Proposed Extension to Warehouse,

14-28 Katrina Street, Oakey

Response to Information Request - Air Quality Impact Assessment

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Role	Name	Position	Signature	Date Signed
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Terms and Abbreviations

Abbreviation	Definition of term
AP-42	Air Pollutant Emissions Factors
Approved Methods	Approved Methods for Modelling and Assessment of Air Pollutants in NSW
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CALPUFF	California Puff Model
CALMET	California Meteorological Model
Council	Toowoomba Regional Council
Cumulative Impacts	Incremental + background
DETSI	Department of Environment, Tourism, Science & Innovation
EA	Environmental Approval
EPA	Environmental Protection Authority
EPP Air 2019	*Environmental Protection (Air) Policy 2019*
EPP Air 2024	*Environmental Protection (Air) Amendment Policy 2024*
EETM	Emission Estimation Technique Manual
Incremental Impacts	Impacts from proposed development
m^3	Cubic metres
NEPM	National Environment Protection Measures
NOOBS	No-observations
NPI	National Pollutant Inventory
$PM_{2.5}$	Particulate Matter ≤2.5 micrometres
PM_{10}	Particulate Matter ≤10 micrometres
QLD	Queensland
SRTM	Shuttle Radar Topography Mission
TAPM	'The Air Pollution Model'
Tpa	Tonnes per annum
TSP	Total Suspended Particulates
UTM	Universal Transverse Mercator coordinate system
VAAU	Virid Ardent AU
µm	micrometre
$\mu g/m^3$	Microgram per cubic metre

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1 Introduction

A development application (DA) has been lodged with Toowoomba Regional Council ('the Council') by Riverina (Australia) Pty Ltd ('Riverina') for proposed expansion of existing warehouse which include grain storage and handling ('the facility') at 14-28 Katrina Street, Oakey QLD.

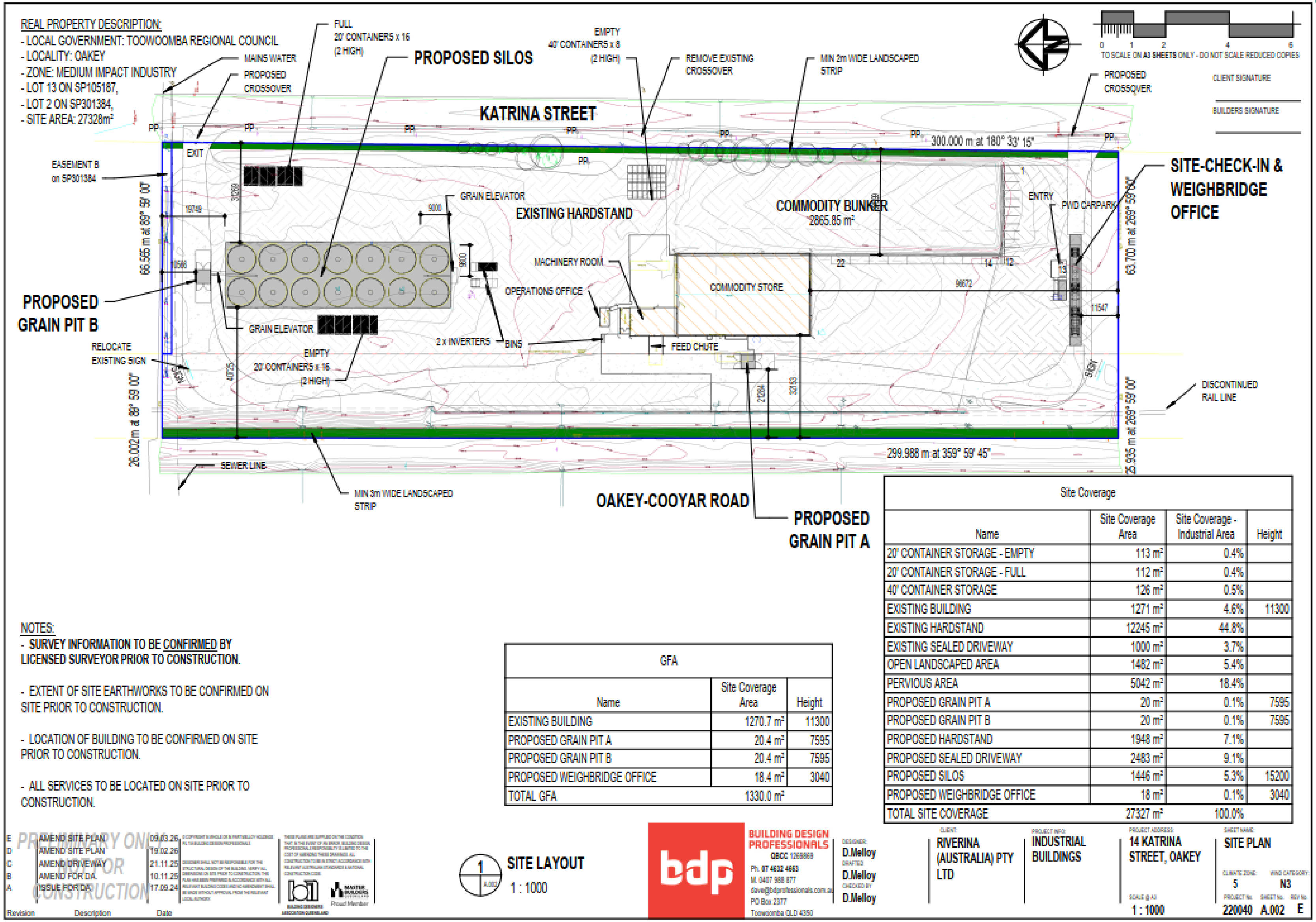
A site plan of the facility is provided in **Figure 1.**

The proposed expansion to the facility will include the following:

- Construction of a new ring road around the rear of the development. A new site access will be provided at the southern end of the site with a new exit at the northern end. The existing access point for the site will be removed,
- Installation of a new weighbridge and office on the southern side of the site,
- Installation of a new grain pit on the northern side of the grain silos and one to the west of the commodity store,
- Installation of pit elevators and drag conveyor at the northern end of the grain silos and installation of inverters at the southern end of the grain silos for loading; and,
- Relocation of the approved carparks to a new location north of the new site access.

An air quality impact assessment was completed in support of the DA and was submitted on 20 August 2025. Upon submission, Council issued an information request (IR) on 23 January 2026, seeking additional details on several environmental matters, including air quality, as outlined in **Table 1**.

Table 1 also summarises Virid ArdentAU's (VAAU) responses to each IR comment and identifies the sections of this report where each matter has been addressed.



GFA

Name	Site Coverage Area	Height
EXISTING BUILDING	1270.7 m²	11300
PROPOSED GRAIN PIT A	20.4 m²	7595
PROPOSED GRAIN PIT B	20.4 m²	7595
PROPOSED WEIGHBRIDGE OFFICE	18.4 m²	3040
TOTAL GFA	1330.0 m²	

Site Coverage

Name	Site Coverage Area	Site Coverage - Industrial Area	Height
20' CONTAINER STORAGE - EMPTY	113 m²	0.4%	
20' CONTAINER STORAGE - FULL	112 m²	0.4%	
40' CONTAINER STORAGE	126 m²	0.5%	
EXISTING BUILDING	1271 m²	4.6%	11300
EXISTING HARDSTAND	12245 m²	44.8%	
EXISTING SEALED DRIVEWAY	1000 m²	3.7%	
OPEN LANDSCAPED AREA	1482 m²	5.4%	
PERVIOUS AREA	5042 m²	18.4%	
PROPOSED GRAIN PIT A	20 m²	0.1%	7595
PROPOSED GRAIN PIT B	20 m²	0.1%	7595
PROPOSED HARDSTAND	1948 m²	7.1%	
PROPOSED SEALED DRIVEWAY	2483 m²	9.1%	
PROPOSED SILOS	1446 m²	5.3%	15200
PROPOSED WEIGHBRIDGE OFFICE	18 m²	0.1%	3040
TOTAL SITE COVERAGE	27327 m²	100.0%	

Figure 1: Proposed site plan

Source: Riverina (Australia) Pty Ltd

Table 1: Air quality and dust impacts component of the Council's IR and VAAU's response

Council IR Comment	VAAU Response
The proposed development includes multiple on-site activities that are expected to generate air and dust emissions, impacting on surrounding receptors. It is noted that the applicant submitted an Air Quality Impact Assessment, Revision 1, prepared by ViridAU and dated 20 August 2025. *Further information is required to demonstrate compliance against Performance Outcomes PO_{20} and PO_{22} of the Environmental Standard Code including:* *1. Council notes that Figure 2 – site plan within the submitted Air Quality Impact Assessment report is outdated and does not reflect the current site plan submitted as part of the application;*	**Figure 1**, in **Section 1**, has been updated and now reflects the current site plan.
2. The submitted Planning Report states that the Cotton Seed Bunker will utilise tarps underneath and on top of the stored cotton seed to control dust emissions. Section 2 of the Air Quality Impact Assessment Report however, states there is a cotton shed used to store the cottons seed. *"Cotton seed delivered to the site will be unloaded into a cotton seed pit that will be installed at the western side of the shed which will be transferred into cotton shed using an auger. Cotton seeds from the shed will be loaded into containers using auger and will be transport off-site."* *It is unclear where the cotton seed is to be stored - in a shed or under the tarpaulined area noted as Cotton Seed on the submitted site plans?*	Cotton seed and grain will be stored in the commodity store, with any excess material placed in commodity bunker covered with tarpaulins to minimise exposure to wind and reduce dust emissions. Refer to **Section 2** for further details.
3. It is unclear whether cotton seeds are to be unloaded directly to the cotton seed area on the site plans, or if they will be loaded to Grain Pit A (refer site plans) and then transferred through some other means. *"Cotton seed delivered to the site will be unloaded into a cotton seed pit that will be installed at the western side of the shed which will be transferred into cotton shed using an auger."* *Will there be another manual handling point to move cotton seeds from the grain store to an existing or new shed? Confirmation is required;*	Excess cotton seed and grains will be unloaded by trucks directly onto commodity bunker. Refer **Section 2** for further details.
4. All loading and unloading points are not clearly outlined in the Air Quality Impact Assessment report. Council	Refer **Section 2** and **Figure 8** for the modelled fugitive dust emission sources

Council IR Comment	VAAU Response
requires an updated Site Plan to be submitted showing all emission sources from site. This must include all pits, lifts, elevators, vents, manual handling (e.g. FEL's), and anything else required for both loading, unloading, and other storage activities;	
5. *Within section 8 of the Air Quality Impact Assessment report, it was assumed that 3% of the total throughput corresponds to cotton seed, whilst the remaining 97% is for grain throughput. Please explain this split. It is also unclear if there are increased emissions from the difference source materials (grains vs cotton seed) and if different controls for cotton seed handling are required compared to grain; and*	At the time of this assessment, the specific throughput for each seed type to be handled and stored are unknown. However, it is anticipated that the majority of material will consist of grain seeds, with cottonseed accounting for no more than 10–15% of the total throughput. Furthermore, literature published by The University of Sydney[1] suggests that there are similarities between both types of seeds with regards to emissions generated, and therefore the assessment considered impacts associated with grain seeds only. Refer **Section 2** for further details.
6. *Table 6 of the Air Quality Impact Assessment report requires an amendment to show all loading and unloading emission sources. At present, only loading is shown. These emissions points / sources must align with the site plan that indicates all the emission sources (see point 4 above).*	Refer **Section 8** and **Table 7**
Provide a revised Air Quality Impact Assessment report, site plans, and additional justification that addresses the issues noted above.	This assessment report

2 Project Overview

The facility is located on Lot 14 SP105187 at 18-29 Katrina Street, Oakey. The site is zoned as Medium Impact Industry within the Toowoomba Regional Council Planning Scheme. The facility currently receives, stores and distributes approximately 13,000 tpa bulk grain and cotton seed including sorghum, wheat, barley, maize, and oilseed.

The primary operation at the facility involves delivery of grain and cotton seed by truck, which are stored in on-site silos, commodity store, and commodity bunker which are packed into containers and trucks for off-site distribution.

Riverina are planning to increase their annual throughput to 26,000 tpa, by implementing several upgrades which include the following:

- Construction of a new ring road around the rear of the development. A new site access will be provided at the southern end of the site with a new exit at the northern end. The existing access point for the site will be removed,
- Installation of a new weighbridge and office on the southern side of the site,
- Installation of a new grain pit to the west of the commodity store (Grain Pit A) and one on the northern side of the grain silos (Grain Pit B),
- Installation of pit elevators and drag conveyor at the northern end of the grain silos and installation of inverters at the southern end of the grain silos for loading; and,
- Relocation of the approved carparks to a new location north of the new site access.

The proposed expansion once approved will include following activities:

- Incoming grain and cotton seed trucks will be weighed at the weighbridge before being directed to either Grain Pit A or Grain Pit B. Following unloading, trucks will exit the site via northern exit gate,
- Grain will be stored within the silos, while the commodity store will be used for storage of both grain and cotton seed,
- Grain or cotton seed unloaded at Grain Pit A will then be transferred into the commodity store via an auger through the roof opening,
- During peak periods when storage capacity of commodity store is exceeded, trucks will be directed to commodity bunker located east of the commodity store, where grain or cotton seed will be temporarily stored and covered with tarpaulins to minimise dust emissions,
- Grain or cotton seed in commodity store will be loaded into trucks via auger north of commodity store,
- Grain unloaded at Grain Pit B will be loaded into the silos using grain elevators,
- Container trucks arriving on site will go over weighbridge get weighed and the empty container will be unloaded using container forklift west of the silos; and,

- The containers is filled using grain elevators and inverters south of the silos. Filled containers will be temporarily stored to the east of the silos before being loaded onto trucks at the northern exit for off-site transport,
- Commodity bunker where excess grain or cotton seed will be stored temporarily and the haul truck route within the site will be concrete paved.

Based on the information provided to VAAU, approximately 4,000 tpa of grain or cotton seed will be stored within the commodity store, 800 tpa within the commodity bunker, and the remaining 21,200 tpa of grain will be stored within the silos.

At this stage, the exact breakdown between seed types i.e., cotton seed and grain seed stored within commodity store and commodity bunker is unknown. However, grain is expected to comprise the majority of the total throughput, with cottonseed assumed to represent no more than 10–15% of the total. Furthermore, based on the literature published by The University of Sydney[1] suggested that there are similarities between both types of seeds with regards to emissions generated, and therefore the assessment considered impacts associated with grain seeds only.

The facility operates between 6:30 AM and 7:00 PM, Monday to Friday. However, for the purpose of this assessment, it is assumed that the facility operates from 6:00 AM to 7:00 PM everyday.

2.1 Potential Source of Air Emissions

This section provides a brief overview of the potential air emission sources associated with the activities undertaken at the site and those considered in this assessment.

- Unloading of grain or cotton seed at Grain Pit A (west of commodity store),
- Unloading of overflow at commodity bunker,
- Unloading of grain at Grain Pit B (north of silos),
- Loading grain or cotton seed into commodity store using auger,
- Loading grain or cotton seed into truck using auger (north of commodity bunker),
- Loading containers using grain elevator and inverter (south of silos); and,
- Wheel generated dust emissions from haul trucks on paved roads.

These activities have the potential to generate particulate matter emissions, including Total Suspended Particles (TSP), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), and deposited dust.

Further reasoning for identifying these sources is presented below.

2.1.1 Construction Emissions

The proposed expansion would include construction of access road, installation of weighbridge, grain and cotton pit and installation of grain elevators and invertors. There would be some dust emissions

[1] *Organic farm dusts , Australian Centre of Agriculture Health and Safety, published by The University of Sydney - No.12 Organic Farm Dusts*

generated during the construction phase of the proposed expansion. However, it is expected that these activities would occur only for a limited period of time, as opposed to the operational activities. Given that construction activities are progressive and transient in nature, the potential for them to adversely impact the local air quality is low and therefore have been excluded from the assessment.

Construction related dust impacts can be effectively managed through implementation of control measures which are summarised below:

- Minimise drop height of material handling equipment,
- Identify weather conditions (dry and high wind blowing from dust source to sensitive receptors) and halt dust emitting activities if visible dust impacts are identified at sensitive receptors,
- Speed restrictions,
- Application of water to reduce dust emissions; and,
- Minimise amount of temporary material stockpile if possible.

2.1.2 Fugitive Emissions

Fugitive dust emissions at the facility are limited to loading, unloading and vehicular movement on the paved surface. Particulate emissions such as PM_{10}, $PM_{2.5}$ and Total Suspended Particles (TSP) are excepted from the identified air emission sources.

As described in the process description, the commodity store will accommodate both grain and cotton seed and will remain enclosed for the majority of the time. While loaders will operate within the commodity store, the enclosed nature of the structure will significantly limit the dispersion of dust beyond the building. Accordingly, emissions from these activities are expected to be minimal and have not been included in the assessment.

During peak periods, any excess material will be directed to the commodity bunker located east of the commodity store. Material stored at the commodity bunker will be covered with tarpaulins to minimise exposure to wind and reduce dust emissions. Accordingly, wind erosion emissions from stockpiles are expected to be negligible and have been excluded from the assessment.

In addition, based on information provided by VAAU, simultaneous loading and unloading activities will not occur at the commodity bunker. Therefore, only fugitive dust emissions associated with unloading activities at this location have been considered.

