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Newcastle Sand Pty Ltd

Bobs Farm Sand Quarry

Air Quality Assessment

70B-25-0300-TRP-128591-3

8 May 2026

Job Title:	Bobs Farm
Report Title:	Air Quality Assessment
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Executive Summary

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Newcastle Sand (the Proponent) to conduct an Air Quality Impact Assessment of the proposed Sand Quarry located on Deposited Plan DP753204 (40.9ha), Bobs Farm NSW.

The Proponent seeks to develop the site for an extractive industry as a sand quarry. Consent is sought for annual extraction of 530,000tpa for 10 years, equating to a total life-of-quarry of approximately 4.4 million tonnes. It is anticipated the proposal will average sales of 10,000 to 12,000 tonnes per week.

The site has an area of approximately 40.9ha with the proposal seeking to use most of the subject site for extractive industry purposes with the exception of:

- A minimum 15m buffer between the site boundary and any areas of extraction
- The existing right-of-carriage way including a 3m buffer in the north-east of the site and the area east of this right-of-carriageway
- The existing electricity easement including a 3m buffer at the southern end of the site and the vegetated area to the south of this easement Dry (surface) sand extraction only is proposed.

No dredging is proposed with only dry (surface) sand extraction being employed.

Extraction will be staged with progressive rehabilitation of exhausted areas.

The air quality impact assessment has been carried out as follows:

- An emissions inventory of TSP, PM_{10}, $PM_{2.5}$, RCS and deposited dust for the proposed Project was compiled using National Pollutant Inventory (NPI) and United States Environmental Protection Agency (USEPA) AP-42 emissions estimation methodology for the Project (outlined in Section 6.1).
- Estimated emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three-dimensional meteorological dataset for use in the CALPUFF dispersion model (Section 6.2).
- The atmospheric dispersion modelling results were assessed against the air quality assessment criteria described in Section 4.3 as part of the impact assessment. Air quality controls are applied to reduce emission rates where applicable.

Table ES-1 to Table ES-4 summarises the results for the two modelled scenarios for the highest impacted receptors for the project in isolation and cumulative impacts. As shown in the tables, the results of the modelling have shown that the TSP, PM_{10}, $PM_{2.5}$, RCS and dust deposition predictions comply with the relevant criteria and averaging periods at all sensitive receptors modelled for the Project in isolation.

TSP, RCS, dust deposition and annual average PM_{10} and $PM_{2.5}$ predictions are also less than criteria for the Project including background at all sensitive receptors modelled. Whilst the 24 hour average PM_{10} and $PM_{2.5}$ predictions are above, the exceedances are driven by the elevated background adopted for the assessment, which are already above their respective criteria. No additional exceedances of the criteria at these receptors are predicted to occur as a result of the proposed quarry operations. Additionally, a range of mitigation and management measures are provided and recommended to be implemented to minimise emissions as far as is practical, including the implementation of air quality monitoring. In the absence of the elevated background therefore, we would anticipate no exceedances of the criteria. As specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required at these receptors.

It is therefore concluded that air quality should not be a constraint for the proposed quarry.

Table ES-1: Summary of Results at the Most Impacted Receptors – Project in Isolation – Scenario 1

ID	**Predicted Concentrations ($\mu g/m^3$)**							**Dust deposition ($g/m^2/mth$)**	**Compliant**
	PM_{10}		**$PM_{2.5}$**		**TSP**	**RCS**			
	24 h	**Annual**	**24 h**	**Annual**	**Annual**	**24 h**	**Annual**	**Month**	
R13	5.78	0.45	1.39	0.14	1.02	1.39	0.14	0.18	✓
R14	6.77	0.59	1.89	0.18	1.37	1.89	0.18	0.25	✓
R15	9.55	1.20	2.65	0.36	3.03	2.65	0.36	0.61	✓
R16	7.74	0.64	2.25	0.23	1.40	2.25	0.23	0.32	✓
R17	7.25	0.45	1.70	0.15	1.01	1.70	0.15	0.19	✓
R18	6.03	0.57	1.90	0.25	1.07	1.90	0.25	0.30	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**14**	**3**	**2**	

Table ES-2: Summary of Results at the Most Impacted Receptors – Project in Isolation – Scenario 2

ID	**Predicted Concentrations ($\mu g/m^3$)**							**Dust deposition ($g/m^2/mth$)**	**Compliant**
	PM_{10}		**$PM_{2.5}$**		**TSP**	**RCS**			
	24 h	**Annual**	**24 h**	**Annual**	**Annual**	**24 h**	**Annual**	**Month**	
R9	4.62	0.41	1.33	0.17	0.74	1.33	0.17	0.17	
R10	2.91	0.12	0.66	0.05	0.22	0.66	0.05	0.06	
R13	2.38	0.98	4.17	0.41	1.96	4.17	0.41	0.50	✓
R14	2.70	1.25	6.22	0.57	2.23	6.22	0.57	0.43	✓
R15	14.92	0.36	1.93	0.19	0.53	1.93	0.19	0.09	✓
R16	17.45	0.25	1.29	0.12	0.36	1.29	0.12	0.06	✓
R18	4.29	0.22	1.49	0.12	0.31	1.49	0.12	0.06	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**14**	**3**	**2**	

Table ES-3: Summary of Results at the Most Impacted Receptors – Cumulative – Scenario 1

ID	Predicted Concentrations (µg/m³)							Dust deposition (g/m²/mth)	Compliant
	PM10		PM2.5		TSP	RCS			
	24 h[1]	Annual	24 h[1]	Annual	Annual	24 h	Annual	Month	
R13	56.48	16.95	31.69	6.24	42.27	2.09	0.84	2.18	✓
R14	57.47	17.09	32.19	6.28	42.62	2.59	0.88	2.25	✓
R15	60.25	17.70	32.95	6.46	44.28	3.35	1.06	2.61	✓
R16	58.44	17.14	32.55	6.33	42.65	2.95	0.93	2.32	✓
R17	57.95	16.95	32.00	6.25	42.26	2.40	0.85	2.19	✓
R18	56.73	17.07	32.20	6.35	42.32	2.60	0.95	2.30	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**14**	**3**	**4**	

1 the exceedances are driven by the elevated background, which is already above the criteria. No additional exceedances of the criteria at these receptors are predicted to occur as a result of the proposed quarry operations and as specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required at these receptors.

