building. This is consistent with the monitored emission rates for other protein recovery plant buildings (TOU 2013b).

8.2 Source Parameters

The source parameters for the odour sources are presented in **Table 12**. The bio-filter is modelled as a point source, whereas the bird reception area and the fugitive odours from by-product processing plant building are modelled as volume sources.

Table 12   Source Parameters

Source	Easting (km)	Northing (km)	Elevation (m)	Height (m)	Diameter (m)	Exit Temperature (°C)	Exit Velocity (m)	OER (ou.m^3/s)[1]
Point Sources								
By-product processing plant (Bio-filter)	751.239	6151.209	676	2.5	27.0	40	0.014	1,917
Volume Sources								
Bird reception area	751.240	6151.160	675	5	NA	NA	NA	5,233
By-product processing plant (Fugitive)	751.239	6151.178	675	11	NA	NA	NA	5,290

[1]   The OER is inclusive of peak to mean value of 2.3.

9 Operational Odour Impact Assessment

This section identifies an appropriate odour impact assessment criterion for the poultry processing plant and presents a summary of the odour impacts predicted by the modelling at the sensitive receptors identified in **Section 2.3**.

Figure 9 illustrates the area predicted to be affected by the proposed poultry processing plant operations (ie the area within the 2 ou contour line). It is noted that as a conservative measure, the affected area include the area occupied by the Development Site.

Based on the 2 ou contour line presented in **Figure 9**, it is estimated that a population of approximately 100 people (including the occupants of the proposed child care centre) may be affected. Therefore, an odour impact assessment criterion (expressed as the 99th percentile for a nose response average, ie 1-second average) of 4 ou has been adopted (refer **Table 2**) for this Project.

Table 13   Predicted Odour Concentrations at the Nearest Receptors

Receptor ID	Coordinates (UTM, m)		Predicted 99th Percentile 1-hour average (nose response time) Odour Concentration (ou)
	X	Y	
R1	751,567	6,151,302	0.7
R2	751,723	6,151,023	1.0
R3	751,701	6,150,879	0.6
R4	751,408	6,150,955	1.1
R5	751,075	6,150,791	0.7
R6	751,131	6,151,285	2.9
R7	751,386	6,151,409	0.8
R8	751,500	6,151,358	0.7
C1	751,636	6,151,266	0.7
C2	750,897	6,151,126	0.6
C3	751,288	6,151,459	0.7
CCC	751,526	6,151,081	1.2
Adopted Criterion (ou)			**4.0**