The conveying of grain via auger systems is largely enclosed and therefore expected to generate minimal emissions. As a result, emissions from the conveying process itself have not been included in the assessment. However, fugitive emissions that may occur at discharge points (e.g., during truck loading), have been considered.

Furthermore, emissions associated with filling of silos are expected to be very minimal due to controlled operational practices. The silos are designed to be sealed (gas-tight), and fumigation is routinely undertaken to control pests within the stored grain using fumigants such as methyl bromide and sulfuryl fluoride, which are commonly applied for stored grain pest control.

The fumigation process involves sealing the silo and undertaking pressure testing to confirm gas-tight integrity. The fumigant is then introduced into the silo via a gas infeed tube, and internal aeration systems are activated to ensure uniform distribution of the fumigant throughout the stored material. Maintaining a gas-tight enclosure is critical to retain the fumigant at the required concentration for effective treatment.

Following the required fumigation period, the silo is vented in a controlled manner, typically through designated top openings, to allow dissipation of the fumigant prior to recommencement of normal operations. Fumigants such as methyl bromide and sulfuryl fluoride will be used. These fumigants are primarily associated with occupational health and exposure risks rather than environmental impacts.

Given the infrequent nature of fumigation activities, the relatively small quantities of fumigants used, and the short duration of venting events, such emissions are not expected to represent a significant source of air pollutants.

In addition, the use of slow and controlled filling processes minimises disturbance of stored material and reduces the potential for dust generation. Accordingly, emissions from silo loading, storage, and fumigation activities have been excluded from the assessment.

3 Assessment Methodology

To assess impacts from the proposed operations, air dispersion modelling has been undertaken which includes the following components:

- Development of a meteorological model to simulate transportation of pollutants from the source to the receptors,
- Estimating pollutant emission rates released from the proposed expansion operations,
- Dispersion modelling of emissions from the proposed expansion operations. The CALPUFF dispersion model has been utilised to simulate the transportation of pollutants from the source to the receptors,
- Determination of background pollutant concentrations for the modelled pollutants, including ascertaining contributions from nearby sources; and,
- Predicting incremental (facility only) and cumulative (facility + background) impacts at the identified receptors and comparing the model predictions against relevant air quality objectives to assess compliance.

The overall assessment has been undertaken in accordance with the following guidelines:

- Department of Environment, Tourism, Science & Innovation (DETSI) publication – *Application to requirements for activities with impacts to air*, Environmental Protection Act 1994, November 2025,
- Queensland *Environmental (Air) Protection Amendment Policy 2019*(EPP Air 2019),
- Queensland *Environmental (Air) Protection Amendment Policy 2024* (EPP Air 2024),
- Toowoomba Regional Council Planning Scheme, V28, November 2022; and,
- *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW*, Australia' published by the NSW – Environment Protection Authority (NSW-EPA) (formerly the Office of Environment and Heritage – OEH), 2011.

4 Study Area and Surrounds

4.1 Existing Land Use and Topography

The site is located on Lot 14 SP105187 at 18-29 Katrina Street, Oakey. The site is zoned as Medium Impact Industry within Toowoomba Regional Council Planning Scheme.

The land surrounding the facility consists of medium industries with the lots to the south zoned as low-density residential zone and rural zone (**Figure 2**). The closest residential dwelling is located approximately 290 m south-west from the facility's site boundary.

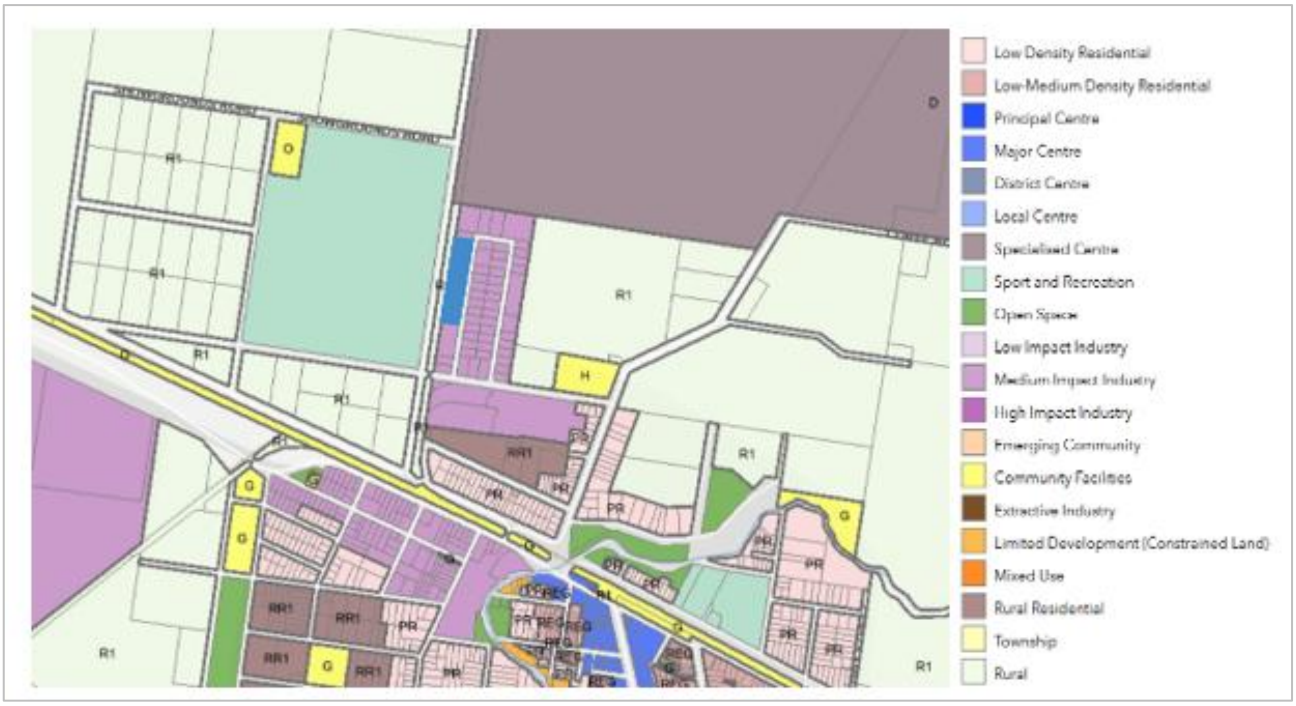


Figure 2: Land-use zoning map identifying the site (blue polygon) and its surrounds
Source: Toowoomba Regional Council Planning Scheme Mapping

Terrain levels surrounding the site mapped over a 10 km x 10 km domain is as shown in **Figure 3**. 1 arc second (~30m) terrain data surrounding the facility has been sourced from the Geoscience Australia website. Topography in the immediate surrounds of the facility is relatively flat, with the highest elevations ranging up to approximately 450 m above sea level south-east of the site.

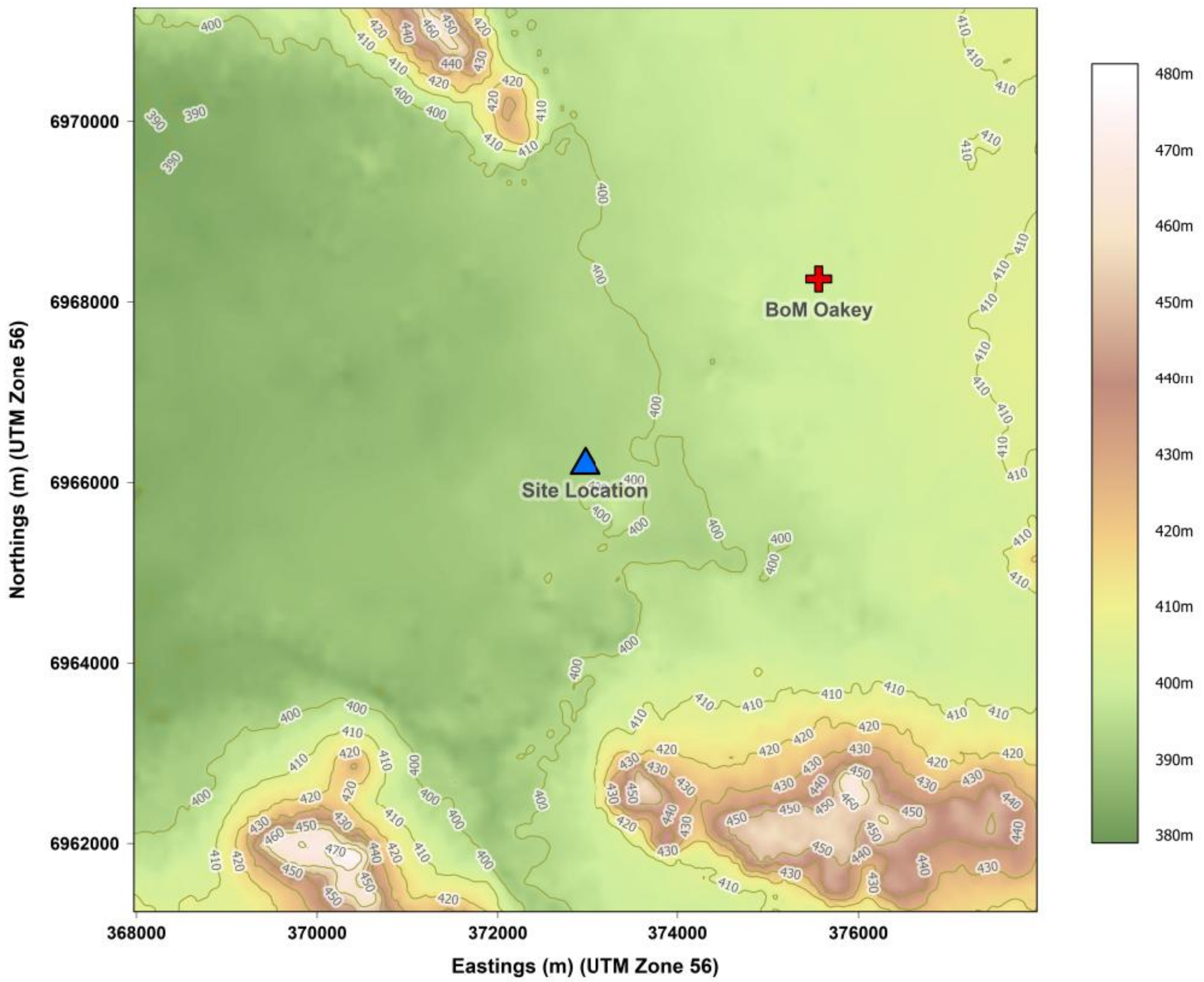


Figure 3: Terrain features surrounding the site

4.2 Sensitive Receptors

To determine air quality impacts from the proposed expansion, a set of carefully selected sensitive receptors representing the receiving environment have been identified and are summarised in **Table 2** and visually illustrated in **Figure 4.**

A total of 31 sensitive receptors representing both residential and non-residential developments have been selected within 2 km extends of the facility which would adequately capture the impacts from the proposed operations.

Model predicted incremental (impacts from the facility) and cumulative (incremental + background) ground level concentrations for all the modelled pollutants have been predicted at each of the below identified sensitive receptors and are compared against assessment criteria to assess compliance.

Table 2: Details of identified sensitive receptors

Sensitive Receptor ID	Easting (m) (UTM Zone 56J)	Northing (m) (UTM Zone 56J)
R1	373071	6965936
R2	373086	6966024
R3	373368	6965963
R4	373786	6966089
R5	373903	6966257
R6	372288	6966819
R7	372231	6966541
R8	372207	6966494
R9	372711	6966061
R10	372227	6965996
R11	372272	6965976
R12	372407	6965964
R13	372690	6965910
R14	372724	6965659
R15	373230	6965849
R16	373417	6965816
R17	373485	6965800
R18	373177	6965598
R19	373308	6965615
R20	373417	6965618
R21	373401	6965566
R22	372917	6965634
R23	372990	6965598
R24	373098	6965546
R25	373243	6965475
R26	373303	6965956
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R28	372923	6967166
R29	373071	6965936
R30	373086	6966024
R31	373368	6965963

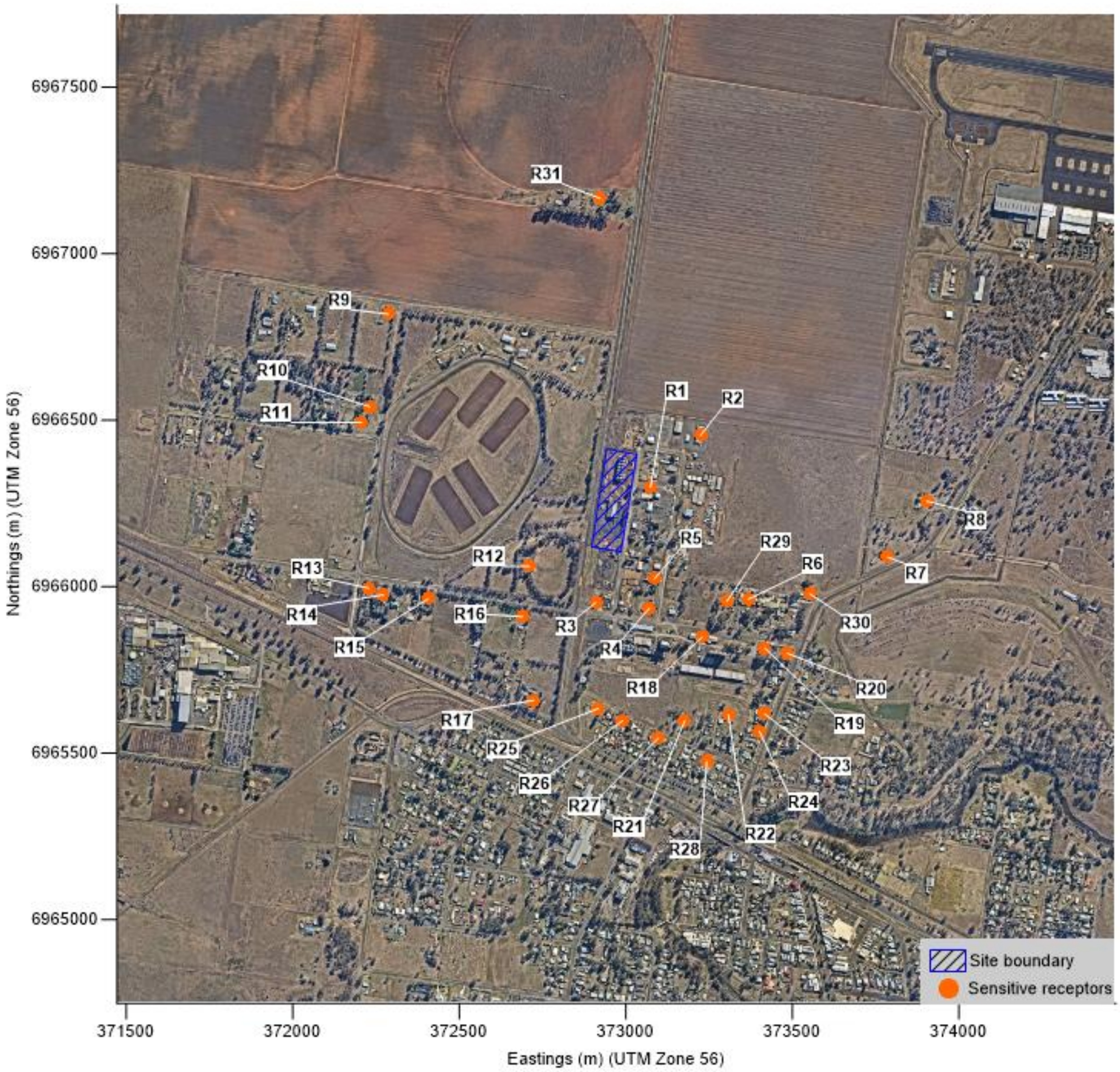

Figure 4: Visual overview of the selected sensitive receptors for the assessment in context to the site

5 Assessment Criteria

As noted previously, dust/particulate matter emissions are the key pollutants generated from the proposed operations. Airborne particulate matter typically consists of dust particles of varying size fractions. From a health and nuisance perspective, particles are categorised primarily by size as total suspended particulates (TSP), PM_{10}, $PM_{2.5}$, and deposited dust.

Particulate matter consists of dust particles of varying size and composition. Air quality refers to measuring the total mass of all particles suspended in air, which is known as total suspended particles (TSP). TSP is usually particles which are 30 µm in size. Two sub-categories of TSP are PM_{10} and $PM_{2.5}$ which are particles with an equivalent aerodynamic diameter of 10 µm and 2.5 µm.

5.1 National Legislation

The National Environmental Protection Council ('NEPC') developed the *Ambient Air Quality National Environment Protection Measure* ('NEPM'), which sets out uniform standards for a suite of pollutants, which includes total solid particulates (TSP), PM_{10}, and $PM_{2.5}$.

5.2 State Legislation

Air quality in Queensland is regulated under the Environment Protection Act 1994 ("the EPA 1994') and the *Environmental Protection (Air) Policy 2019* ('the EPP Air 2019'), which has been in effect since 01 September 2019. The Act provides for long-term protection for the environment in Queensland in a manner that is consistent with the principles of ecologically sustainable development. The purpose of the EPP Air 2019 is to achieve the objectives listed in the EPA 1994.

Schedule 1 of the EPP Air 2019 specifies the air quality objectives that are to be (progressively) achieved though no timeframe for achievement of these objectives is specified. The Schedule includes objectives designed to protect the environmental values of:

- Health and wellbeing,
- Aesthetic environment,
- Health and biodiversity of ecosystems; and
- Agriculture.