Table ES-4: Summary of Results at the Most Impacted Receptors – Cumulative – Scenario 2

ID	Predicted Concentrations (µg/m³)							Dust deposition (g/m²/mth)	Compliant
	PM10		PM2.5		TSP	RCS			
	24 h	Annual	24 h	Annual	Annual	24 h	Annual	Month	
R9	55.32	16.91	31.63	6.27	41.99	2.03	0.87	2.17	
R10	53.61	16.62	30.96	6.15	41.47	1.36	0.75	2.06	
R13	65.62	17.48	34.47	6.51	43.21	4.87	1.11	2.50	✓
R14	68.15	17.75	36.52	6.67	43.48	6.92	1.27	2.43	✓
R15	54.99	16.86	32.23	6.29	41.78	2.63	0.89	2.09	✓
R16	54.00	16.75	31.59	6.22	41.61	1.99	0.82	2.06	✓
R18	53.65	16.72	31.79	6.22	41.56	2.19	0.82	2.06	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**14**	**3**	**4**	

1 the exceedances are driven by the elevated background, which is already above the criteria. No additional exceedances of the criteria at these receptors are predicted to occur as a result of the proposed quarry operations and as specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required at these receptors.

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1 Introduction

1.1 Overview

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Newcastle Sand (the Proponent) to conduct an Air Quality Impact Assessment of the proposed Sand Quarry (the Project) located on Deposited Plans DP753204 (40.9ha), Bobs Farm NSW.

The Proponent seeks to develop the site for an extractive industry as a sand quarry. Consent is sought for annual extraction of 530,000tpa for 10 years, equating to a total life-of-quarry of approximately 4.4 million tonnes. It is anticipated the proposal will average sales of 10,000 to 12,000 tonnes per week.

The purpose of this assessment is to evaluate the potential impacts of air pollutants generated from the Project and to provide recommendations to mitigate any potential impacts that might have an effect on nearby sensitive receptors.

1.2 Study Objective and Requirements

The NSW Department of Planning, Housing and Infrastructure (DPHI) issued Secretary's Environmental Assessment Requirements (SEARS) on 18/12/25 for the Project, which specify the information required to be addressed in the Environmental Impact Statement (EIS). The key requirements relating to air quality and how this assessment report addresses them are summarised in Table 1-1.

The purpose of this assessment is to evaluate the potential impacts of air pollutants generated from the Project which addresses the specific EPA requirements and provides recommendations to mitigate any potential impacts that might have an effect on nearby sensitive receptors.

Table 1-1: Summary of SEARs

Requirements (Air Quality Impact Assessment)	How requirement is addressed
a detailed assessment of potential construction and operational air quality and odour impacts, in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, and with a particular focus on dust emissions including PM2.5 and PM10, and having regard to the Voluntary Land Acquisition and Mitigation Policy;	A quantitative air quality assessment is prepared in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2022) and Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System. The assessment methodology is discussed in section 6. Exceedances of relevant Air Quality Criteria are not predicted to be likely, and as such no recommendations for Land acquisition in regard to the Voluntary Land Acquisition and Mitigation Policy have been made. As discussed in Section 3, the operational phase of the project has been quantitatively assessed. As noted in Section 3, potential for air quality impacts due to the construction phase of the project would typically be addressed and controlled based upon a construction management plan. In addition, an Air quality Management Plan is provided in Error! Reference source not found..
an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products;	As above, and the assessment of air quality impacts are presented in Section 7.
an assessment of the greenhouse gas emission impacts of the development;	A greenhouse gas emission impact assessment is detailed in Vipac Report (Ref: 70B-25-0300-TRP-136416-0)
reasonable and feasible mitigation measures to minimise dust and emissions; and	recommendations for air quality mitigation measures and monitoring are presented in Section 8 and Error! Reference source not found..
- details of proposed monitoring and management measures in particular, real-time air quality monitoring.	As above

2 Project Description

2.1 Overview

The Proponent seeks to develop the site for an extractive industry as a sand quarry. Consent is sought for annual extraction of 530,000tpa for 10 years, equating to a total life-of-quarry of approximately 4.4 million tonnes. It is anticipated the proposal will average sales of 10,000 to 12,000 tonnes per week.

The site has an area of approximately 40.9ha with the proposal seeking to use most of the subject site for extractive industry purposes with the exception of:

- A minimum 15m buffer between the site boundary and any areas of extraction
- The existing right-of-carriage way including a 3m buffer in the north-east of the site and the area east of this right-of-carriageway
- The existing electricity easement including a 3m buffer at the southern end of the site and the vegetated area to the south of this easement Dry (surface) sand extraction only is proposed.

No dredging is proposed with only dry (surface) sand extraction being employed.

Extraction will be staged with progressive rehabilitation of exhausted areas. The proposed extraction staging plan during the Project life is shown in Figure 2-1.