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Figure 9   Affected Area for Modelled Scenarios
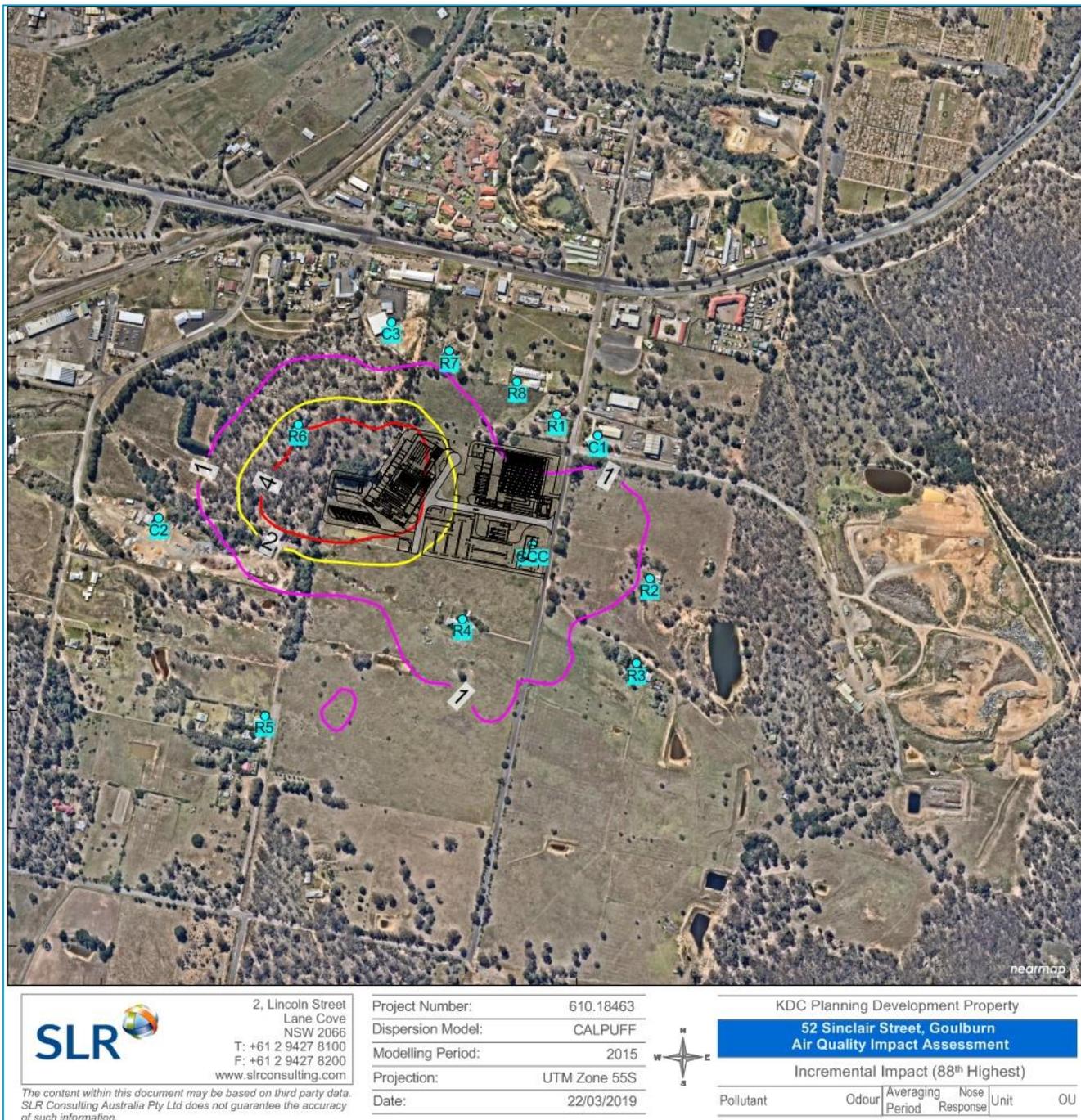
The 99th percentile 1-hour average odour concentrations predicted for the operations of the proposed poultry processing plant are presented in **Table 13**. The results show that the predicted 99th percentile odour concentrations at the nearest lots are below the relevant criterion.

The predicted 1-hour average 99th percentile odour concentrations are presented as a contour plot in **Figure 9**. It is noted that the odour contour plot does not reflect odour concentrations occurring at any particular instant in time, but rather illustrates a compilation of the predicted 99th percentile (88th highest) odour concentration at all locations downwind, taking into account all combinations of meteorological conditions modelled across the entire year.

To provide some context, the UK *Odour Guidance for Local Authorities* (DEFRA 2010) provides the following guidance as to when odour concentrations becomes apparent (derived from laboratory measurements of intensity):

- 1 ou is the detection threshold for odour (by definition);

- 5 ou is a typical concentration for a faint odour; and

- 10 ou is a typical concentration for a distinct odour.

Therefore, odours may be detected at all the identified sensitive receptors, but are unlikely to be of such an intensity to be considered offensive, especially given the semi-rural setting of the Project.

Maximum concentrations of odour generally tend to occur when meteorological conditions are least favourable for dispersion. These times of day are usually characterised by low winds speeds (ie calm conditions) and a stable atmosphere, which typically occur during the evenings and overnight.

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10   Conclusions

SLR was commissioned by KDC to conduct an air quality impact assessment (AQIA) for the construction and operation of a proposed mixed use development including a poultry processing plant, child care facility and other associated infrastructure (combined 'the Development Site'), to be located 52 Sinclair St, Goulburn NSW.