The Environmental Protection (Air) Amendment Policy 2024 (EPP Air 2024), commenced on January 1, 2025, in Queensland, Australia, sets new air quality objectives for $PM_{2.5}$, which have been in this revised air quality assessment.

5.3 Relevant Assessment Criteria

Air quality objectives for the pollutants of interest are tabulated in **Table 3.** Objectives have been referenced from the Schedule 1 of EPP Air 2024. Reference has also been drawn to the NSW-EPA Publication - *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW,* *Environment Protection Authority*, August 2022 ('the Approved Methods in NSW') for those pollutants which do not have an assessment criterion in the EPP Air 2024 Policy.

Air quality objectives (also referred to as 'assessment criteria') for the modelled pollutants are tabulated in **Table 3.**

Objectives have been referenced from the Schedule 1 EPP Air 2019. Objectives for $PM_{2.5}$ have been referenced from the EPP Air 2024.

Reference has also been drawn to the NSW EPA Publication – *Approved Methods for Modelling and Assessment of Air Pollutants in NSW,* Environment Protection Authority, August 2022 ('the Approved Methods 2022) for those pollutants which do not have an assessment criterion in the EPP 2024 policy.

Table 3: Summary of assessment criteria

Pollutant	Assessment Criteria	Unit	Averaging Period	Value	Reporting Percentile	Reference
TSP	90	µg/m^3	Annual	health & wellbeing	n.a	EPP Air 2019
PM_{10}	50	µg/m^3	24-hour	health & wellbeing	100th	
	25	µg/m^3	Annual	health & wellbeing	n.a	
$PM_{2.5}$	20	µg/m^3	24-hour	health & wellbeing	100th	EPP Air 2024
	7	µg/m^3	Annual	health & wellbeing	n.a	
Deposited Dust	4	g/m^2/month – max increase in deposited dust level	Annual	n.a	n.a	Approved Methods 2022

6 Characterisation of Existing Air Quality Levels

Characterisation of existing air quality levels (i.e., background concentrations) is essential for determining cumulative concentrations. This section provides details on existing air quality levels.

A desktop review was conducted by VAAU to identify if there are any industries with similar operations that release similar pollutants as the facility thereby contributing to cumulative impacts. Upon conducting the review, it was understood that there are 2 facilities within a 5 km study area that report their emissions to the National Pollutant Inventory (NPI) - Oakey Beef export and Oakey Army Aviation Unit. However, their operations are different from the proposed expansion operations at the site and are not expected to contribute to the cumulative ground-level concentrations.

Furthermore, as discussed in **Section 4.1**, the project site is located within a Medium Impact Industry zone, and is surrounded by agricultural services, auto body shops and mechanics. As discussed in the subsequent sections of this report, modelling shows low-level impacts from the proposed expansion, and therefore not expected to contribute considerably to the cumulative ground level concentrations.

To determine background pollutant concentrations, ambient air quality levels recorded at the nearest and most representative National Environment Protection Measures (NEPM) ambient air quality monitoring stations have been used.

For this assessment, background concentrations for PM_{10} and $PM_{2.5}$ have been determined from Toowoomba NEPM station which is located approximately 26 km from the facility. Toowoomba NEPM station was established in January 2022 and is located in densely populated area and covers emissions from nearby sources and major roads. Given its relative proximity, the air quality levels measured at Toowoomba NEPM station are deemed representative of those likely experienced at the facility and have been used for determination of cumulative air quality impacts.

Background concentrations measured have been referenced from the most recent ambient air monitoring report published by QLD Government – *Queensland air monitoring 2023* National Environment Protection (Ambient Air Quality) Measure, June 2024.

Summary of the background air quality concentrations adopted for this assessment are presented in **Table 4.**

Table 4: Summary of background pollutant concentrations adopted for this assessment

Pollutant	Averaging Period	Units	Ambient Concentrations Adopted for the Cumulative Assessment ($\mu g/m^3$)	Notes
TSP	Annual	$\mu g/m^3$	35.5	No monitoring data was available, and therefore, it was assumed that the PM_{10} annual average is typically of the order of 40% TSP.
PM_{10}	24-hour	$\mu g/m^3$	19.9	90th percentile 24-hour average PM_{10} concentration measured at Toowoomba in 2023.
	Annual	$\mu g/m^3$	14.2	Annual average PM_{10} concentration measured at Toowoomba in 2023.
$PM_{2.5}$	24-hour	$\mu g/m^3$	9.1	90th percentile 24-hour average $PM_{2.5}$ concentration measured at Toowoomba in 2023.
	Annual	$\mu g/m^3$	6.1	Annual average $PM_{2.5}$ concentration measured at Toowoomba in 2023.
Deposited dust	Annual	g/m^2/month	2	Conservative assumptions – consistent with other air quality assessments

7 Meteorological Modelling

Meteorological mechanisms govern the generation, dispersion, transformation, and eventual removal of pollutants from the atmosphere. The local meteorology at the site plays a significant role in understanding the pollutant transport and dispersion mechanisms, and to adequately characterise the local meteorological conditions, information is needed on key parameters such as prevailing wind regime, mixing depth, atmospheric stability, ambient temperatures, rainfall, and relative humidity. The following sections outline the methodology for characterising the meteorological conditions at the project site.

No site-specific weather data was available and due to non-availability of on-site meteorological data, reference was drawn to data from the nearest site-representative meteorological monitoring station, which is Bureau of Meteorology (BoM) Automatic Weather Station (AWS) at Oakey Aero (Station No:041359), which is approximately 3 km from the site. Data from the BoM AWS has been analysed from 2017-2021 and presented in **Appendix A.** Inter-annual analysis of the 5 years of data shows minimal divergence of wind-fields across the analysed years, and therefore 2021 was selected as a representative modelling year.

Meteorological modelling was conducted using a combination of 'The Air Pollution Model' (TAPM) (Version 4.0.5) and CALMET meteorological models.

Meteorology modelling for the 2021 calendar year was conducted using a combination of 'The Air Pollution Model' (TAPM) and CALMET meteorological models. Analysis of the CALMET generated meteorological data at the project site location was undertaken to demonstrate that the meteorological data used in the dispersion model adequately describes the patterns expected at the subject site.

Further details of the TAPM and CALMET modelling is presented in the below sections.

7.1 TAPM

For this modelling assessment, the meteorological model 'The Air Pollution Model (TAPM) was used to generate the prognostic output. TAPM facilitates the development of localised meteorological datasets based on synoptic weather conditions. The model predicts the regional flows that are important to atmospheric dispersion of pollutants, such as sea breezes and terrain induced flows, against a background of larger-scale meteorology provided by synoptic analyses. The TAPM output provides a meteorological dataset suitable for use in a diagnostic meteorological model (CALMET for this assessment).

The 3D prognostic data was derived using TAPM model was configured with a series of nested grids chosen to provide an appropriate communication and transfer of information from the broad synoptic to the local scale. The model was configured to use a domain consisting of 30 x 30 x 30 grid points with nesting spacings of 30 km, 10 km, 3 km and 1 km. A summary of the TAPM settings is presented in **Table 5.**

Table 5: Summary of TAPM settings

Parameter	Value
Year of Analysis	2021
Grid Centre Coordinates (lat, long)	-27deg, 25.0min' south, 151deg, 43min' east
Number of grids (spacing)	4 (30km, 10km, 3km, 1km)
Grid dimensions (nx, ny, nz)	30, 30, 30
Data assimilation	Yes – BoM AWS at Oakey Aero (AWS No.: 041359)

7.2 CALMET

CALMET (version 6.4.0) was used to derive higher resolution meteorological fields at 250 m resolution over a 10 km x 10 km modelling domain centred over the proposed development site. CALMET was run in no-observations mode (NOOBS = 2) with prognostic output from TAPM used as an input to the CALMET model. The CALMET model settings were in general accordance with the 'Generic Guidance and Optimum Settings for the CALPUFF Modelling System for Inclusion into the '*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, Australia'* (OEH, 2011) (hereafter 'Approved Methods).

The geophysical dataset for CALMET contains terrain and land use information for the modelling domain. For this assessment, terrain data for the CALMET grid was extracted from 1-arc second (30m) resolution terrain data surrounding the facility has been sourced from the Geoscience Australia website. The land use or land cover data for the modelling domain was based on the land-use data published by the Queensland Government which is based on the Queensland Land Use Mapping Program (QLUMP).

The geotechnical parameters for the land use classification were adopted from the default CALMET corresponding land use categories. A summary of the CALMET settings is given below in **Table 6**.

Table 6: Summary of CALMET settings

Parameter	Value
Year of Analysis	2021
Number of Grid Cells (NX, NY)	41, 41
Grid Spacing (DGRIDKM) (km)	0.25
XORIG (km), YORIG (km)	367.847, 6961.123
Vertical Levels (NZ)	12
Meteorological Data Option	NOOBS = 2
Upper Air and Surface Data	TAPM Generated MM4/MM5/3D
Geophysical Datasets	USGS GLCC (land use) & SRTM 1 – arc second terrain

7.3 Modelled Meteorology

Wind roses plotted using hourly wind data and direction for the calendar year 2021 are visually represented in **Figure 5.** Prevailing winds are generally from the east, along with presence from the north-east and south-east vectors, and a to a lesser extent from the remaining directions. Calm winds are predicted to occur for about 4% of the year.

Figure 5: CALMET predicted annual and seasonal wind roses – 2021

7.3.1 Stability

Stability of the atmosphere is determined by a combination of horizontal turbulence caused by the wind and vertical turbulence caused by the solar heating of the ground surface. Stability cannot be measured directly; instead, it must be inferred from available data, either measured or numerically simulated. The Pasquill-Gifford scale defines stability on a scale from A to G, with stability class A being the least stable, occurring during strong daytime sun and stability class G being the most stable condition, occurring during low wind speeds at night. For any given wind speed, the stability category may be characterised by two or three categories depending on the time of day and the amount of cloud present. In meteorological models such as CALMET, the stability classes F and G are combined.

A summary of the numerically simulated hourly stability class data using CALMET for 2021 is presented in **Figure 6.** A higher frequency (55%) of stability class D followed by 14% for E class indicating that the dominant conditions are moderately to very stable, with very little lateral and vertical diffusion.

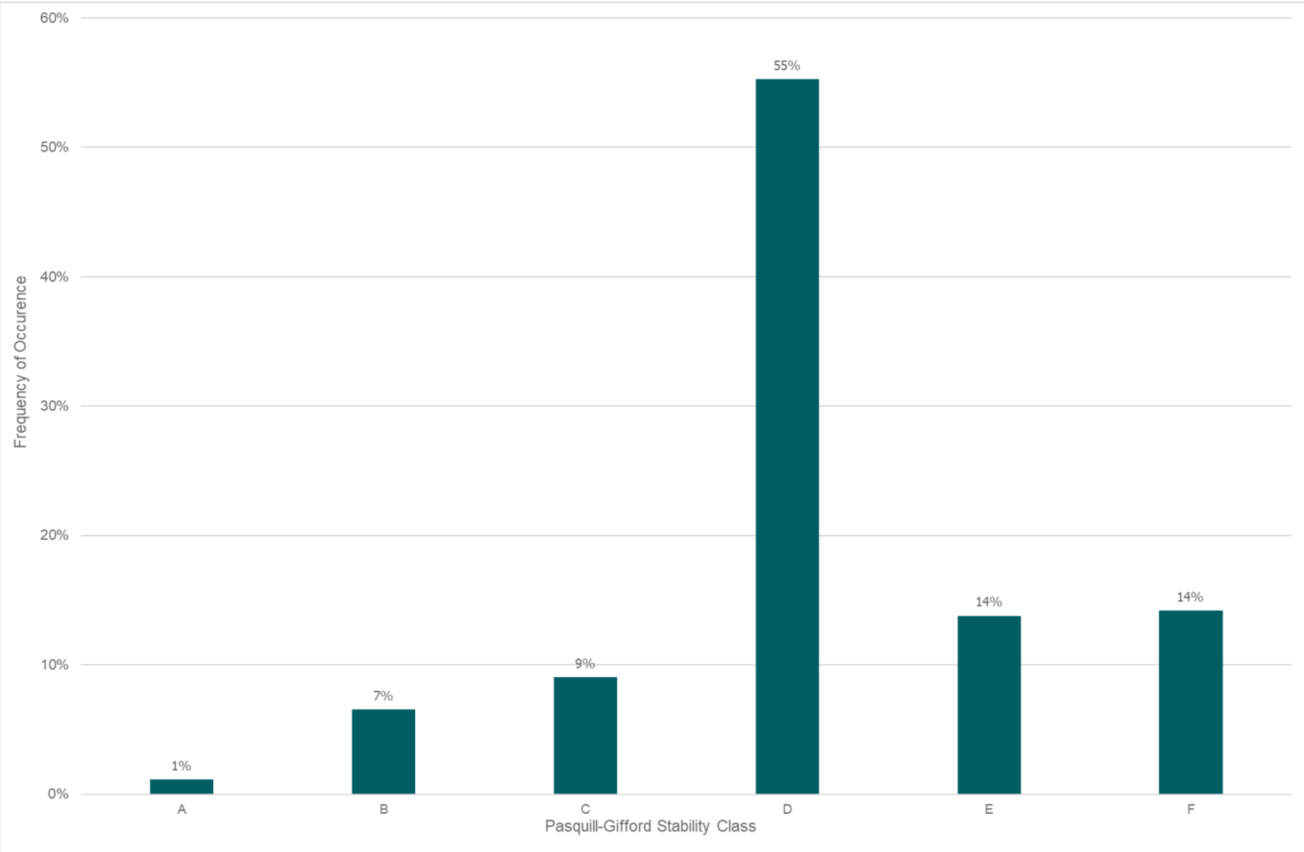

Figure 6: CALMET predicted frequency of atmospheric stability - 2021

7.3.2 Mixing Height

The mixing height quantifies the vertical height of mixing in the atmosphere and is a modelled parameter that cannot be measured directly. The mixing height decreases in the late afternoon, particularly after sunset, due to the change from surface heating from the sun to a net heat loss overnight. Low mixing heights typically translate to stagnant air with little vertical motion, while high mixing heights allow vertical mixing and good dispersion of pollutants.

CALMET simulated hourly mixing height data for the year 2021 is shown in **Figure 7.** The data presented in **Figure 7** shows the mixing height as a function of the hour of the day at the proposed location of the subject site. The graph represents the typical growth of the boundary layer, whereby the mixing height is generally lowest during the night and into the early morning and highest during the late afternoon.

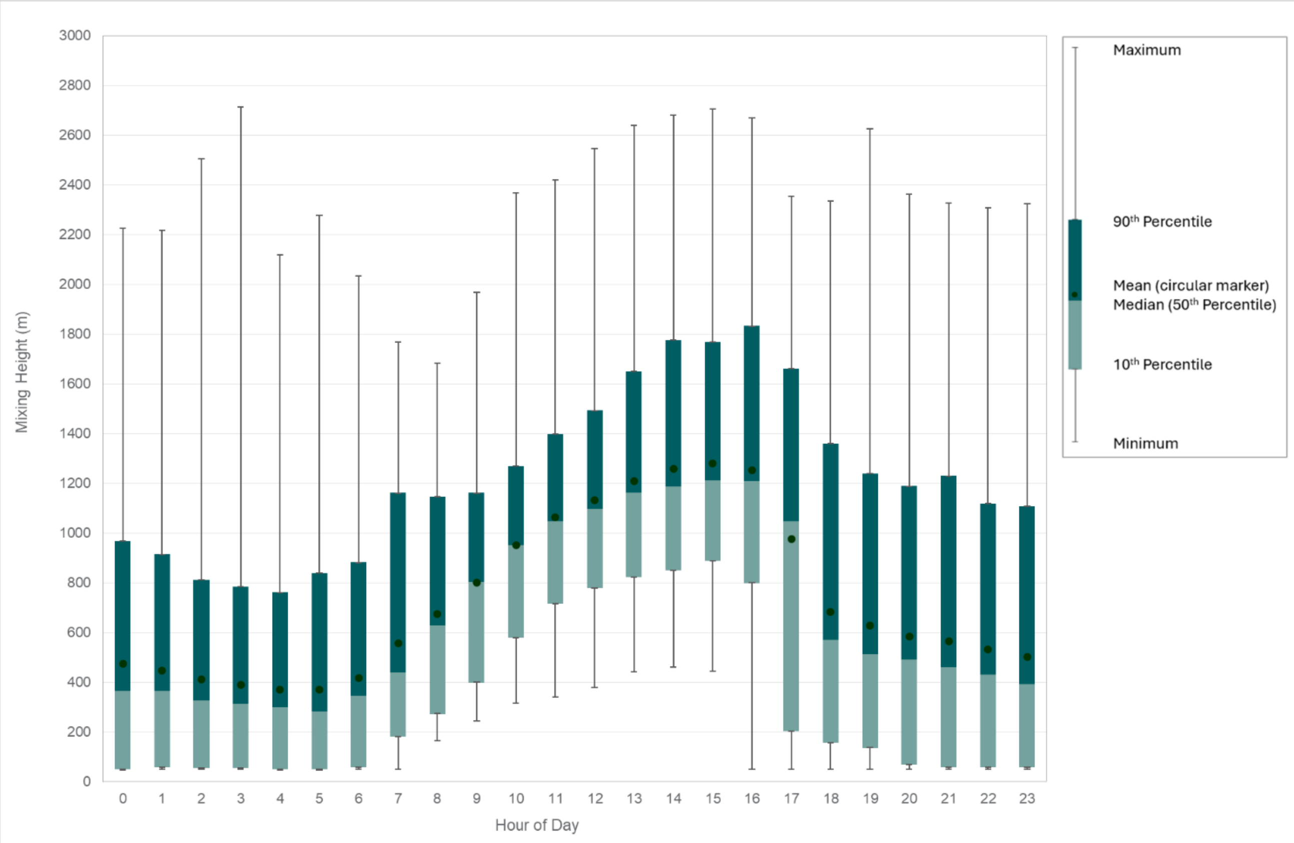

Figure 7: CALMET predicted mixing height profile – 2021

8 Emission Estimation

As detailed in **Section 2.1,** the sources / activities at the site that have the potential to generate fugitive dust emissions include:

- Material handling (loading / unloading); and,
- Wheel generated dust from haulage on paved roads.