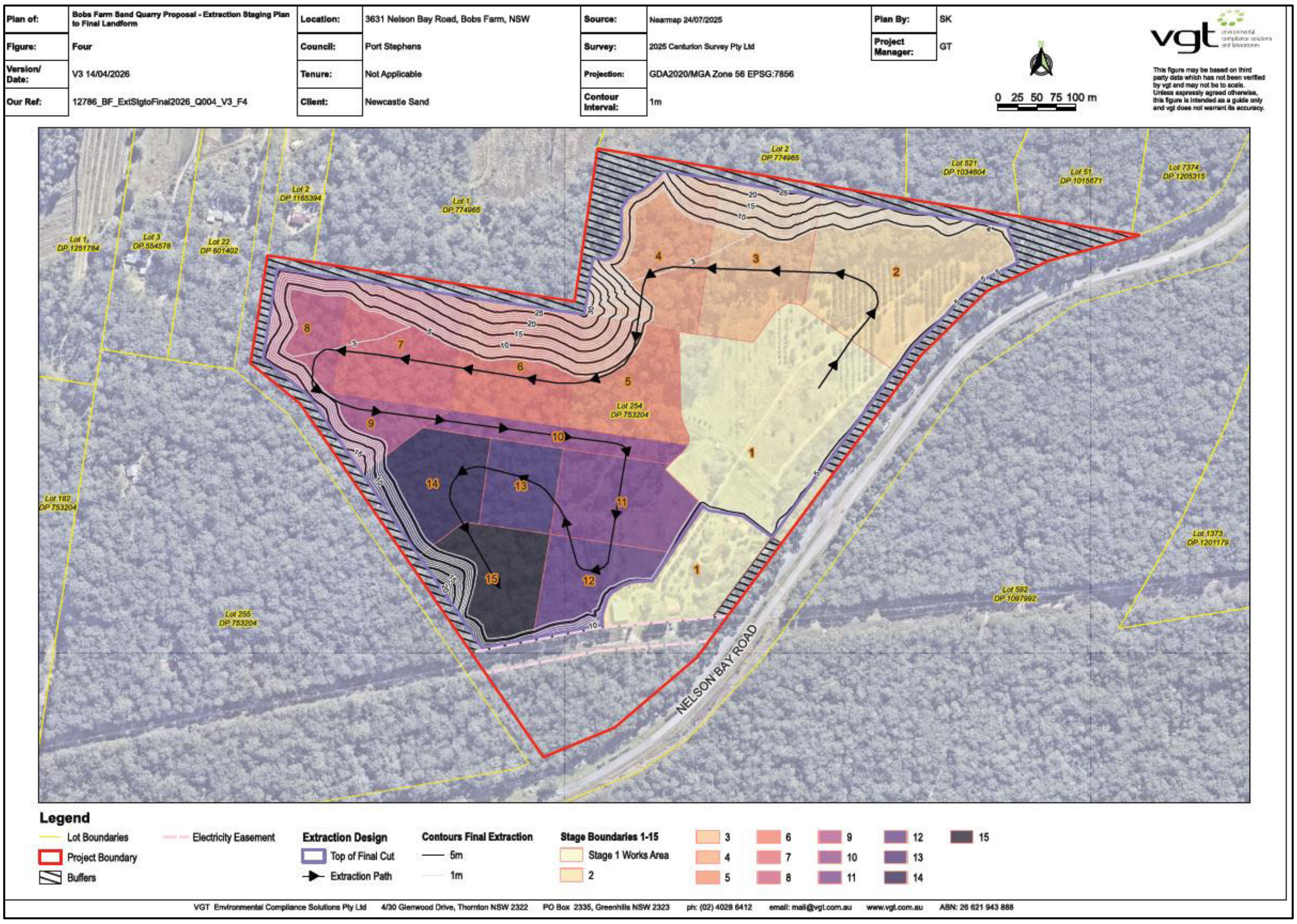


Figure 2-1: Bobs Farm Quarry Extraction Staging Plan

2.2 Proposed Operations

Preparation of the site and proposed sand quarry operations would broadly comprise:

- Construction of a new left-in left-out intersection
- Establishment of processing and sales area including installation of onsite office (Atco structure), installation of screening and wash facilities, designation of stockpiling areas, and use of the existing dwelling at the site for a manager's residence
- Staged vegetation clearing and topsoil stripping in accordance with the approved staging plan with topsoil stored onsite to be used for future rehabilitation works
- Dry extraction methods only down to a maximum of 0.7m above the ground water table
- Ongoing rehabilitation.

Day-to-day operations would require two (2) articulated haul trucks (Volvo A40G) loaded by a hydraulic excavator (Volvo EC350) to transport sand from the extraction area to the on-site processing facility being a full electric screen and wash plant. Equipment will include excavators, front-end loaders, haul trucks, conveyors and water carts. Operations will utilise modern, well-maintained equipment incorporating advanced noise attenuation and water saving measures as well as fuel efficiency technology to reduce operational impacts on the surrounding environment.

The site benefits from a Water Access Licence (WAL5960) for 40ML per annum which is proposed to be used for sand washing purposes. Approximately 85% of extracted sand will be washed requiring a total of approximately 32ML per annum which is within the current Water Access Licence.

All essential services are available, or able to be made available, at the site including electricity, water tanks for potable water, pump-out system for sewage management, stormwater drainage and suitable vehicular access.

Sales would be by haulage truck at a maximum of ten (10) loaded trucks per hour equating to a maximum of 120 loaded trucks per day but with an average of 46 loaded trucks per day. All transport trucks would travel east along Nelson Bay Road and complete a U-turn at the Port Stephens Drive roundabout. Haulage trucks will be prohibited from using Marsh Road.

The site will be accessed by way of a new left-in left-out intersection onto Nelson Bay Road. The existing access to the site at the electricity easement is proposed to be retained for light vehicle access for the quarry as well as for access to the manager's residence.

Progressive rehabilitation of exhausted areas will take place in accordance with the approved rehabilitation plan. The proposed post-quarry use of the site is to return the site to its current condition, being the same ratio of vegetated land and land used for the purpose of extensive agriculture.

An indicative layout of the processing area proposed to be developed in stage 1 is presented in Figure 2-2.