This report has been prepared to inform a State Significant Development Application (SSDA) and focused on assessing potential air quality impacts from the construction of the Development Site, and operation of the proposed poultry processing plant.

The aim of this AQIA is to determine the potential air quality risks associated with the construction of the Development Site and the operation of the proposed poultry processing plant.

The assessment of air quality impacts during construction of the Development Site was conducted based on a qualitative risk assessment method developed by the Institute of Air Quality Management (IAQM). It was concluded that off-site impacts associated with dust deposition and human health impacts during earthworks and construction activities can be managed to be *low,* whereas for trackout activities impacts can be managed to *negligible.* A range of mitigation measures have been recommended for consideration as part of the CEMP.

To assess the air quality impacts during operations of the proposed poultry processing plant, emissions estimation and dispersion modelling were performed. The assessment methodology included meteorological and dispersion modelling using established and recognised modelling techniques. Emission rates and source parameters defined for the modelling scenario were based on site-specific information and assessments carried out for similar facilities.

Predicted ground level concentrations of odour were below the impact assessment criterion of 4 ou at the identified sensitive receptor locations. Odours may be detected at the closest residences to the Development Site but are unlikely to be of such an intensity to be considered offensive, especially given the rural nature of the setting.

It is recommended that once the detailed ventilation design is completed, the dispersion modelling is repeated to ensure compliance with the regulatory criterion.

Based on the above, it is concluded that provided the poultry processing plant and the associated operations are well managed, minimal adverse off-site odour impacts are anticipated.

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11   References

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CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

Step 1 – Screening Based on Separation Distance

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receptors are located more than 350 m from the boundary of the site, more than 50 m from the route used by construction vehicles on public roads and more than 500 m from the site entrance. This step is noted as having deliberately been chosen to be conservative, and will require assessments for most projects.

Step 2a – Assessment of Scale and Nature of the Works

Step 2a of the assessment provides "dust emissions magnitudes" for each of four dust generating activities; demolition, earthworks, construction, and track-out (the movement of site material onto public roads by vehicles). The magnitudes are: *Large*; *Medium*; or *Small*, with suggested definitions for each category. The definitions given in the IAQM guidance for earthworks, construction activities and track-out, which are most relevant to this Development, are as follows:

Demolition *(Any activity involved with the removal of an existing structure [or structures]. This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time)*:

- **Large**: Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;

- **Medium**: Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and

- **Small**: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

Earthworks *(Covers the processes of soil-stripping, ground-levelling, excavation and landscaping)*:

- **Large**: Total site area greater than 10,000 m^2, potentially dusty soil type (eg clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 8 m in height, total material moved more than 100,000 t.

- **Medium**: Total site area 2,500 m^2 to 10,000 m^2, moderately dusty soil type (eg silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 4 m to 8 m in height, total material moved 20,000 t to 100,000 t.

- **Small**: Total site area less than 2,500 m^2, soil type with large grain size (eg sand), less than five heavy earth moving vehicles active at any one time, formation of bunds less than 4 m in height, total material moved less than 20,000 t, earthworks during wetter months.

Construction *(Any activity involved with the provision of a new structure (or structures), its modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, etc)*:

- **Large**: Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting.

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- *Medium*: Total building volume 25,000 m^3 to 100,000 m^3, potentially dusty construction material (eg concrete), piling, on site concrete batching.

- *Small*: Total building volume less than 25,000 m^3, construction material with low potential for dust release (eg metal cladding or timber).

Track-out *(The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network)*:

- *Large*: More than 50 heavy vehicle movements per day, surface materials with a high potential for dust generation, greater than 100 m of unpaved road length.

- *Medium*: Between 10 and 50 heavy vehicle movements per day, surface materials with a moderate potential for dust generation, between 50 m and 100 m of unpaved road length.

- *Small*: Less than 10 heavy vehicle movements per day, surface materials with a low potential for dust generation, less than 50 m of unpaved road length.

Note: No demolition of existing structures will be performed as part of this Development.

In order to provide a conservative assessment of potential impacts, it has been assumed that if at least one of the parameters specified in the 'large' definition is satisfied, the works are classified as large, and so on.