Particulate matter (TSP, PM_{10} and $PM_{2.5}$) emission rates for dust generating sources have been quantified by the usage of emission factors published in emission estimation technique manuals. For this assessment, reference has been drawn to the NPI Emission Estimation Technique Manuals and the United States Environmental Protection Agency (US-EPA) AP-42 emission factors.

Specially, the following Emission Estimation Technique ('EET') manuals have been used for quantifying fugitive dust emissions for the various size fractions – TSP, PM_{10} and $PM_{2.5}$:

- AP-42 Emission Factors, *Chapter 13.2.1 Paved Roads*, United states Environmental Protection Agency (US-EPA 2010); and,
- AP-42 Emission Factors, *Chapter – 9.9.1 – Grain Elevators and Process*.

The following assumptions and information were considered for estimating fugitive dust emissions from the site:

- Operating hours – 7 days a week between 6:00 AM to 7:00 PM,
- Approximately 4,000 tpa of grain or cotton seed will be stored within the commodity store, 800 tpa within the commodity bunker, and the remaining 21,200 tpa of grain will be stored within the silos,
- For the determination of longer-term averaging period pollutants (i.e., annual average TSP, PM_{10}, and $PM_{2.5}$), the intensity of activities was uniformly distributed across the whole year, whereas for the short-term averaging period pollutants (i.e., 24-hour average PM_{10} and $PM_{2.5}$), it was assumed that the activities will be 1.5 times the average daily,
- Mean weight of the haul truck – 60 tonnes,
- The total truck trips per day will not exceed 20 trips during normal operations,
- The total truck trips per day will not exceed 50 trips during peak day operations,
- Haul road surface – paved; and,
- Silt content of the haul roads – 12 g/m^2 (conservative assumption – value representative of heavy industrial facilities)

The location of the modelled sources is presented in **Figure 8**.

A summary of the annual fugitive dust emission rates for the TSP, PM_{10} and $PM_{2.5}$ size-fractions and peak daily dust emission rates for PM_{10} and $PM_{2.5}$ from the above listed sources are presented in **Table 7** and **Table 8** respectively**.**

Additional information on the estimated fugitive dust emissions is presented in **Appendix B .**

Table 7: Summary of fugitive dust emissions corresponding to annual average activities

Activity	Source ID	Quantity	Units	Annual Emission Rates (kg/year)		
				TSP	PM_{10}	$PM_{2.5}$
Truck unloading grain/cotton seed at Grain Pit A (west of commodity store)	S1	4,000	tpa	360	118	20
Truck unloading overflow (grain/cotton seed) at commodity bunker	S2	800	tpa	72	24	4
Truck unloading grain at Grain Pit B (north of silos)	S3	21,200	tpa	1,908	625	106
Loading grain/cotton seed from Grain Pit A into commodity store using auger	S4	4,000	tpa	122	68	12
Loading grain/cotton seed to truck using auger (north of commodity bunker)	S5	4,000	tpa	122	68	12
Loading grain into containers using grain elevator	S6	21,200	tpa	647	360	61
Wheel generated dust from haul trucks	S7	3,910	VKT/Annum	1,513	290	70
			Total Annual Emissions	**4,743**	**1,554**	**285**

Table 8: Summary of fugitive dust emissions corresponding to peak daily activities

Activity	Quantity	Units	Peak Daily Emission Rates (kg/day)	
			PM_{10}	$PM_{2.5}$
Truck unloading grain/cotton seed at Grain Pit A (west of commodity store)	16	tpd	0.5	0.1
Truck unloading overflow (grain/cotton seed) at commodity bunker	3	tpd	0.1	0.02
Truck unloading grain at Grain Pit B (north of silos)	87	tpd	2.6	0.4
Loading grain/cotton seed from Grain Pit A into commodity store using auger	16	tpd	0.3	0.05
Loading grain/cotton seed to truck using auger (north of commodity bunker)	16	tpd	0.3	0.05
Loading grain into containers using grain elevator	87	tpd	1.5	0.3
Wheel generated dust from haul trucks	27	VKT/day	2.0	0.5

Figure 8: Spatial distribution of modelled emission sources across the site

9 Result and Discussion

Model predicted incremental and cumulative TSP, PM_{10}, and $PM_{2.5}$ ground level concentrations & deposited dust levels at the nearest sensitive receptors from the modelled emission sources (refer **Table 7**) are presented in this section.

Cumulative ground levels concentrations of TSP, PM_{10}, $PM_{2.5}$ and deposited dust have been determined by adding the incremental impacts (i.e., contribution from the proposed expansion) with the background concentrations as presented in **Table 4.**

9.1 Total Solid Particles (TSP) Concentrations

Incremental and cumulative TSP ground level concentrations predicted at the nearest sensitive receptors for are summarised in **Table 9.**

Results predicted in **Table 9** show that the predicted cumulative annual average TSP concentration at all identified sensitive receptors are well below their assessment criteria of 90 μg/m^3.

Table 9: Incremental and cumulative annual average TSP concentrations

Receptor ID	Incremental Annual Average TSP Ground Level Concentrations (μg/m^3)	Cumulative Annual Average TSP Ground Level Concentrations (μg/m^3)	Compliance Achieved
R1	1.60	37.10	Yes
R2	0.45	35.95	Yes
R3	0.22	35.72	Yes
R4	0.16	35.66	Yes
R5	0.25	35.75	Yes
R6	0.08	35.58	Yes
R7	0.04	35.54	Yes
R8	0.04	35.54	Yes
R9	0.05	35.55	Yes
R10	0.10	35.60	Yes
R11	0.10	35.60	Yes
R12	0.32	35.82	Yes
R13	0.07	35.57	Yes
R14	0.07	35.57	Yes
R15	0.09	35.59	Yes
R16	0.13	35.63	Yes
R17	0.05	35.55	Yes
R18	0.08	35.58	Yes
R19	0.05	35.55	Yes
R20	0.04	35.54	Yes

Receptor ID	Incremental Annual Average TSP Ground Level Concentrations (μg/m³)	Cumulative Annual Average TSP Ground Level Concentrations (μg/m³)	Compliance Achieved
R21	0.04	35.54	Yes
R22	0.03	35.53	Yes
R23	0.03	35.53	Yes
R24	0.02	35.52	Yes
R25	0.05	35.55	Yes
R26	0.04	35.54	Yes
R27	0.03	35.53	Yes
R28	0.02	35.52	Yes
R29	0.09	35.59	Yes
R30	0.05	35.55	Yes
R31	0.03	35.53	Yes

9.2 PM_{10} Concentrations

24-hour average and annual average incremental and cumulative PM_{10} concentrations predicted at the nearest sensitive receptors are summarised in **Table 10.**

The 24-hour average incremental impacts have been based on peak daily activities (refer **Table 8**) and the annual average incremental impacts are a consequence of the average daily emission rates as shown in **Table 7**.

Modelling shows that the cumulative 24-hour average ground level PM_{10} concentrations comply with the 50 μg/m³ assessment criteria at all the sensitive receptors.

Similarly, the annual average impacts across all the sensitive receptors comply with the air quality objective of 25 μg/m³.

Table 10: Incremental and cumulative annual average PM_{10} concentrations

Receptor ID	24-hour Average PM_{10} Ground Level Concentrations (µg/m³)		Annual Average PM_{10} Ground Level Concentrations (µg/m³)		Compliance Achieved
	Incremental	Cumulative	Incremental	Cumulative	
R1	11.64	31.5	0.63	14.8	Yes
R2	3.58	23.5	0.19	14.4	Yes
R3	3.13	23.0	0.10	14.3	Yes
R4	2.57	22.5	0.07	14.3	Yes
R5	3.29	23.2	0.11	14.3	Yes
R6	1.79	21.7	0.04	14.2	Yes
R7	0.98	20.9	0.02	14.2	Yes
R8	0.57	20.5	0.02	14.2	Yes
R9	0.53	20.4	0.03	14.2	Yes
R10	0.82	20.7	0.05	14.3	Yes
R11	0.89	20.8	0.05	14.3	Yes
R12	3.18	23.1	0.13	14.3	Yes
R13	0.95	20.8	0.04	14.2	Yes
R14	0.97	20.9	0.04	14.2	Yes
R15	1.11	21.0	0.05	14.2	Yes
R16	1.91	21.8	0.06	14.3	Yes
R17	0.72	20.6	0.03	14.2	Yes
R18	1.27	21.2	0.04	14.2	Yes
R19	1.14	21.0	0.03	14.2	Yes
R20	1.08	21.0	0.02	14.2	Yes
R21	0.61	20.5	0.02	14.2	Yes
R22	0.56	20.5	0.02	14.2	Yes
R23	0.64	20.5	0.02	14.2	Yes
R24	0.53	20.4	0.01	14.2	Yes
R25	0.75	20.6	0.03	14.2	Yes
R26	0.64	20.5	0.02	14.2	Yes
R27	0.58	20.5	0.02	14.2	Yes
R28	0.45	20.4	0.01	14.2	Yes
R29	1.86	21.8	0.05	14.2	Yes
R30	1.42	21.3	0.03	14.2	Yes
R31	0.46	20.4	0.02	14.2	Yes

9.3 $PM_{2.5}$ Concentrations

24-hour average and annual average incremental and cumulative $PM_{2.5}$ concentrations predicted at the nearest sensitive receptors are summarised in **Table 11**.

The 24-hour average incremental impacts have been based on peak daily activities (refer **Table 8**) and the annual average incremental impacts are a consequence of the average daily emission rates as shown in **Table 7**.

Modelling shows that the cumulative 24-hour average ground level $PM_{2.5}$ concentrations comply with the 20 µg/m^3 assessment criteria at all the sensitive receptors.

Similarly, the annual average impacts across all the sensitive receptors comply with the air quality objective of 7 µg/m^3.

Table 11: Incremental and cumulative $PM_{2.5}$ ground level concentrations

Receptor ID	24-hour Average $PM_{2.5}$ Ground Level Concentrations (µg/m^3)		Annual Average $PM_{2.5}$ Ground Level Concentrations (µg/m^3)		Compliance Achieved
	Incremental	Cumulative	Incremental	Cumulative	
R1	2.24	11.3	0.122	6.22	Yes
R2	0.79	9.9	0.038	6.14	Yes
R3	0.76	9.9	0.021	6.12	Yes
R4	0.62	9.7	0.016	6.12	Yes
R5	0.78	9.9	0.023	6.12	Yes
R6	0.41	9.5	0.009	6.11	Yes
R7	0.23	9.3	0.005	6.10	Yes
R8	0.13	9.2	0.005	6.11	Yes
R9	0.12	9.2	0.007	6.11	Yes
R10	0.20	9.3	0.012	6.11	Yes
R11	0.22	9.3	0.012	6.11	Yes
R12	0.77	9.9	0.030	6.13	Yes
R13	0.26	9.4	0.009	6.11	Yes
R14	0.26	9.4	0.009	6.11	Yes
R15	0.29	9.4	0.011	6.11	Yes
R16	0.48	9.6	0.014	6.11	Yes
R17	0.20	9.3	0.006	6.11	Yes
R18	0.32	9.4	0.009	6.11	Yes
R19	0.27	9.4	0.006	6.11	Yes
R20	0.26	9.4	0.005	6.10	Yes
R21	0.16	9.3	0.005	6.10	Yes
R22	0.14	9.2	0.004	6.10	Yes

Receptor ID	24-hour Average $PM_{2.5}$ Ground Level Concentrations (µg/m³)		Annual Average $PM_{2.5}$ Ground Level Concentrations (µg/m³)		Compliance Achieved
	Incremental	Cumulative	Incremental	Cumulative	
R23	0.16	9.3	0.004	6.10	Yes
R24	0.14	9.2	0.003	6.10	Yes
R25	0.20	9.3	0.006	6.11	Yes
R26	0.17	9.3	0.005	6.11	Yes
R27	0.15	9.3	0.004	6.10	Yes
R28	0.12	9.2	0.003	6.10	Yes
R29	0.42	9.5	0.010	6.11	Yes
R30	0.33	9.4	0.006	6.11	Yes
R31	0.11	9.2	0.004	6.10	Yes

9.4 Deposited Dust

Incremental and cumulative deposited dust levels predicted at each of the nominated sensitive receptors are summarised in **Table 12.**

Modelling shows that the incremental and cumulative annual average deposited dust levels comply with the respective assessment criteria.

Table 12: Incremental and cumulative annual average deposited dust flux predicted at sensitive receptors

Receptor ID	Incremental Annual Average Deposited Dust Flux (g/m²/month)	Cumulative Annual Average Deposited Dust Flux (g/m²/month)	Compliance Achieved
R1	0.69	2.69	Yes
R2	0.19	2.19	Yes
R3	0.07	2.07	Yes
R4	0.05	2.05	Yes
R5	0.08	2.08	Yes
R6	0.03	2.03	Yes
R7	0.01	2.01	Yes
R8	0.01	2.01	Yes
R9	0.02	2.02	Yes
R10	0.04	2.04	Yes
R11	0.04	2.04	Yes
R12	0.10	2.10	Yes
R13	0.02	2.02	Yes
R14	0.02	2.02	Yes
R15	0.03	2.03	Yes
R16	0.04	2.04	Yes
R17	0.02	2.02	Yes

Receptor ID	Incremental Annual Average Deposited Dust Flux (g/m²/month)	Cumulative Annual Average Deposited Dust Flux (g/m²/month)	Compliance Achieved
R18	0.03	2.03	Yes
R19	0.02	2.02	Yes
R20	0.01	2.01	Yes
R21	0.01	2.01	Yes
R22	0.01	2.01	Yes
R23	0.01	2.01	Yes
R24	0.01	2.01	Yes
R25	0.02	2.02	Yes
R26	0.01	2.01	Yes
R27	0.01	2.01	Yes
R28	0.01	2.01	Yes
R29	0.03	2.03	Yes
R30	0.02	2.02	Yes
R31	0.01	2.01	Yes

9.5 Recommendations

Based on the modelling results and the conclusion that predicted concentrations are well below the applicable air quality objectives, no significant air quality impacts are anticipated from the proposed expansion. Notwithstanding compliance with the air quality objectives, the following recommendations are provided:

- Peak daily throughput should not exceed 107 tonnes per day,
- Total truck movements should not exceed 20 trips per day during normal operations and 50 trips per day during peak operations; and,
- Regular inspection and maintenance (e.g., sweeping) of paved roads and surface to remove any accumulated dust.

10 Conclusion

An air quality impact assessment was prepared in support of the proposed expansion of existing warehouse which include grain storage and handling (‘the facility’) at 14-28 Katrina Street, Oakey QLD and was issued on 20 August 2025.

Upon submission, Council issued an information request (IR) on 23 January 2026, seeking additional details on environmental matters, including air quality.

This assessment responds to Council’s information request including remodelling of sources. Activities on site that have the potential to generate dust emissions include:

- Material handling (loading / unloading); and,
- Haulage emissions generated from heavy vehicle activity on the sealed road surfaces.

Air dispersion modelling was conducted in accordance with the DETSI publication – *Application to requirements for activities with impacts to air*, November 2025, and Toowoomba Regional Council (TRC) Planning Scheme.

Modelling clearly shows that that the ground level cumulative concentrations of the modelled pollutants are well below their respective assessment criteria. Furthermore, the emissions from the proposed expansion are not expected to have a discernible impact on the local airshed and this is evident by comparing the incremental concentrations against the cumulative concentrations for all the modelled pollutants.

In concluding, it can be summarised that the proposed expansion operations at the site would not pose any major concerns as far as ambient air quality is concerned.

11 References

EPP (2019): Queensland Environment (Air) Protection Policy 2019.

EPP (2024): Queensland Environment (Air) Protection Amendment Policy 2024.

NEPM (1998): National Environment Protection Measure for Ambient Air Quality. National Environment Protection Council

NPI (2015): National Pollutant Inventory Guide, version 6.1, September 2015

NSW-EPA (2022): Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, NSW-Environment Protection Authority, August 2022.

NSW-OEH (2011): *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW*, Australia

NEPM (2024) – Queensland air monitoring 2023 – National Environment Protection (Ambient Air Quality) Measure, Air Quality Monitoring – Department of Environment and Science, June 2024

QLD DETSI Guideline (2025): Application to requirements for activities with impacts to air, Department of Environment, Tourism, Science and Innovation, Environmental Protection Act 1994, November 2025

SRC (2000): A User's Guide for the CALMET Meteorological Model

SRC (2011): CALPUFF Modelling System Version 6 User Instructions, April 2011

TRC (2022): Toowoomba Regional Council Planning Scheme, V28, November 2022

TRC (2026): Information Request, Material Change of Use – Impact – Extension to Warehouse 14-28 Katrina Street, Oakey QLD 4401, Toowoomba Regional Council, January 2026

US-EPA (2010): AP-42 Emission Factors, Chapter 13.2.2 Unpaved Roads, United states Environmental Protection Agency

US-EPA (2014): AP-42 Emission Factors, Chapter 9.9.1 – Grain Elevators and Process, United states Environmental Protection Agency.