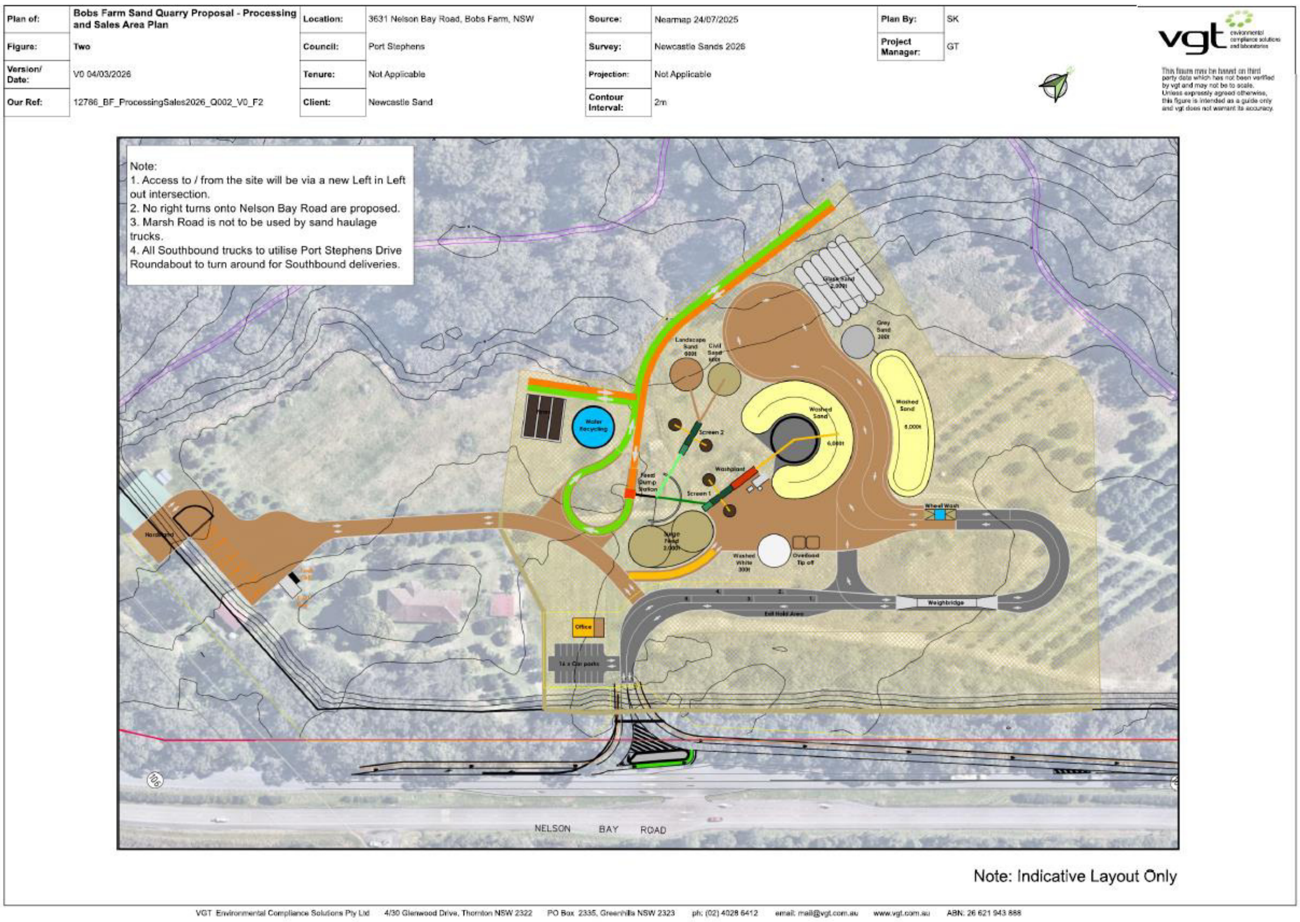


Figure 2-2: Sales and Processing Area Indicative Layout

2.3 Construction

The construction phases of the project are considered to comprise the following activities:

- Construction of a new left-in left-out intersection;
- Establishment of processing and sales area including installation of onsite office (Atco structure), installation of screening and wash facilities and designation of stockpiling areas;
- Development of internal haul roads; and
- Preparation of land prior to extraction, including clearing of vegetation and removal of topsoil and overburden in accordance with the proposed extraction staging plan.

As noted, progressive rehabilitation of exhausted areas will take place in accordance with an approved rehabilitation plan.

2.4 Hours of Operation

The Project's proposed equipment and hours of operation are summarised in Table 2-1. It is noted that the proposed equipment use is generally consistent across different stages.

Table 2-1: Proposed hours of operation

Activity	Equipment	Operating Hours
Sand processing, washing and production	• Volvo EC350E Excavator • Volvo A40G x 2 Articulated Dump Truck • Conveyor System • Sales Loader (Volvo L220) • McLanahan Wash Plant • McLanahan De-watering Screen	• 7:00 am to 5:00 pm, Monday to Friday • 7:00 am to 4:00 pm, Saturdays • Closed Sundays and public holidays
Sales	• Sales Loader (Volvo L220) • Export Road Truck	• 6:00 am to 6:00 pm, Monday to Friday • 7:00 am to 4:00 pm, Saturdays • Closed Sundays and public holidays

2.5 Air Sensitive Receptors

The subject site is located at 3631 Nelson Bay Road Bobs Farm within the Port Stephens local government area Located within Lot 254 DP 753204.

The Bobs Farm site deposit is situated on the northern end of the Stockton Bight Dunal system, approximately 200 km north of Sydney, near Bobs Farm, NSW. The surrounding area is predominately zoned as rural with minimal primary production. The site is located in Bobs Farm approximately 27 km north-east of Newcastle and approximately 14 km south-west of Nelsons Bay. The site is bounded to the south by Nelson Bay Road.

The closest dwellings to the extraction area are located between approximately 40 m to 60 m along the northern boundary. The sensitive receptors considered in this assessment are presented in Table 2-2 and illustrated in Figure 2-3.

Table 2-2 - Sensitive Receptors

Reference	Description	Distance from Site Boundary (approx.)	UTM Coordinates	
			Easting	Northing
R1	724 Marsh Road - Residential	250m	407080	6373782
R2	776 Marsh Road - Residential	650m	407432	6374056
R3	772 Marsh Road - Residential	650m	407410	6374157
R4	764 Marsh Road (Marsh Road Public School)	700m	407377	6374169
R5	762 Marsh Road - Residential	700m	407313	6374153
R6	760 Marsh Road (Marsh Road Public Hall)	700m	407306	6374183
R7	756 Marsh Road - Residential	650m	407270	6374128
R8	710 & 712 Marsh Road - Residential	500m	406822	6374040
R9	698 Marsh Road - Residential	150m	406807	6373689
R10	666 Marsh Road - Residential	350m	406409	6373926
R11	650 Marsh Road - Residential	350m	406345	6373915
R12	686 Marsh Road (Shark and Ray Centre)	250m	406209	6373694
R13	686 Marsh Road (Tourist Accommodation – Managers Residence)	40m	406497	6373636
R14	686 Marsh Road (Tourist Accommodation – Nearest Eco Cabins)	60m	406444	6373588
R15	644 Marsh Road - Residential	50m	406123	6373508
R16	640 Marsh Road - Residential	60m	406016	6373514
R17	630 Marsh Road - Residential	150m	405912	6373456
R18	3551 Nelson Bay Road - Residential	200m	405906	6373182
R19	3515 Nelson Bay Road - Residential	500m	405758	6372941
R20	723 Marsh Road - Residential	650m	406868	6374185
R21	731 Marsh Road - Residential	700m	407003	6374232
R22	761 Marsh Road - Residential	800m	407322	6374277
R23	767 Marsh Road - Residential	800m	407385	6374280
R24	781 Marsh Road - Residential	800m	407503	6374223
R25	3780 Nelson Bay Road - Residential	700m	407631	6374081
R26	3724 Nelson Bay Road - Residential	500m	407629	6373758
R27	3790 Nelson Bay Road - Residential	400m	407547	6373678
R28	774 Marsh Road - Residential	450m	407339	6373929