Step 2b – Risk Assessment

Assessment of the Sensitivity of the Area

Step 2b of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:

- The specific sensitivities that identified sensitive receptors have to dust deposition and human health impacts;

- The proximity and number of those receptors;

- In the case of PM$_{10}$, the local background concentration; and

- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Individual receptors are classified as having *high*, *medium* or *low* sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects as summarised in **Table A1**. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

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Table A1   IAQM Guidance for Categorising Receptor Sensitivity

Value	High Sensitivity Receptor	Medium Sensitivity Receptor	Low Sensitivity Receptor
Dust soiling	Users can reasonably expect a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land.	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.	The enjoyment of amenity would not reasonably be expected; or Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.
	Examples: Dwellings, museums, medium and long term car parks and car showrooms.	*Examples: Parks and places of work.*	*Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*
Health effects	Locations where the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where human exposure is transient.
	Examples: Residential properties, hospitals, schools and residential care homes.	*Examples: Office and shop workers, but will generally not include workers occupationally exposed to PM10.*	*Examples: Public footpaths, playing fields, parks and shopping street.*

According to the IAQM methods, the sensitivity of the identified individual receptors (as described above) is then used to assess the *sensitivity of the area* surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background PM_{10} concentration (in the case of potential health impacts) and other site-specific factors. Additional factors to consider when determining the sensitivity of the area include:

- any history of dust generating activities in the area;

- the likelihood of concurrent dust generating activity on nearby sites;

- any pre-existing screening between the source and the receptors;

- any conclusions drawn from analysing local meteorological data which accurately represent the area and if relevant, the season during which the works will take place;

- any conclusions drawn from local topography;

- the duration of the potential impact (as a receptor may be willing to accept elevated dust levels for a known short duration, or may become more sensitive or less sensitive (acclimatised) over time for long-term impacts); and

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- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in **Table A2**. The sensitivity of the area should be derived for each of activity relevant to the project (ie construction and earthworks).

Table A2   IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

Receptor Sensitivity	Number of receptors	Distance from the source (m)			
		<20	**<50**	**<100**	**<350**
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Note: Estimate the total number of receptors within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors < 20m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors < 50 m is 102. The sensitivity of the area in this case would be high.

A modified version of the IAQM guidance for assessing the *sensitivity of an area* to health impacts is shown in **Table A3**. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (ie an annual average of 19.8 µg/m^3 for PM_{10}) the IAQM method has been modified slightly.

This approach is consistent with the IAQM guidance, which notes that in using the tables to define the *sensitivity of an area*, professional judgement may be used to determine alternative sensitivity categories, taking into account the following factors:

- any history of dust generating activities in the area;

- the likelihood of concurrent dust generating activity on nearby sites;

- any pre-existing screening between the source and the receptors;

- any conclusions drawn from analysing local meteorological data which accurately represent the area, and if relevant the season during which the works will take place;

- any conclusions drawn from local topography;

- duration of the potential impact; and

- any known specific receptor sensitivities which go beyond the classifications given in this document.

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Table A3   IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Receptor sensitivity	Annual mean PM$_{10}$ conc.	Number of receptors [a,b]	Distance from the source (m) <20	<50	<100	<200	<350
High	>25 µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	21-25 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	17-21 µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<17 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>25 µg/m^3	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	21-25 µg/m^3	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	17-21 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<17 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Notes:

(a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m); noting that only the highest level of area sensitivity from the table needs to be considered.

(b) In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

Risk Assessment

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then used in the matrices shown in **Table A4** (earthworks and construction) and **Table A5** (track-out) to determine the risk category with no mitigation applied.

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Table A4   Risk Category from Earthworks and Construction Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A5   Risk Category from Track-out Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Table A6   Risk Category from Demolition Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

APPENDIX B

SELECTION OF REPRESENTATIVE METEOROLOGICAL DATA

Once emitted to atmosphere, the emissions will:

- Rise according to the momentum and buoyancy of the emission at the discharge point relative to the prevailing atmospheric conditions;

- Be adverted from the source according to the strength and direction of the wind at the height which the plume has risen in the atmosphere;

- Be diluted due to mixing with the ambient air, according to the intensity of turbulence; and

- (Potentially) be chemically transformed and/or depleted by deposition processes.