Appendix A.

Meteorological Modelling

Analysis of the TAPM model over five (5) years between 2017 – 2021 has been undertaken.

The following charts have been produced to compare the 1 – year site representative data (2021) with 5 years observations and to support the selection of the 2021 meteorological modelling year.

- Interannual (2017 – 2021) wind roses – BoM AWS Oakey Aero,
- Interannual (2017 – 2021) mean maximum and mean minimum temperature profile – BoM AWS Oakey Aero; and,
- Interannual (2017 – 2021) wind speed frequency distribution chart - BoM AWS Oakey Aero.

Interannual analysis in **Figure A 1** through to **Figure A 4** shows that there is minimal interannual variation in the winds measured across this period. Therefore, the 2021 calendar year is considered the site representative.

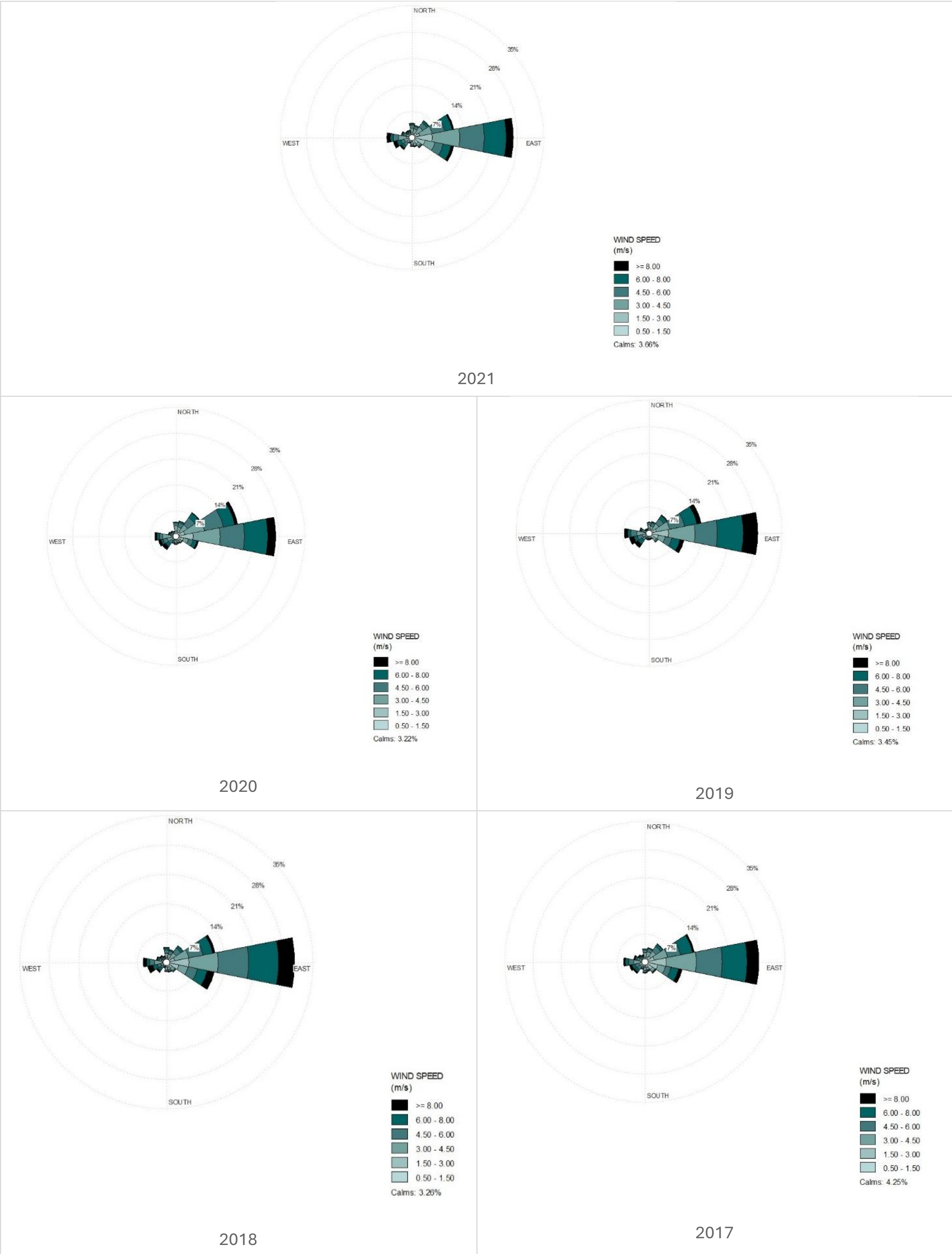

Figure A 1: Processed interannual wind roses – 2017 – 2021 BoM AWS Oakey Aero

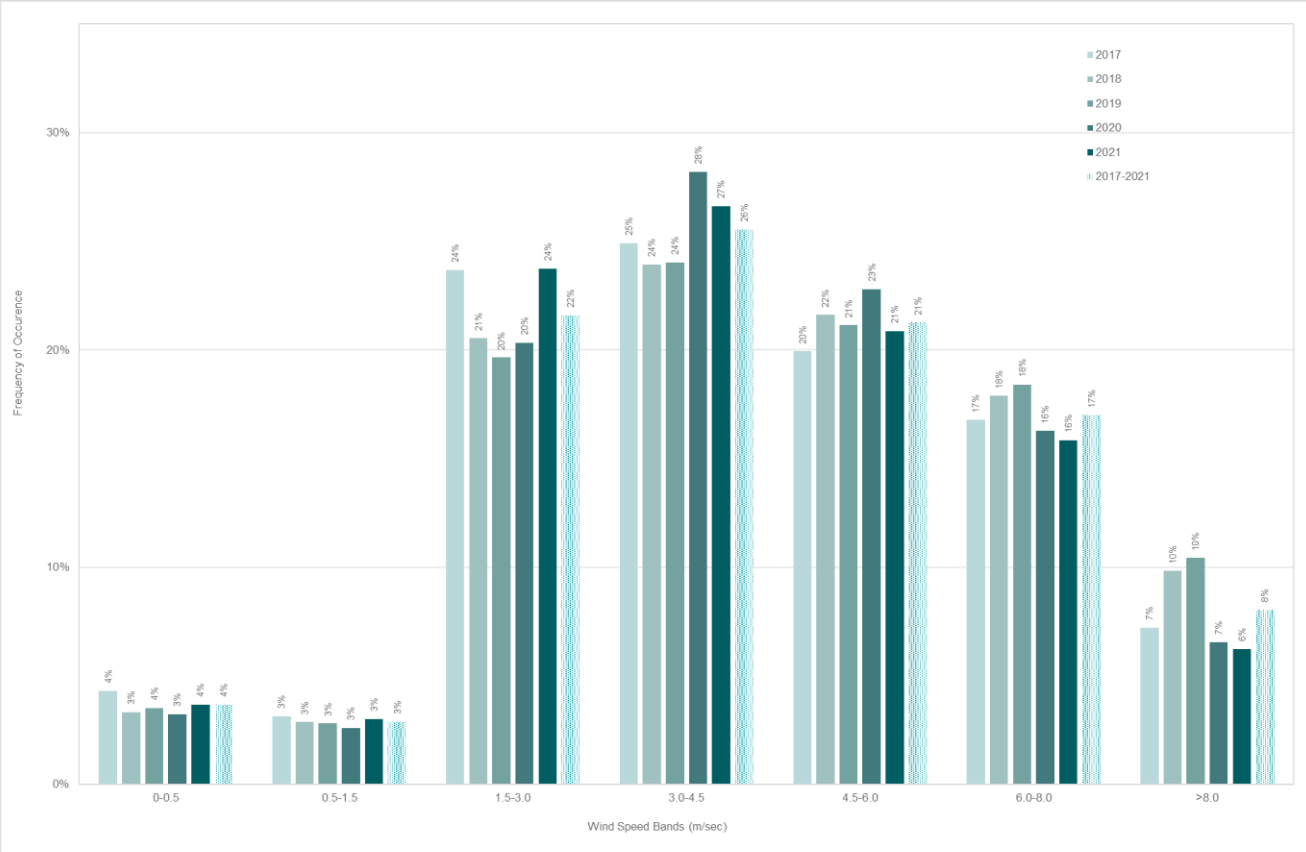

Figure A 2: Interannual Wind Speed Distribution – 2017 – 2021 – BoM AWS Oakey Aero

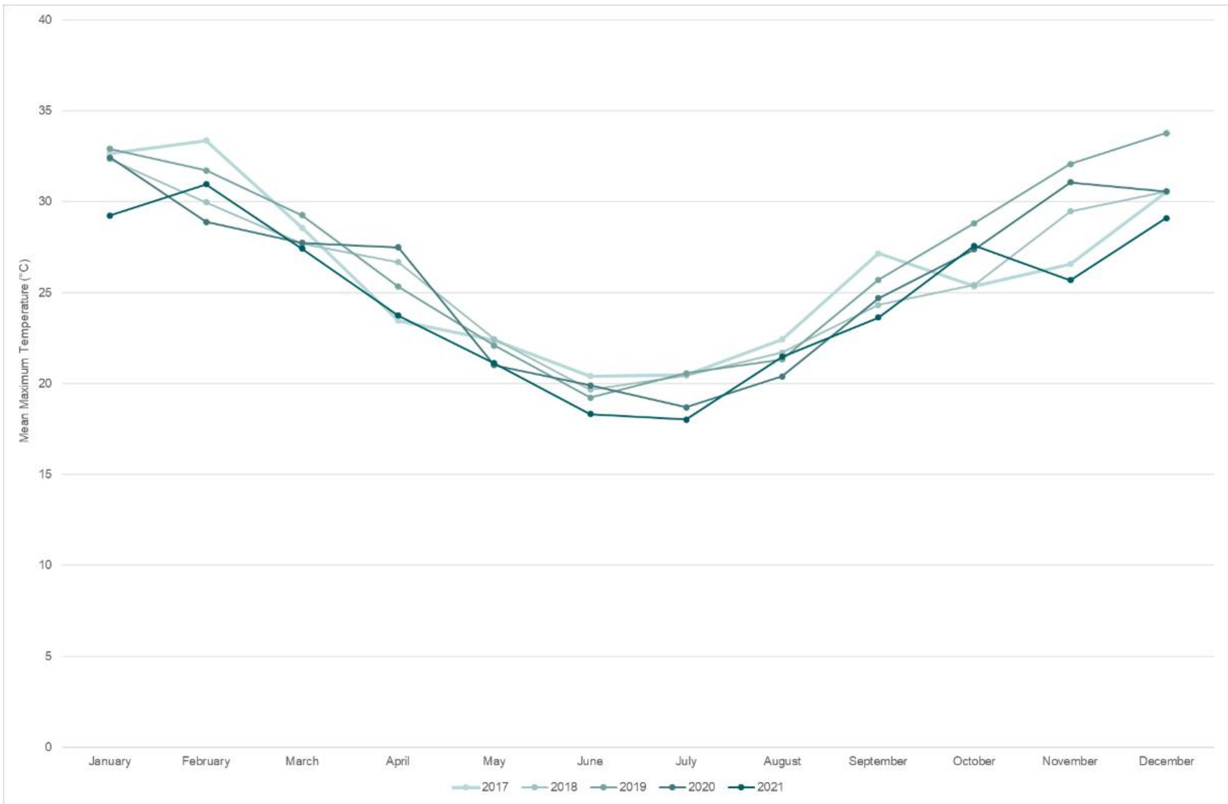

Figure A 3: Interannual Mean Maximum Temperature Profile – 2017 – 2021 – BoM AWS Oakey Aero

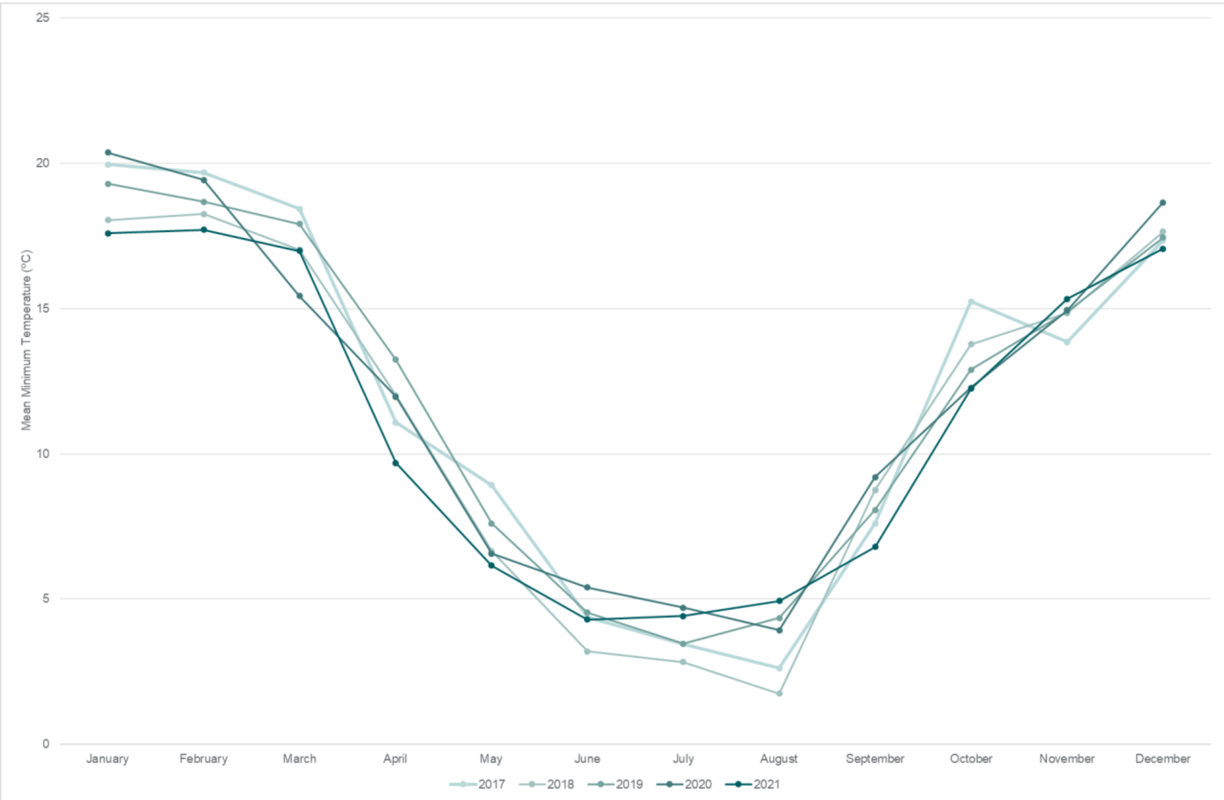

Figure A 4: Interannual Mean Minimum Temperature Profile – 2017 – 2021 – BoM AWS Oakey Aero

Appendix B.

Fugitive Dust Emissions Inventory Background

Fugitive dust emissions (TSP, PM_{10} and $PM_{2.5}$) for the proposed expansion have been identified and quantified based on the information & site plans provided to VAAU, as explained in **Section 8** and through application of accepted published emission estimation factors, collated from a combination of United States Environmental Protection Agency (US-EPS) AP – 42 Air Pollutant Emission Factors and NPI emission estimation manuals, including the following:

- AP-42 Emission Factors, *Chapter 13.2.1 Paved Roads*, United states Environmental Protection Agency (US-EPA 2010); and,
- AP-42 Emission Factors, Chapter – *9.9.1 – Grain Elevators and Process*.