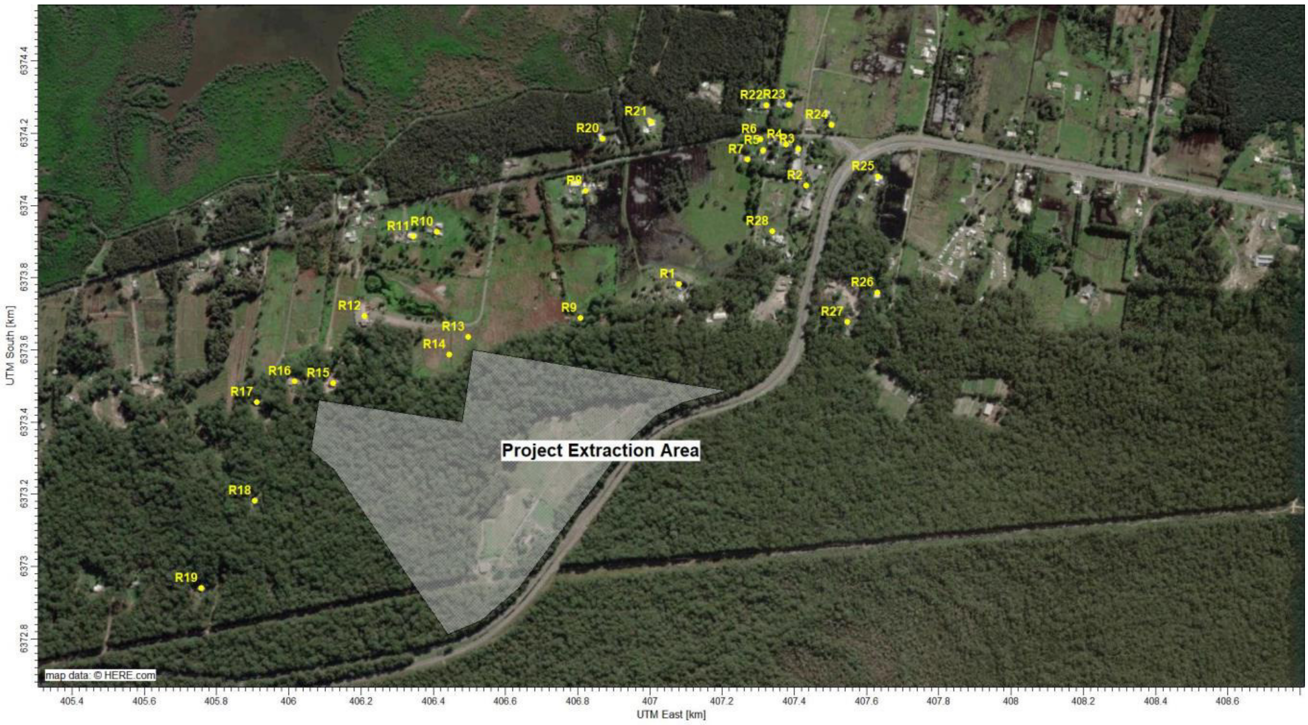


Figure 2-3 - Sensitive Receptors

3 Pollutants of Concern

3.1 Operation

The main emissions to air from quarrying operations are caused by wind-borne dust, vehicle usage, materials handling and transfers. Fugitive air emissions can be estimated using emission factors combined with site-specific information such as the silt and moisture content of material being handled.

Dust is a generic term used to describe fine particles that are suspended in the atmosphere. The dust emissions considered in this report are particulate matter in various sizes:

- Total Suspended Particles (TSP) - Particulate matter with a diameter up to 50 microns;
- PM_{10} - Particulate matter less than 10 microns in size;
- $PM_{2.5}$ - Particulate matter less than 2.5 microns in size;
- Dust Deposition – deposited matter that falls out of the atmosphere; and
- Respirable crystalline silica (RCS)

3.2 Construction

The main air pollution and amenity impacts from construction activities are:

- annoyance due to dust deposition (soiling of surfaces) and visible dust;
- elevated concentrations of airborne particulate matter due to dust-generating activities; and
- exhaust emissions from construction equipment.

Very high levels of soiling can also damage plants and affect the diversity of ecosystems.

Dust emissions can occur during the preparation of the land. However, construction activities are inherently temporary and localised. Potential off-site impacts upon air quality (primarily as dust) are typically addressed and controlled based upon a construction management plan, utilising standard mitigation measures (e.g., water carts, speed limits). Furthermore, progressive rehabilitation of exhausted areas will occur in accordance with an approved rehabilitation plan. As a consequence, a quantitative assessment of dust emissions from this stage only (e.g. using air dispersion modelling) is not reported here. However, it is noted that much of the Project's construction activities (e.g. top soil stripping and earth moving, site preparation and initial extraction) will overlap with planned operations in Stage 1 which are cumulatively assessed with the identified worst-case operational stages.

4 Regulatory Framework

4.1 National Legislation

4.1.1 National Environment Protection (Ambient Air Quality) Measure

Australia's first national ambient air quality standards were outlined in 1998 as part of the National Environment Protection Measure for Ambient Air Quality.

The Ambient Air Measure (referred to as Air NEPM) sets national standards for the key air pollutants; carbon monoxide, ozone, sulfur dioxide, nitrogen dioxide, lead and particles (PM_{10}). A revision to the Measure was issued in 2003 with the inclusion of advisory $PM_{2.5}$ standards and the most recent revision being active as of 26 May 2021. The Air NEPM requires the State's governments to monitor air quality and to identify potential air quality problems.