Dispersion is the combined effect of these processes. Dispersion modelling is used as a tool to simulate the air quality effects of specific emission sources, given the meteorology typical for a local area together with the expected emissions. Selection of a year when the meteorological data is atypical means that the resultant predictions may not appropriately represent the most likely air quality impacts. Therefore, in dispersion modelling, one of the key considerations is the representative nature of the meteorological data used.

The year of meteorological data used for the dispersion modelling was selected by reviewing the most recent five years of historical surface observations at Goulburn Airport AWS (2013 to 2017 inclusive) to determine the year that is most representative of average conditions. Wind direction, wind speed and ambient temperature were compared to averages for the region to determine the most representative year.

Data collected from 2013 to 2017 is summarised in **Figure B1** to **Figure B3**. Examination of the data indicates the following:

- **Figure B1** indicates relatively similar wind roses for all years analysed. It is noted that the most significant difference is observed for the year 2016;

- **Figure B2** indicates that 2015 exhibit wind speeds that are closest to the long term average; and

- **Figure B3** shows that temperatures in 2014 and 2015 more closely reflect the long term average.

Given the above, the year 2015 was selected as the representative year of meteorology.

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APPENDIX B – SELECTION OF REPRESENTATIVE METEOROLOGICAL DATA

Figure A1 Frequency of Winds at Goulburn Airport AWS for 2013 – 2017

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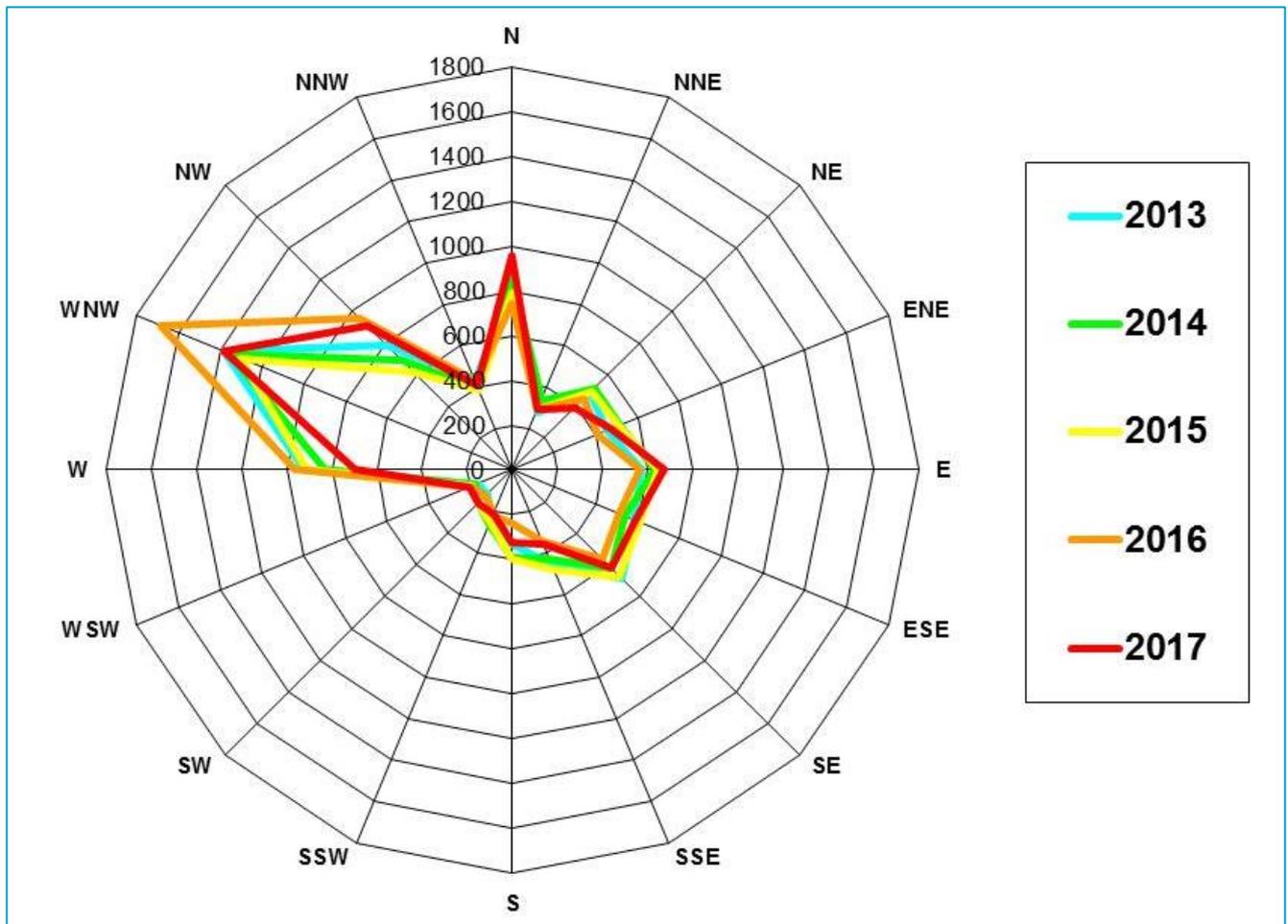
Figure A2 Monthly Average Wind Speed at Goulburn Airport AWS for 2013 – 2017
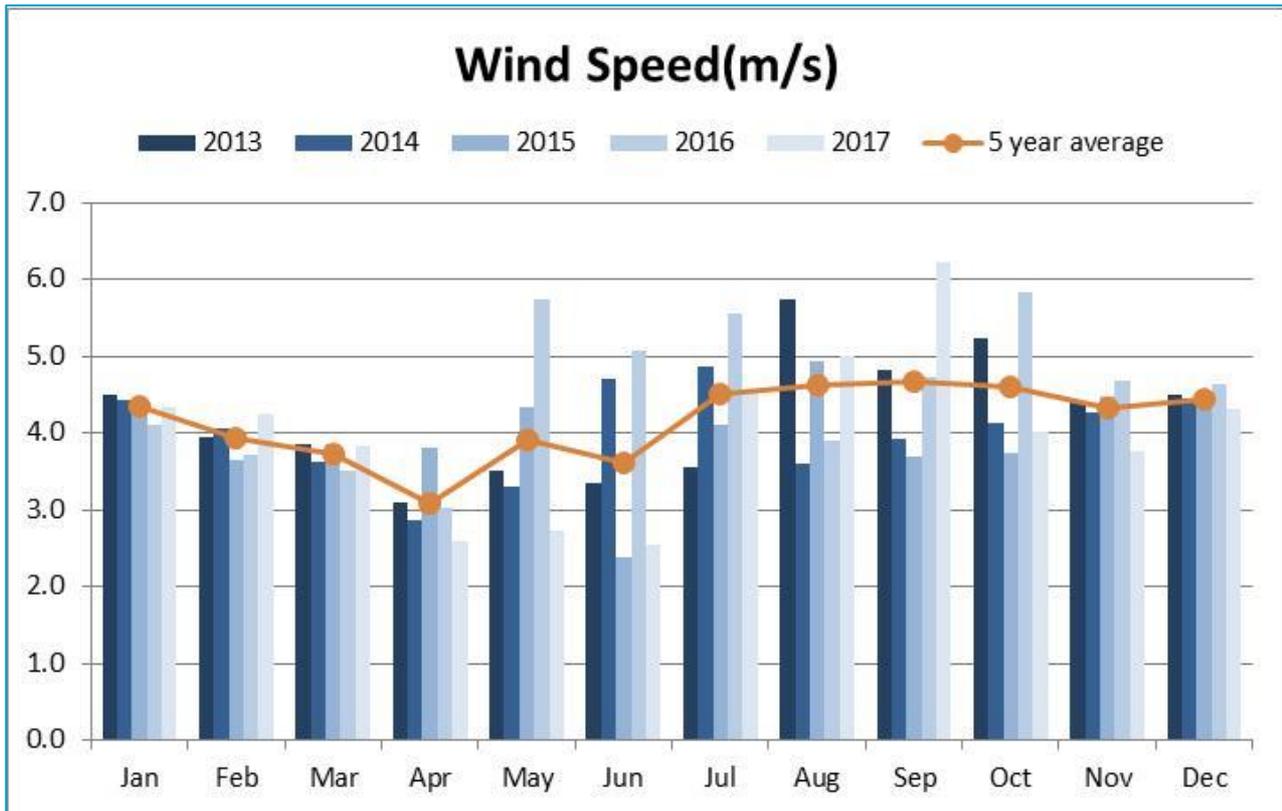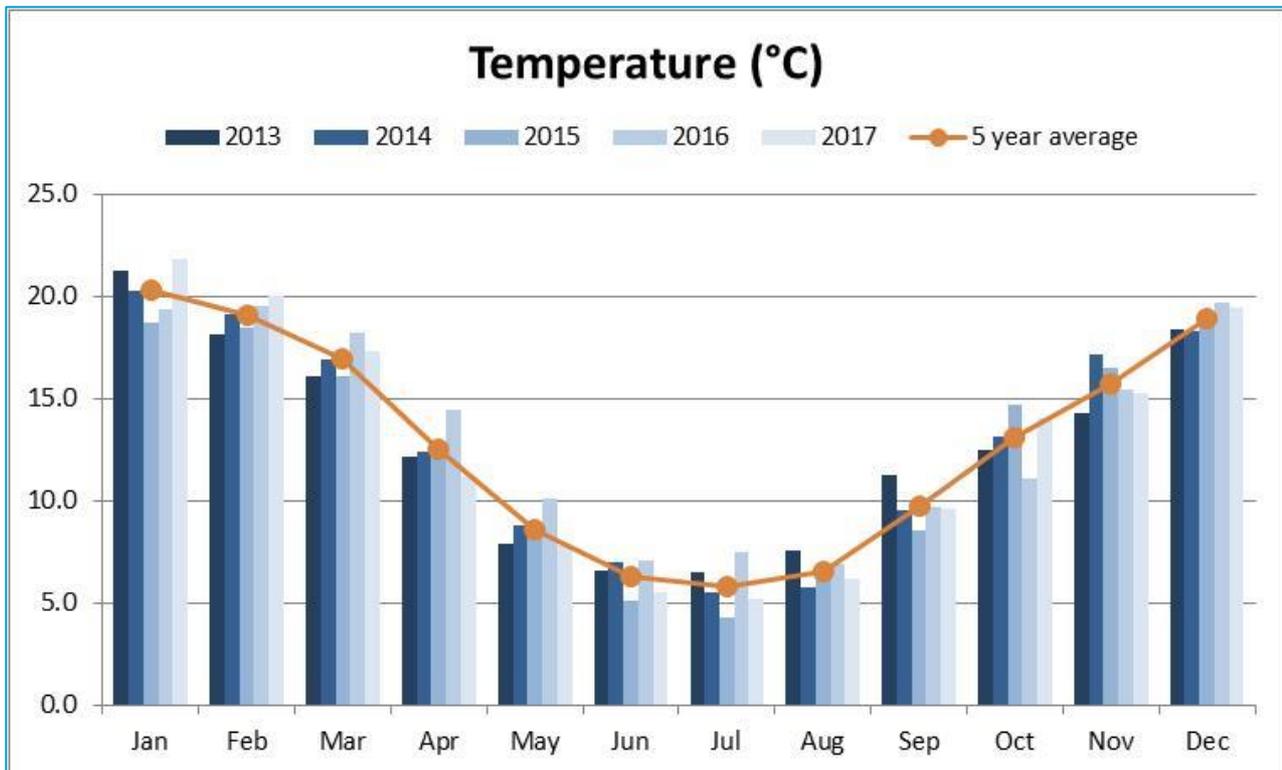

Figure A3 Monthly Average Temperature at Goulburn Airport AWS for 2013 – 2017

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