Dust generating activities along with the corresponding emission factor and key variables used to estimate annual TSP, PM_{10} and $PM_{2.5}$ emission at the proposed operations are summarised in **Table B 1.**

Table B 1: Emission factors and key variables for estimating dust (TSP, PM_{10} and $PM_{2.5}$) emissions for proposed operations at the site

Activity	Emission Factor	Key Variables and Assumptions	Source of Emission Factor
Material handling operations – unloading (including loading, unloading, and conveying operations)	E_{TSP} – 0.090 kg/tonne E_{PM10} – 0.030 kg/tonne $E_{PM2.5}$ – 0.005 kg/tonne	-	AP – 42, Chapter 9.9.1- *Grain Elevators and Processes*, Table 9.9.1-1, Grain receiving – straight truck
Material handling operations – loading	E_{TSP} – 0.03 kg/tonne E_{PM10} – 0.02 kg/tonne $E_{PM2.5}$ – 0.03 kg/tonne	-	AP – 42, Chapter 9.9.1- *Grain Elevators and Processes*, Table 9.9.1-1, Headhouse and grain handling
Haulage on Unpaved Roads	$E = k(s / 12)^{a}(W / 3)^{b}$	k TSP = 3.23 kg/VKT k PM10 = 0.62 kg/VKT k PM2.5 = 0.15 kg/VKT s – surface material silt content (%), assumed to be 12 g/m^2 W – mean vehicle weight in tons – Dump truck ~ 66 tons	AP – 42, Chapter 13.2.1 – *Paved Roads*

TSP, PM_{10} and $PM_{2.5}$ emission calculations for the proposed operations are illustrated in **Figure B 1** through to **Figure B 5.**

Activity	TSP Emissions (kg/year)	Intensity	Units	TSP Emission Factor	Units	Operational Hours
Truck unloading grain/cotton seed at Grain Pit A (west of commodity store)	360	4,000	tpa	0.0900	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading overflow (grain/cotton seed) at commodity bunker	72	800	tpa	0.0900	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading grain at Grain Pit B (north of silos)	1,908	21,200	tpa	0.0900	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed from Grain Pit A into commodity store using auger	122	4,000	tpa	0.0305	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed to truck using auger (north of commodity bunker)	122	4,000	tpa	0.0305	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain into containers using grain elevators (south of silos)	647	21,200	tpa	0.0305	kg/t	6 am to 7.00pm, Monday to Friday
Haulage emissions on paved roads	1,513	3,910	VKT/Annum	0.3868	kg/t	6 am to 7.00pm, Monday to Friday
Total TSP Emissions (kg/year)	**4,743**					

Figure B 1: Annual TSP emission estimate

Activity	PM10 Emissions (kg/year)	Intensity	Units	PM10 Emission Factor	Units	Operational Hours
Truck unloading grain/cotton seed at Grain Pit A (west of commodity store)	118	4,000	tpa	0.0295	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading overflow (grain/cotton seed) at commodity bunker	24	800	tpa	0.0295	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading grain at Grain Pit B (north of silos)	625	21,200	tpa	0.0295	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed from Grain Pit A into commodity store using auger	68	4,000	tpa	0.0170	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed to truck using auger (north of commodity bunker)	68	4,000	tpa	0.0170	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain into containers using grain elevators (south of silos)	360	21,200	tpa	0.0170	kg/t	6 am to 7.00pm, Monday to Friday
Haulage emissions on paved roads	290	3,910	VKT/Annum	0.0743	kg/t	6 am to 7.00pm, Monday to Friday
Total PM10 Emissions (kg/year)	**1,554**					

Figure B 2: Annual PM_{10} emission estimate

Activity	PM2.5 Emissions (kg/year)	Intensity	Units	PM2.5 Emission Factor	Units	Operational Hours
Truck unloading grain/cotton seed at Grain Pit A (west of commodity store)	20	4,000	tpa	0.0050	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading overflow (grain/cotton seed) at commodity bunker	4	800	tpa	0.0050	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading grain at Grain Pit B (north of silos)	106	21,200	tpa	0.0050	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed from Grain Pit A into commodity store using auger	12	4,000	tpa	0.0029	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed to truck using auger (north of commodity bunker)	12	4,000	tpa	0.0029	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain into containers using grain elevators (south of silos)	61	21,200	tpa	0.0029	kg/t	6 am to 7.00pm, Monday to Friday
Haulage emissions on paved roads	70	3,910	VKT/Annum	0.018	kg/VKT	6 am to 7.00pm, Monday to Friday
Total PM2.5 Emissions (kg/year)	**285**					

Figure B 3: Annual $PM_{2.5}$ emission estimate

Activity	PM10 Emissions (kg/day)	Intensity	Units	PM10 Emission Factor	Units	Operational Hours
Truck unloading grain/cotton seed at Grain Pit A (west of commodity store)	0.5	16	tpd	0.0295	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading overflow (grain/cotton seed) at commodity bunker	0.1	3	tpd	0.0295	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading grain at Grain Pit B (north of silos)	2.6	87	tpd	0.0295	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed from Grain Pit A into commodity store using auger	0.3	16	tpd	0.0170	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed to truck using auger (north of commodity bunker)	0.3	16	tpd	0.0170	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain into containers using grain elevators (south of silos)	1.5	87	tpd	0.0170	kg/t	6 am to 7.00pm, Monday to Friday
Haulage emissions on paved roads	2.0	27	VKT/day	0.0743	kg/t	6 am to 7.00pm, Monday to Friday
Total PM10 Emissions (kg/day)	**7**					

Figure B 4: Peak daily PM_{10} emission estimate

Activity	PM2.5 Emissions (kg/day)	Intensity	Units	PM2.5 Emission Factor	Units	Operational Hours
Truck unloading grain/cotton seed at Grain Pit A (west of commodity store)	0.1	16	tpd	0.0050	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading overflow (grain/cotton seed) at commodity bunker	0.02	3	tpd	0.0050	kg/t	6 am to 7.00pm, Monday to Friday
Truck unloading grain at Grain Pit B (north of silos)	0.4	87	tpd	0.0050	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed from Grain Pit A into commodity store using auger	0.05	16	tpd	0.0029	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain/cotton seed to truck using auger (north of commodity bunker)	0.05	16	tpd	0.0029	kg/t	6 am to 7.00pm, Monday to Friday
Loading grain into containers using grain elevators (south of silos)	0.3	87	tpd	0.0029	kg/t	6 am to 7.00pm, Monday to Friday
Haulage emissions on paved roads	0.5	27	VKT/day	0.01796	kg/VKT	6 am to 7.00pm, Monday to Friday
Total PM2.5 Emissions (kg/day)	**1**					

Figure B 5: Peak daily $PM_{2.5}$ emission estimate

Appendix C.

Incremental and cumulative concentration isopleths

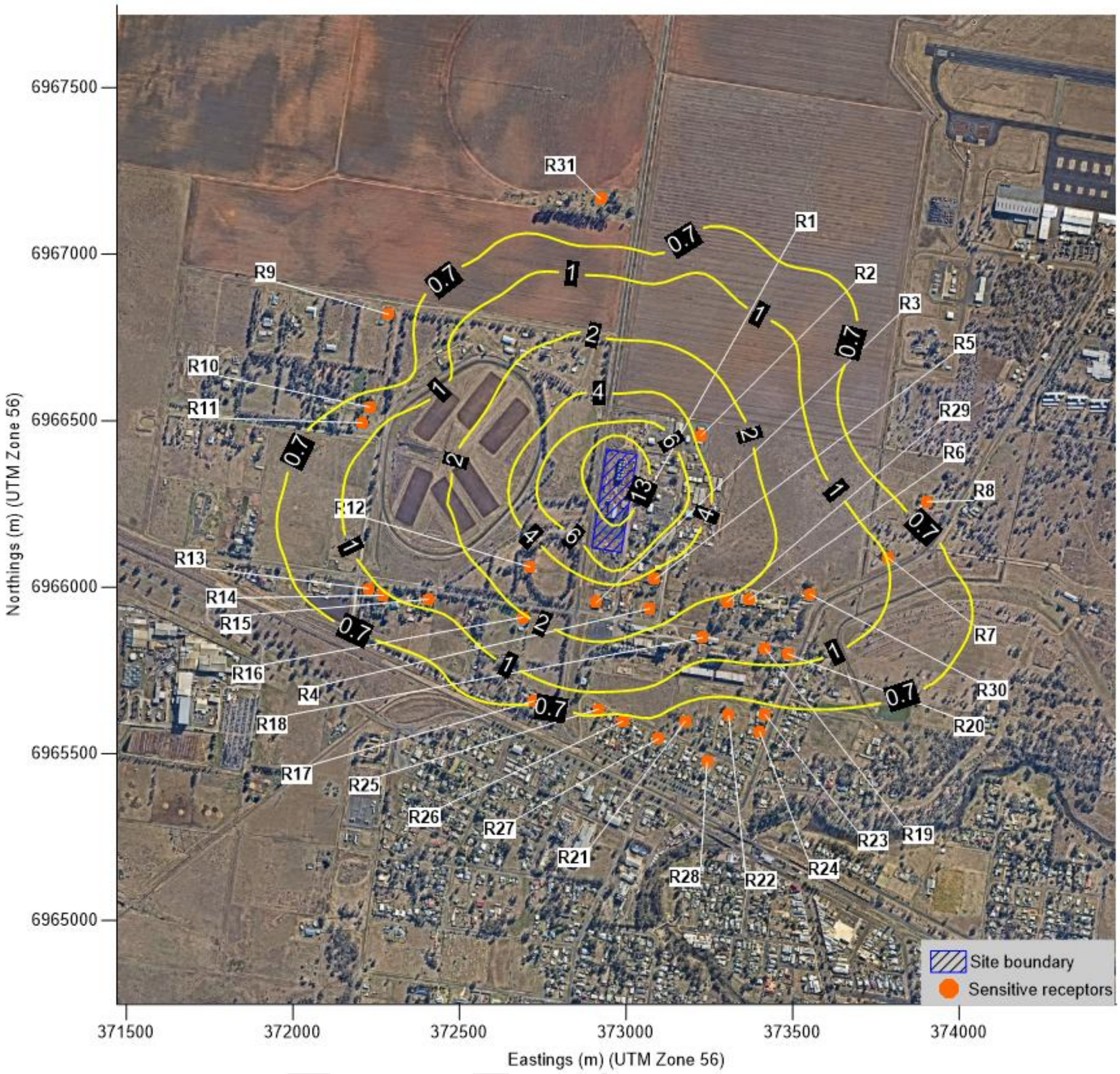

Figure C 1: Predicted maximum 24-hour average ground level incremental PM_{10} concentration (Criteria: 50 µg/m³)

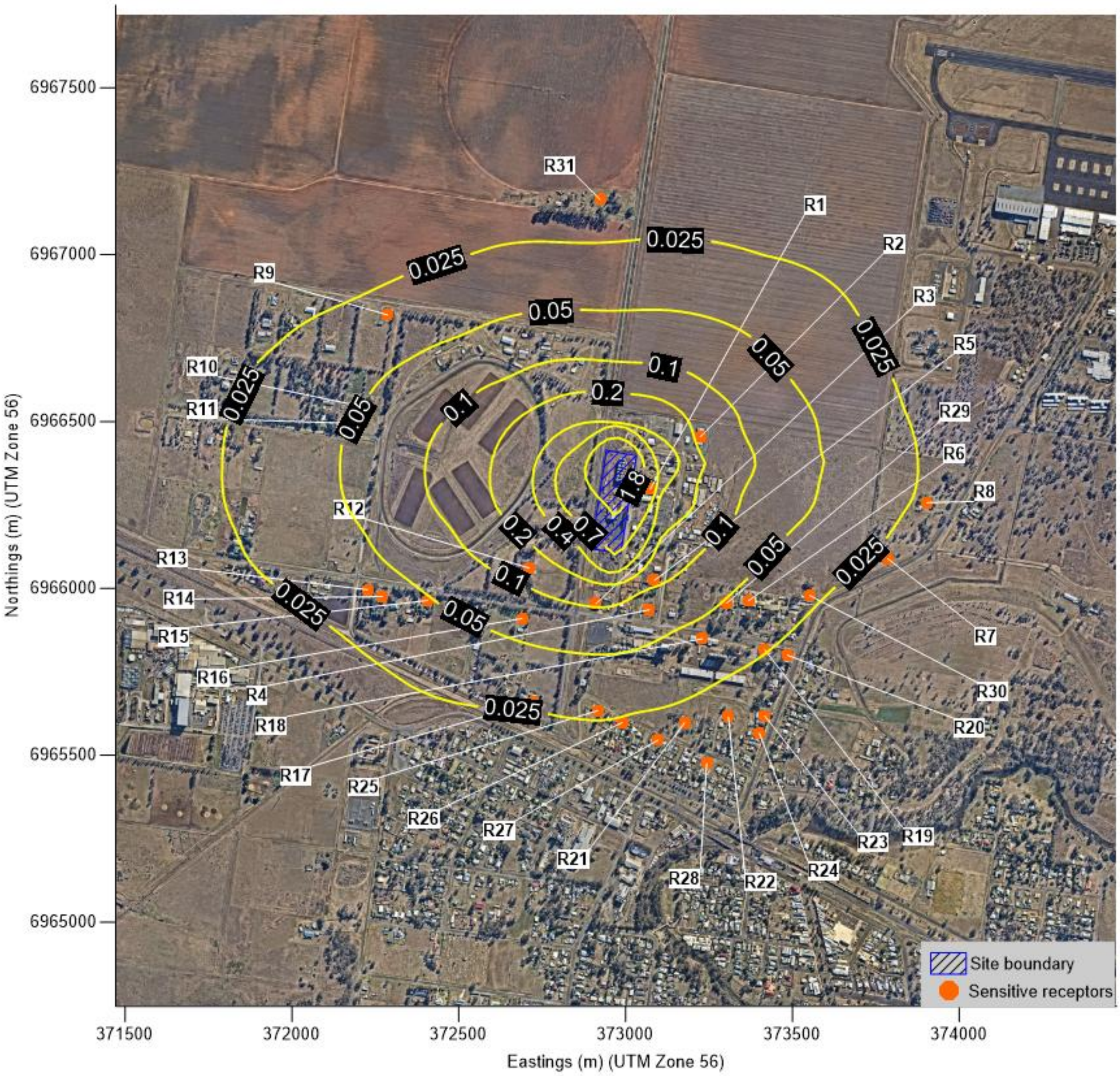

Figure C 2: Predicted annual average ground level incremental PM_{10} concentration (Criteria: 25 µg/m^3)

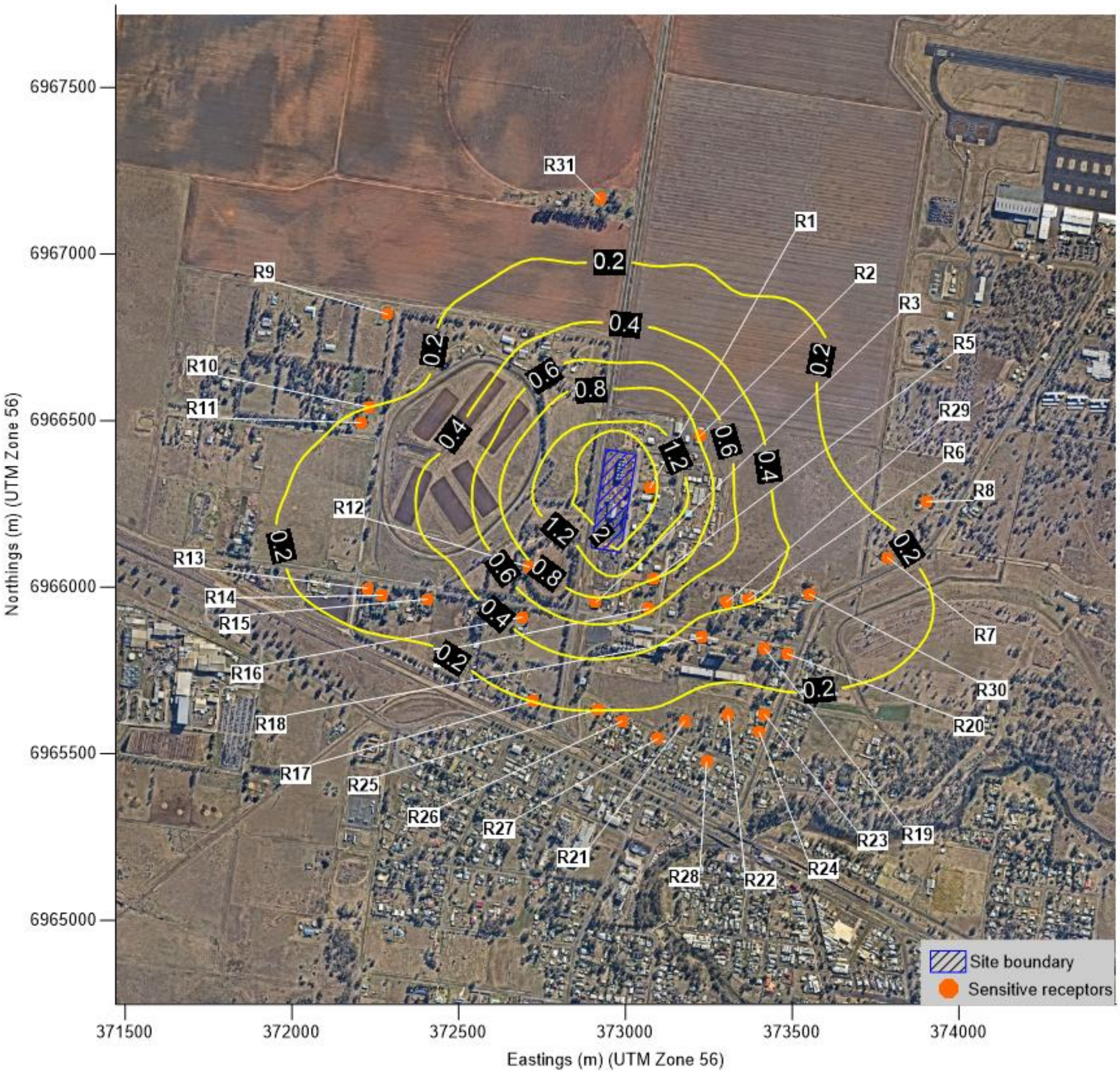

Figure C 3: Predicted maximum 24-hour average ground level incremental $PM_{2.5}$ concentration (Criteria: 20 $\mu g/m^3$)