4.2 State Legislation and Guidelines

4.2.1 Department of Environment and Planning Approved Methods

The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW Environment Protection Authority, 2022) detail both the assessment methodology and criteria for air quality assessments. Due to the type of industry and proximity to sensitive receptors, the requirements for a Level 2 assessment have been followed.

It is noted that the Approved Methods document at the time of assessment was dated August, 2022. A draft Approved Methods has since been released for public consultation in March 2026 with potential finalisation in Mid 2026. NSW EPA provides the following guidance on the application of the draft Approved Methods:

The draft Approved Methods will come into effect once the guidance document has been finalised and formally gazetted. All assessments lodged in the planning system after publication must comply with the updates. Assessments submitted during the draft consultation period should take into consideration the proposed updates.

4.3 Project Criteria

The applicable criteria selected for this assessment are presented in Table 4-1.

The draft Approved Methods includes impact assessment criteria for Respirable Crystalline Silica (RCS). These criterion have been adopted for this assessment.

Table 4-1: Project Air Quality Goals

Pollutant	Basis	Criteria	Averaging Time	Source
TSP	Human Health	90 $\mu g/m^3$	Annual	Approved Methods
PM_{10}	Human Health	50 $\mu g/m^3$	24-hour	Approved Methods
	Human Health	25 $\mu g/m^3$	Annual	Approved Methods
$PM_{2.5}$	Human Health	25 $\mu g/m^3$	24-hour	Approved Methods
	Human Health	8 $\mu g/m^3$	Annual	Approved Methods
RCS	Human Health	14 $\mu g/m^3$	24-hour	Draft Approved Methods
	Human Health	3 $\mu g/m^3$	Annual	Draft Approved Methods
Dust deposition	Amenity	Maximum incremental increase of 2 g/m^2/month	Annual	Approved Methods
	Amenity	Maximum total of 4 g/m^2/month	Annual	Approved Methods

5 Existing Environment

5.1 Dispersion Meteorology

5.1.1 Regional Meteorology

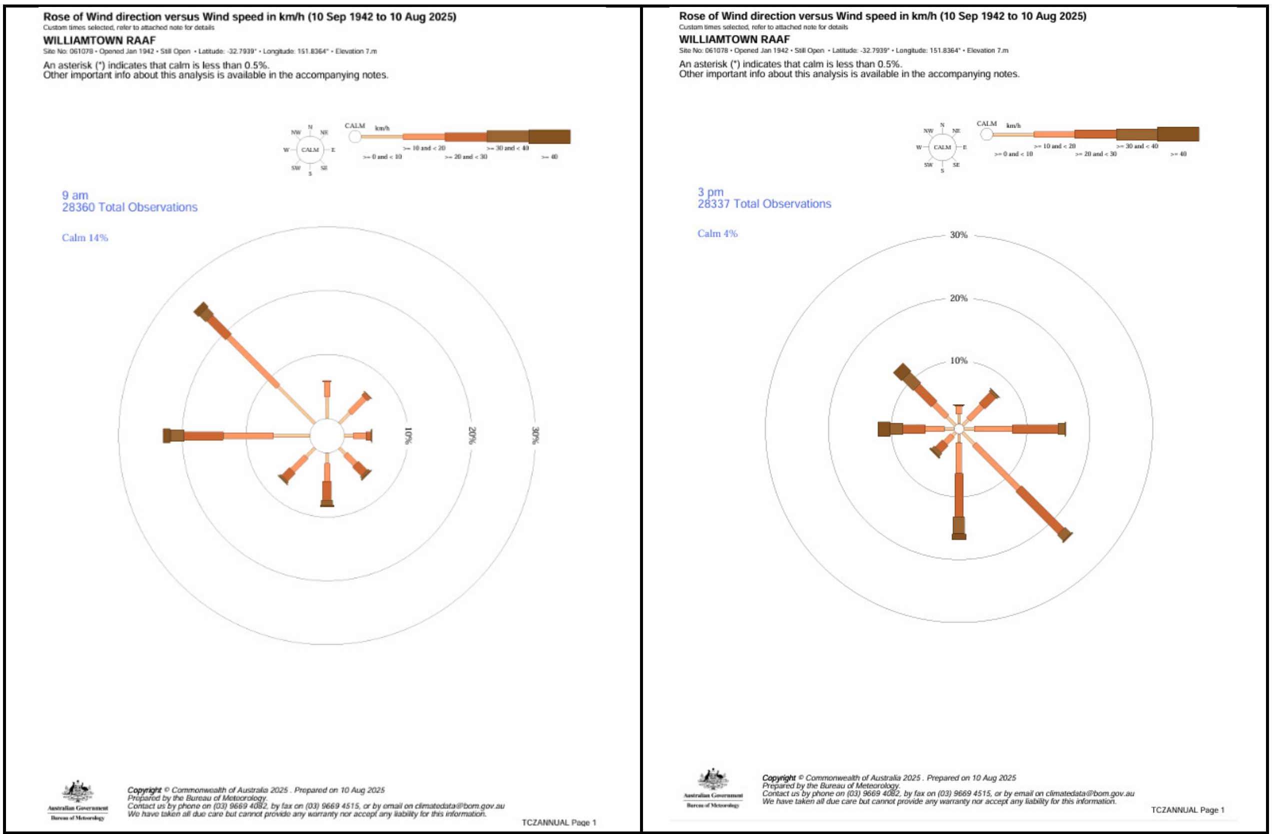
The nearest open Bureau of Meteorology (BOM) station with suitable long-term data is at Williamtown RAAF Automatic Weather Station (AWS) (Site number 061078), located approximately 15.5 km west of the project site. This monitoring station has recorded data since 1942 and a summary of the climate is presented in Table 5-1.

The long term mean temperature range recorded at the Williamtown RAAF AWS is between 6.5°C and 28.3°C with the coldest month being July and the hottest month being January. Rainfall in the region is variable throughout the year, on average, higher annual rainfall is received between January and June. Rainfall is lowest between July and September, with a mean annual rainfall of 1134.4 mm. A review of the number of rainfall days per year at Williamtown RAAF AWS shows that on average, the number of days where rainfall is ≥ 1 mm is 87 days per year.