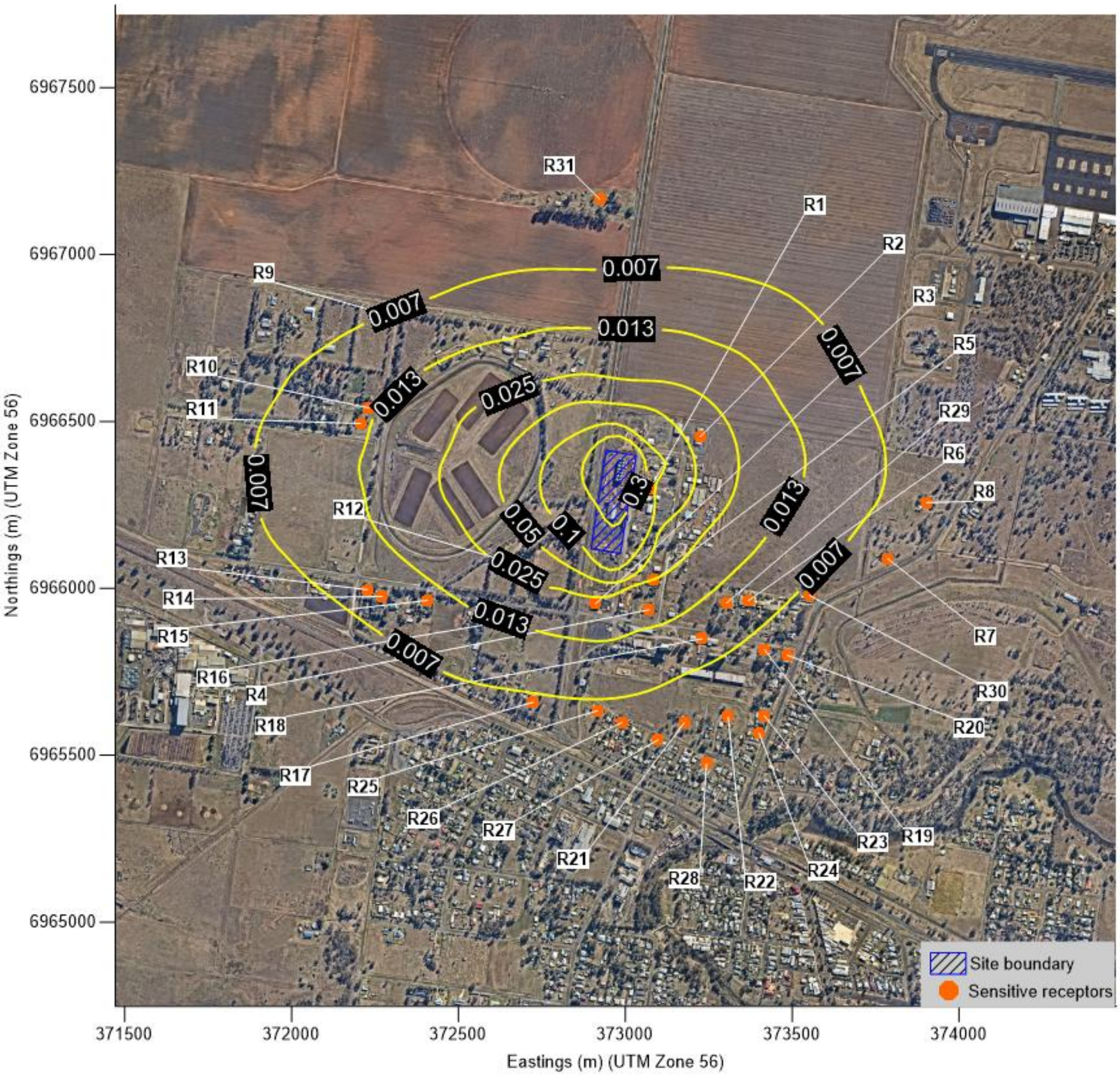

Figure C 4: Predicted annual average ground level incremental $PM_{2.5}$ concentration (Criteria: 7 µg/m³)

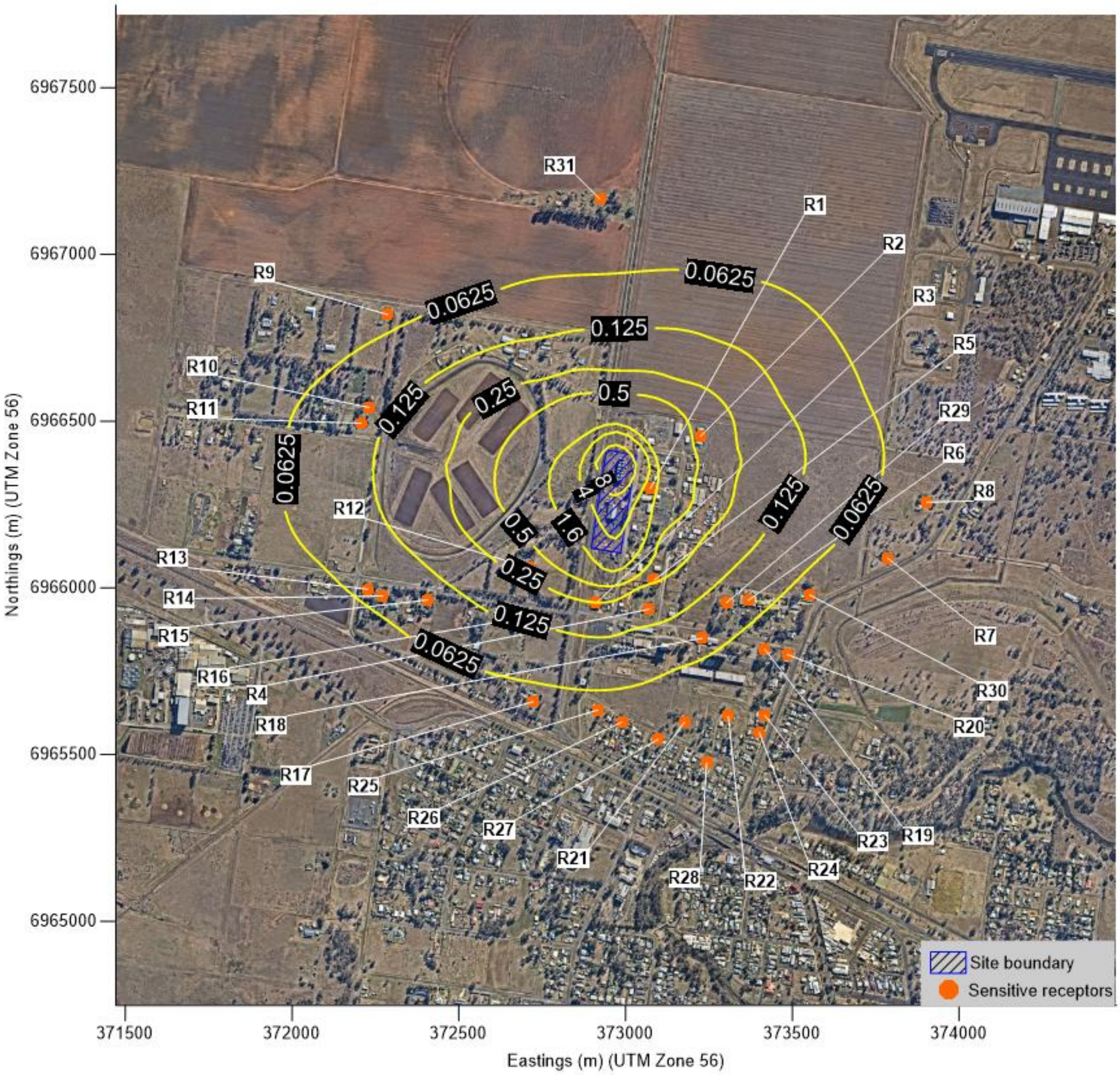

Figure C 5: Predicted annual average ground level incremental TSP concentration (Criteria: 90 µg/m³)

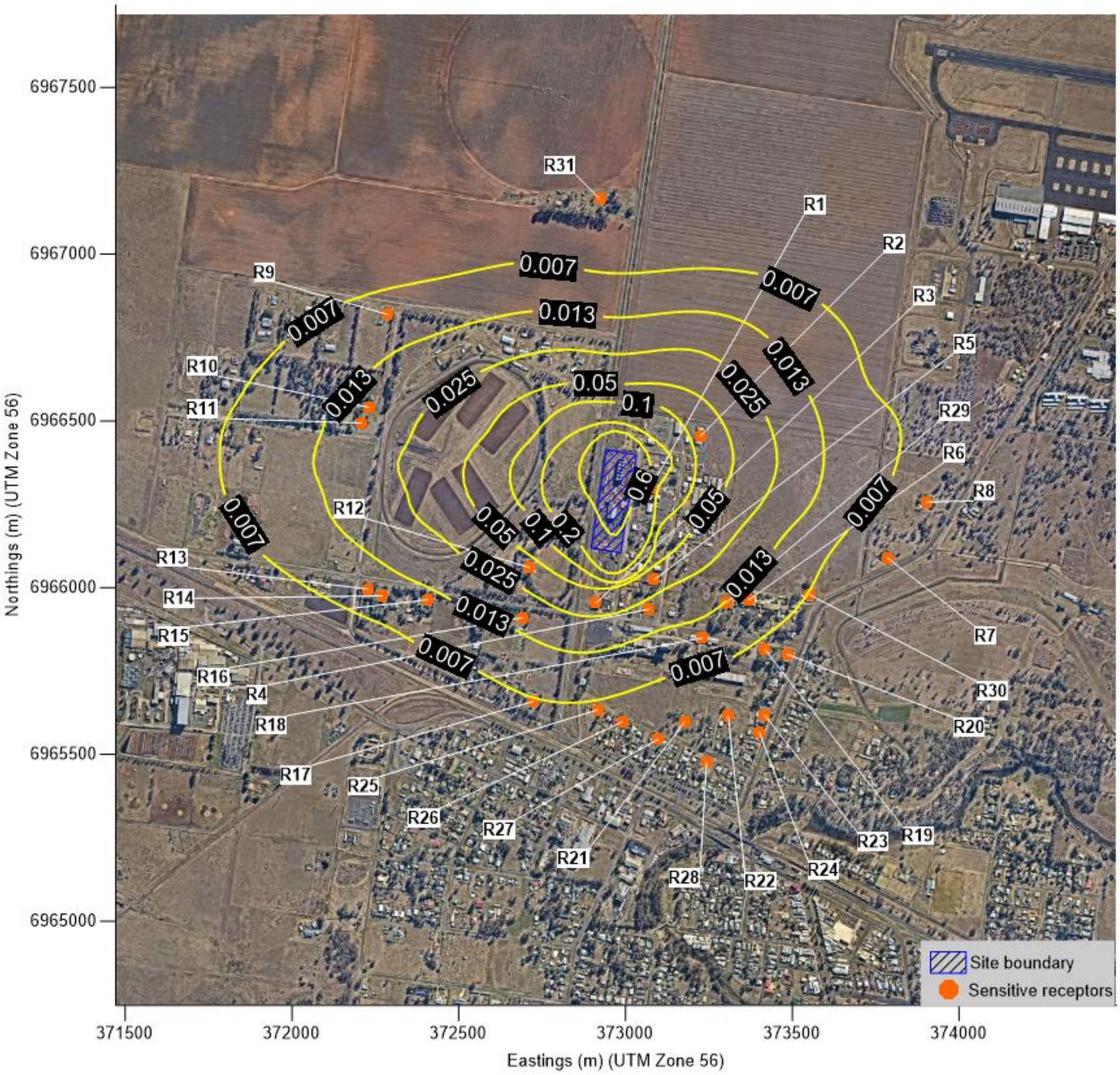

Figure C 6: Predicted annual average ground level incremental deposited dust concentration (Criteria: 4 g/m²/month)

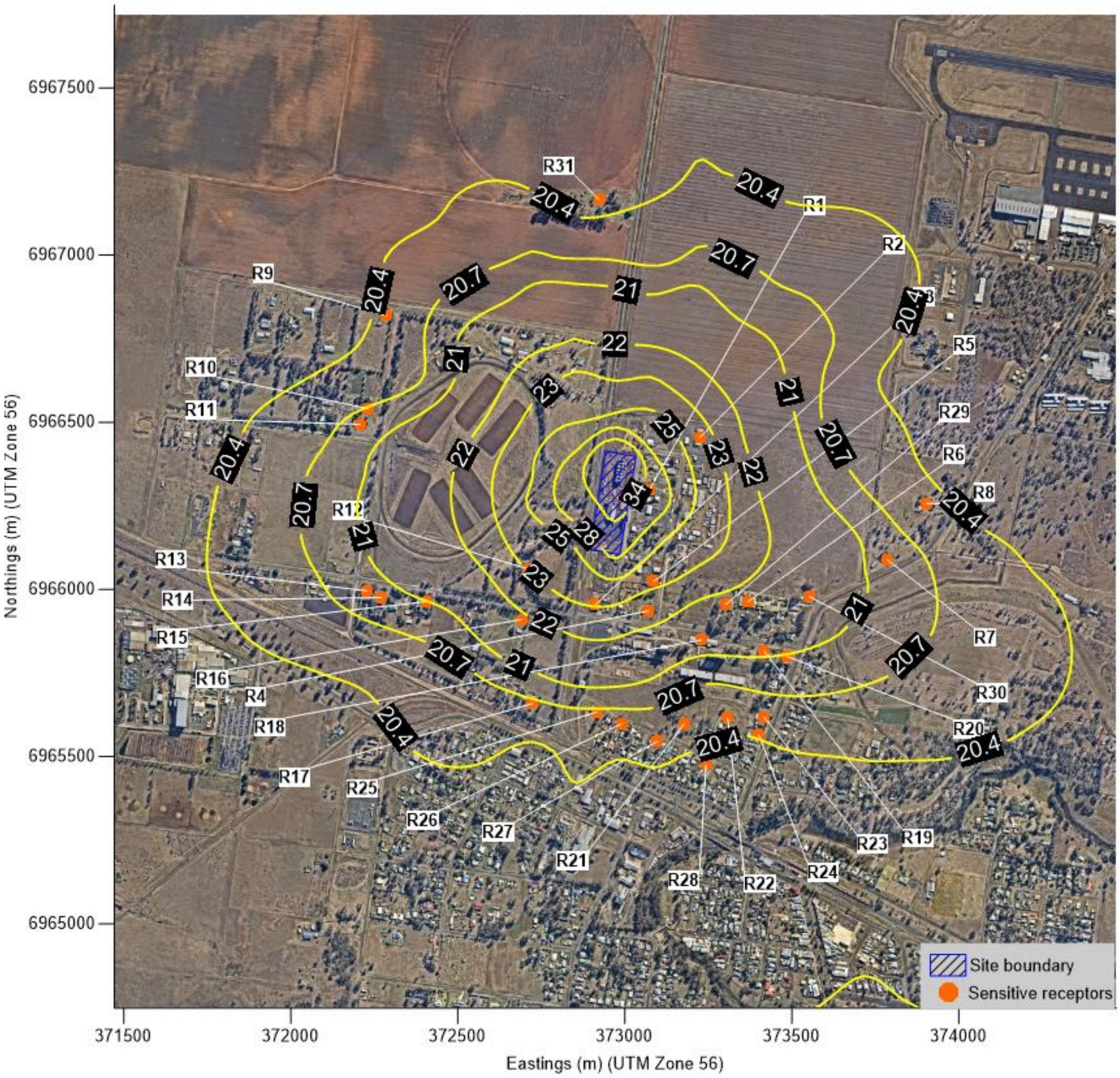

Figure C 7: Predicted maximum 24-hour average ground level cumulative PM_{10} concentration (Criteria: 50 µg/m^3)

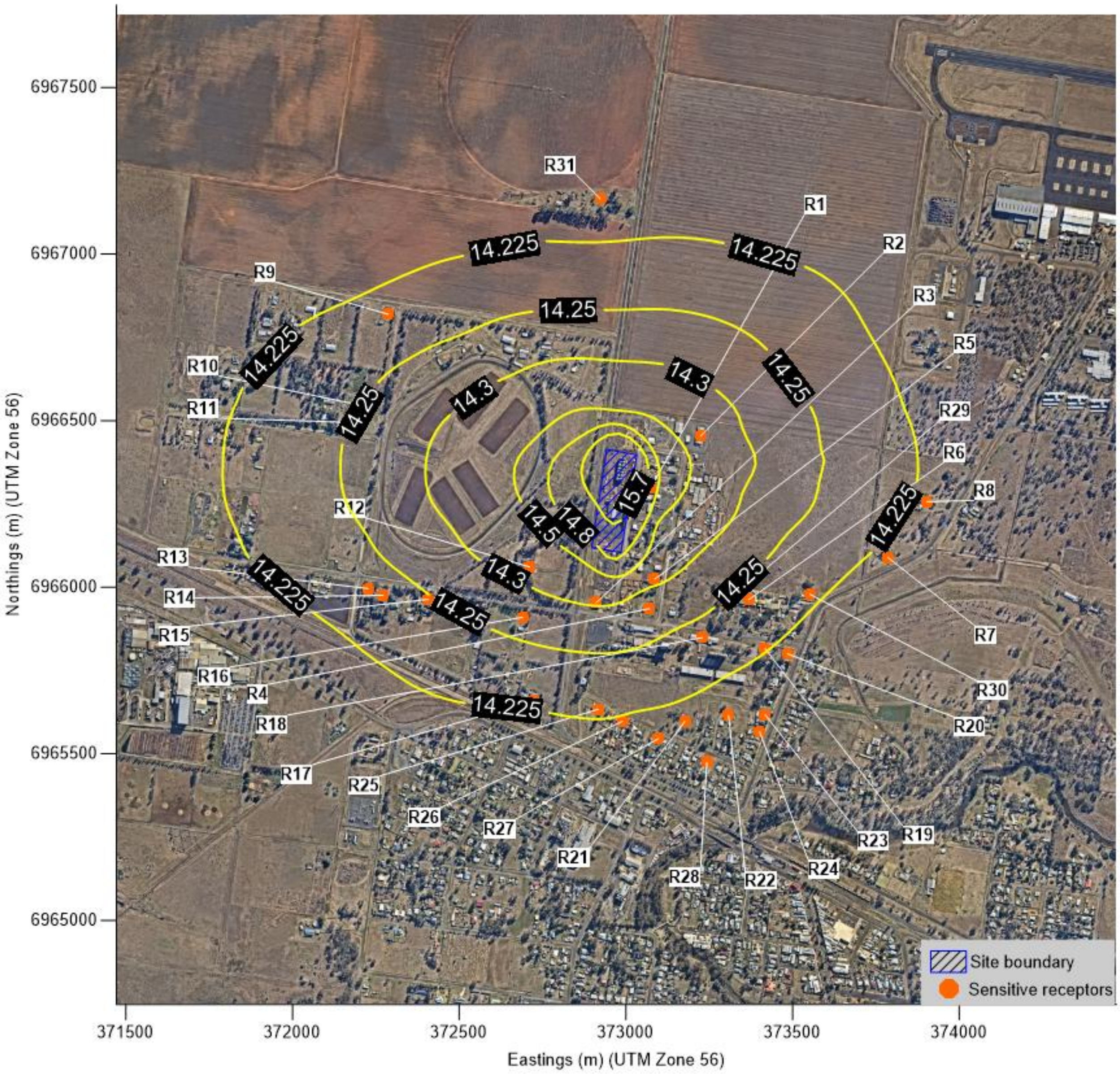

Figure C 8: Predicted annual average ground level cumulative PM_{10} concentration (Criteria: 25 µg/m^3)