The long-term wind roses recorded daily at the Williamtown RAAF AWS station at 9am and 3pm are provided in Figure 5-1. Winds are shown to be primarily from the west and northwest at 9am and with calms occurring for 14% of the year. At 3pm wind direction is variable, with winds from the south, southeast and east being more common and stronger winds (>40km/hr or >11.1m/s) occurring infrequently from the west and northwest.

Table 5-1: Long-term weather data for Williamtown RAAF [BOM]

Month	Mean Temperature		Rainfall		9 am Conditions			3 pm Conditions		
	Max (°C)	Min (°C)	Mean (mm)	Mean No. of Days ≥ 1 mm	Temp (°C)	RH (%)	Wind Speed (km/h)	Temp (°C)	RH (%)	Wind Speed (km/h)
Jan	28.3	18.2	100.2	7.2	23.0	72	11.9	26.5	59	21.9
Feb	27.7	18.2	117.6	7.5	22.5	76	10.6	26.1	62	20.6
Mar	26.4	16.5	127.2	8.5	21.2	77	10.2	24.9	61	18.9
Apr	23.8	13.3	111.6	7.6	18.2	76	11.4	22.5	59	17.2
May	20.4	10.1	115.8	7.9	14.3	79	13.7	19.3	60	15.8
Jun	17.7	8.0	121.4	8.2	11.6	80	15.9	16.8	60	17.5
Jul	17.2	6.5	76.4	6.6	10.5	77	16.4	16.2	55	18.7
Aug	18.8	7.0	73.8	6.2	12.2	71	16.8	17.6	50	20.9
Sep	21.6	9.2	60.1	5.7	15.7	66	15.3	20.0	50	22.0
Oct	23.9	12.1	75.1	7.3	18.8	64	14.4	21.9	54	22.5
Nov	25.7	14.5	81.8	7.2	20.5	66	14.4	23.8	55	23.5
Dec	27.5	16.7	75.5	7.0	22.2	68	12.9	25.6	56	23.5
Annual	**23.2**	**12.5**	**1134.4**	**86.9**	**17.6**	**73**	**13.7**	**21.8**	**57**	**20.2**



Location: Williamtown RAAF AWS BoM Station	**Data Period:** 1942 to 2025	**Data Type:** Measured Data

Figure 5-1: Annual wind roses for Williamtown RAAF AWS (2001 to 2025)

5.1.2 Selection of Representative Year for Meteorological Modelling

A review of five years of meteorological data (2021–2025) from the Newcastle Air Quality Monitoring Station (AQMS), located approximately 28.5 km to the southwest of the proposed site, was undertaken to determine the most representative meteorological year for use in the dispersion model.

The following parameters were considered in the determination:

- Frequency and distribution of the predominant wind directions;
- Wind speed; and
- Temperature

The review identified that the 2025 calendar year was the most representative meteorological year for the study, exhibiting wind speed and directional frequencies most closely matching the five-year average. Further details, including a year-by-year comparison of key parameters, are provided in Appendix A.

Figure 5-2 presents the annual, 9 am and 3 pm wind roses for the 2025 calendar year at Newcastle AQMS. These figures are provided to support the assessment of representativeness against the long-term wind roses discussed in Section 5.1.1.