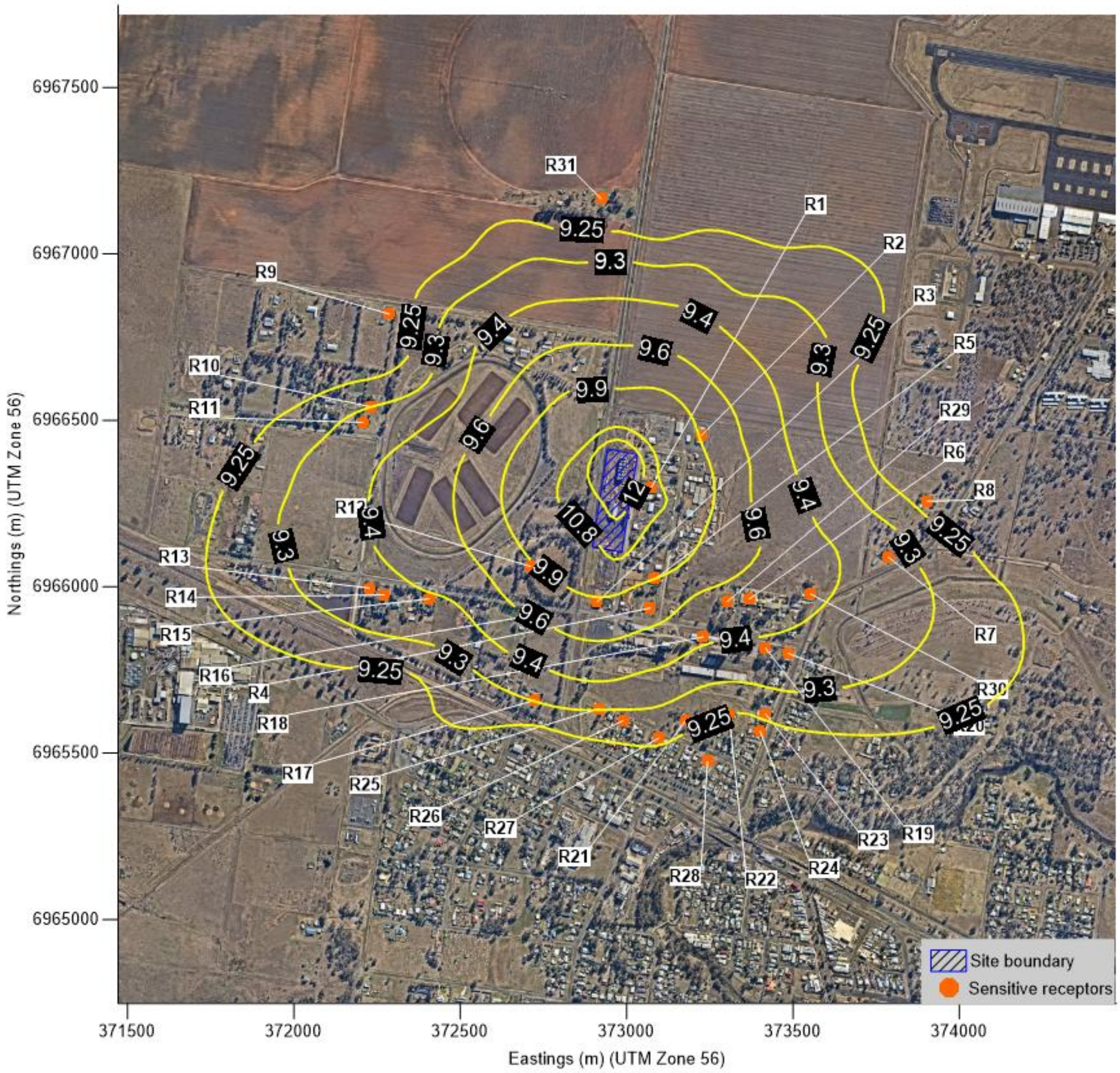

Figure C 9: Predicted maximum 24-hour average ground level cumulative $PM_{2.5}$ concentration (Criteria: 20 $\mu g/m^3$)

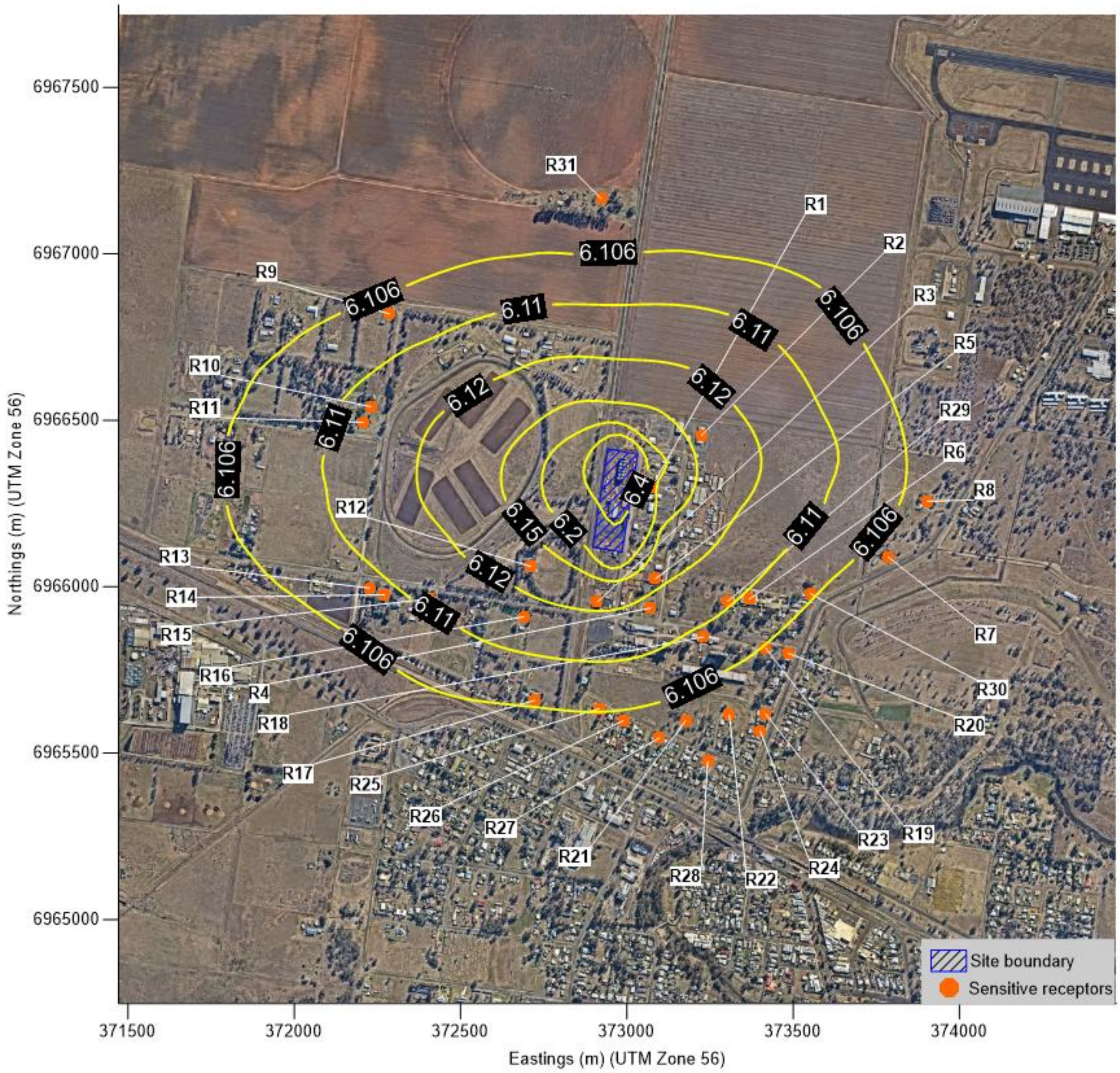

Figure C 10: Predicted maximum annual average ground level cumulative $PM_{2.5}$ concentration (Criteria: 7 µg/m^3)

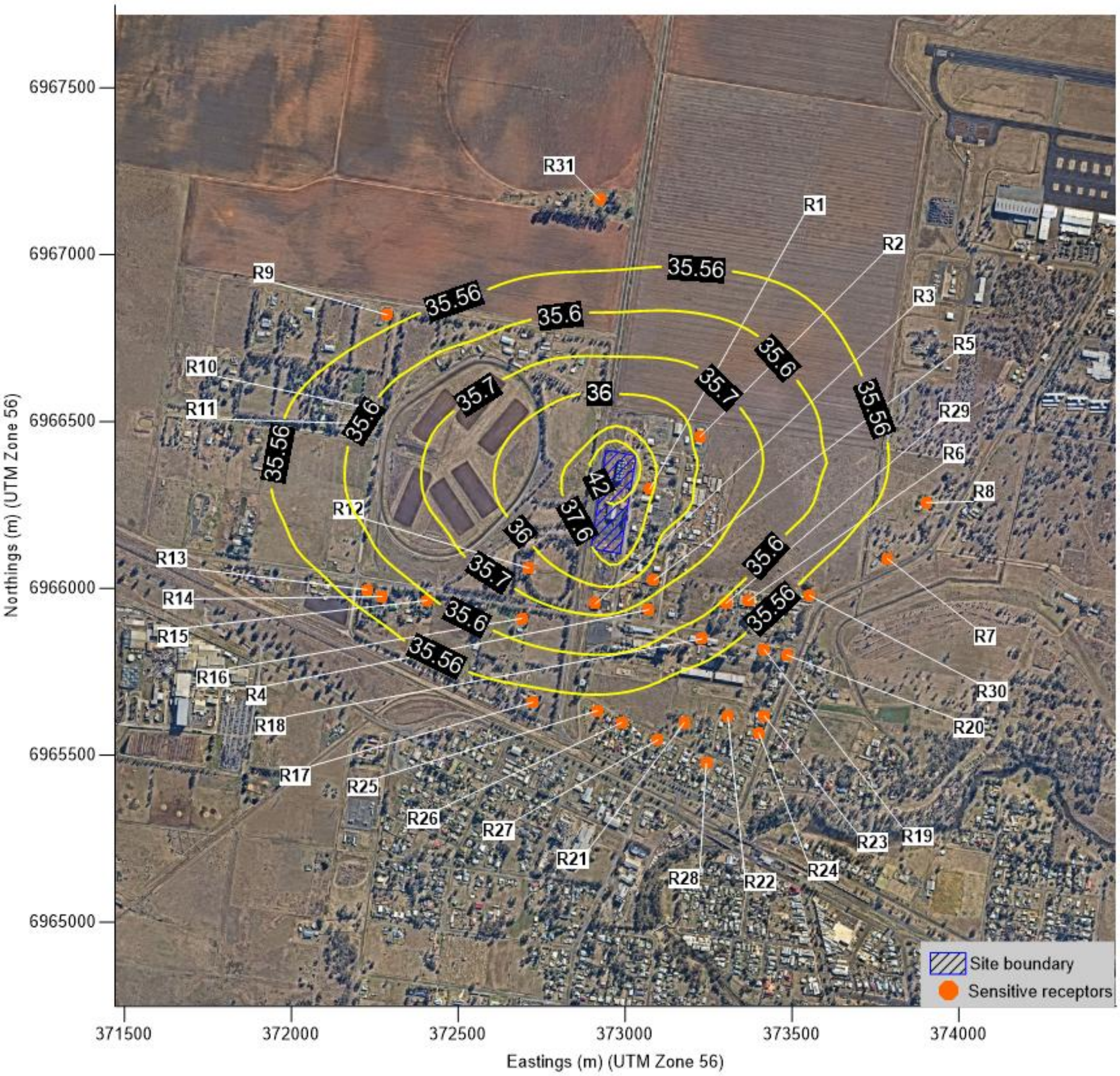

Figure C 11: Predicted annual average ground level cumulative TSP concentration (Criteria: 90 µg/m^3)

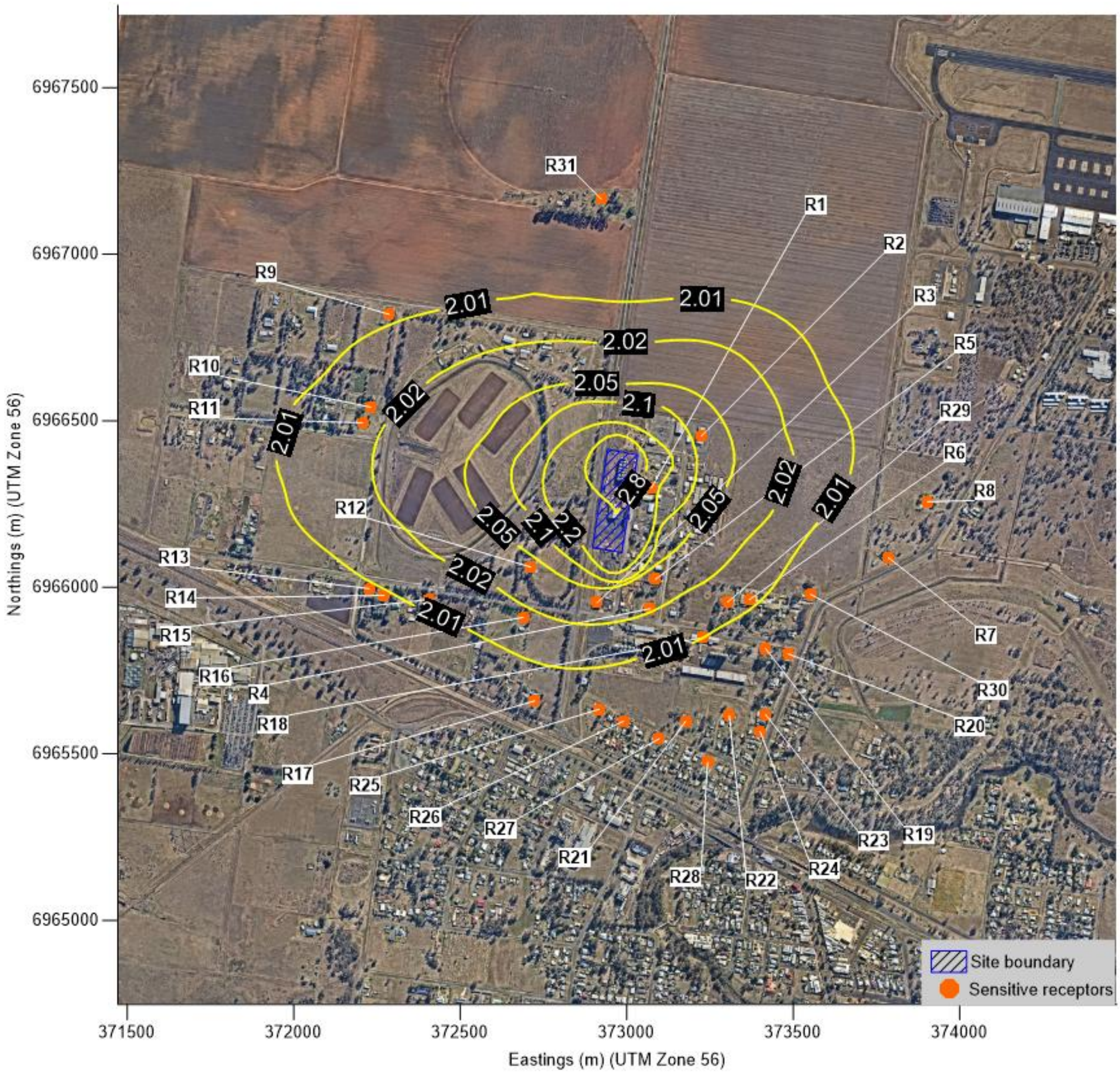

Figure C 12: Predicted annual average ground level cumulative deposited dust concentration (Criteria: 4 g/m²/month)