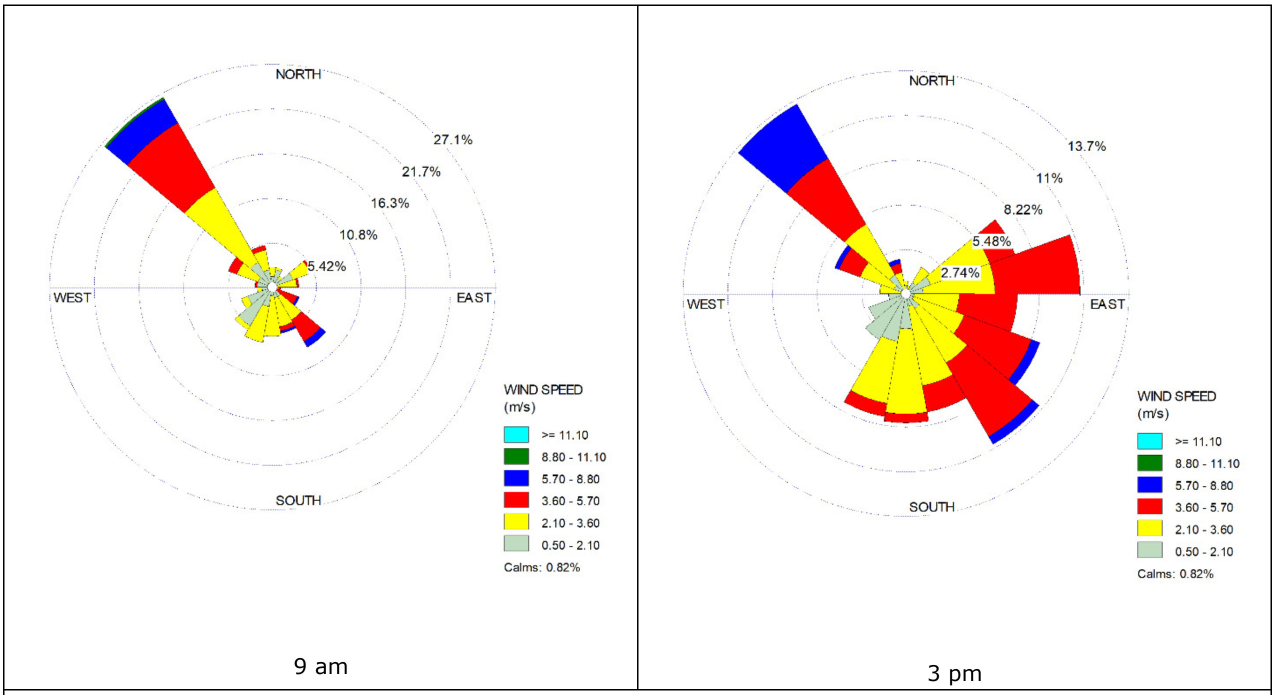


Figure 5-2: Annual 9 am and 3 pm Wind Rose for Newcastle AQMS, 2025

5.1.1 Local Meteorology

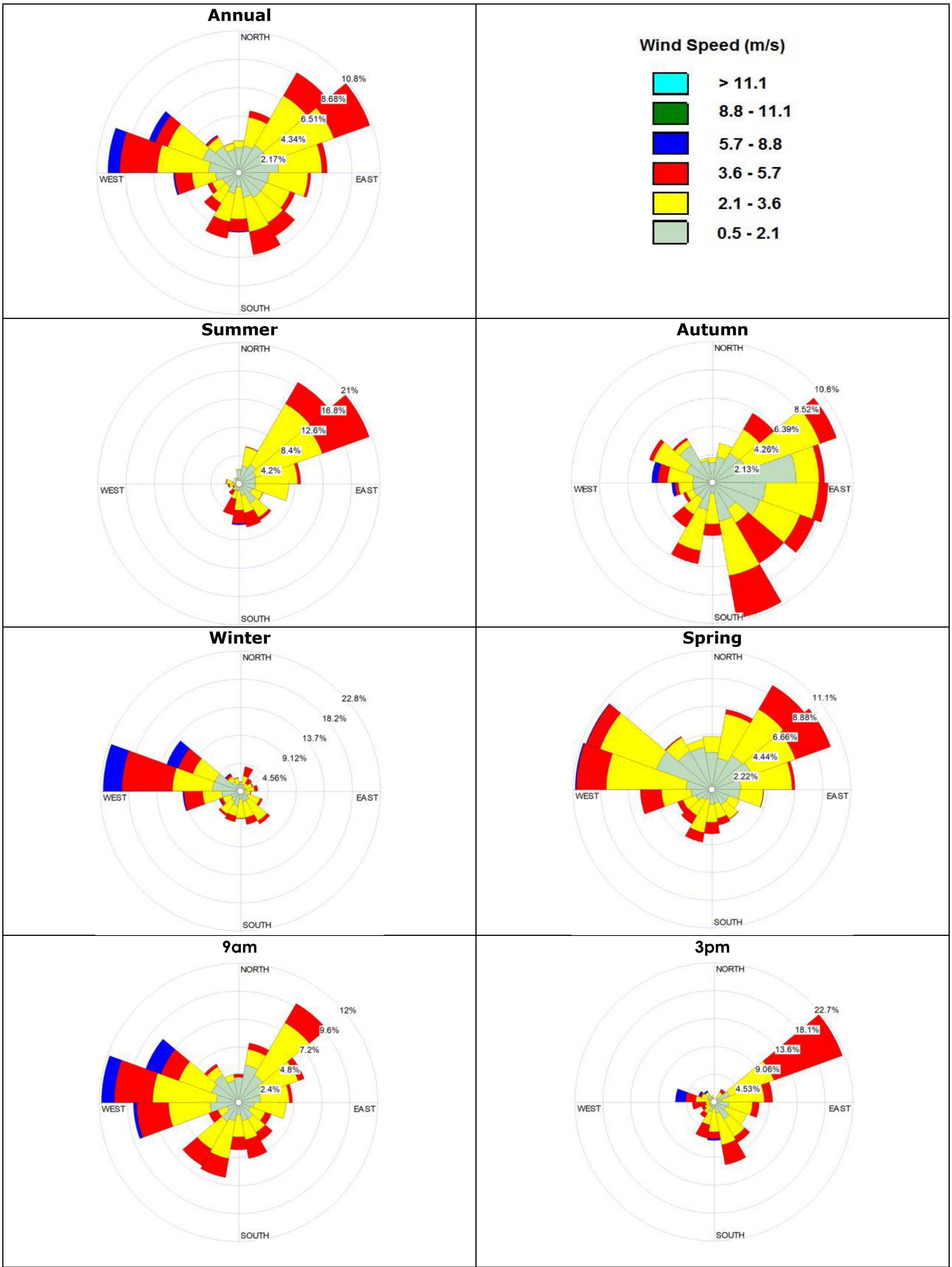
A three-dimensional meteorological field was required for the air dispersion modelling that includes a wind field generator accounting for slope flows, terrain effects and terrain blocking effects. The Air Pollution Model, or TAPM, is a three-dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research and can be used as a precursor to CALMET which produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables for each hour of the modelling period. The TAPM-CALMET derived dataset for 12 continuous months of hourly data from the year 2025 and approximately centred at the proposed site has been used to provide further information on the local meteorological influences.

5.1.1.1 Wind Speed and Direction

Figure 5-3 presents the annual and seasonal wind roses from the TAPM-CALMET derived dataset for the year 2025 at the site location. Wind roses from 9am and 3pm for the derived dataset are also provided in Figure 5-3 for comparison with the long term recorded data from the Williamtown RAAF BoM Weather Station.

Key features of the winds are:

- Winds are predominantly from the west to north west and north east with average wind speed of 2.6 m/s;
- Calm winds (<0.5m/s) represent 0.73% of the winds for the year;
- The strongest winds (>5.7m/s) occur from the west mostly in winter;
- Lighter winds (<5.7 m/s) primarily from the south occur in autumn and summer;
- The 9am and 3pm wind roses for the TAPM-CALMET derived dataset are generally consistent with the long-term measured data from the Williamtown RAAF BoM Weather Station presented in section 5.1.1. Winds are shown to be primarily from the west and north east at 9am and from the north east at 3pm.



Location: Newcastle	**Data Period:** Jan 2025 to Dec 2025	**Data Type:** TAPM- CALMET extract

Figure 5-3: Wind Roses for the TAPM-CALMET Derived Dataset at the Project site, 2025

5.1.1.2 Atmospheric Stability

The Pasquill-Gifford stability classification scheme denotes stability classes from A to F. Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution. At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Intermediate stability classes grade from moderately unstable (B), through neutral (D) to slightly stable (E). Whilst classes A and F are strongly associated with clear skies, class D is linked to windy and/or cloudy weather, and short periods around sunset and sunrise when surface heating or cooling is small. Figure 5-4 shows the stability class percentages from the TAPM-CALMET derived meteorological data for the project site.

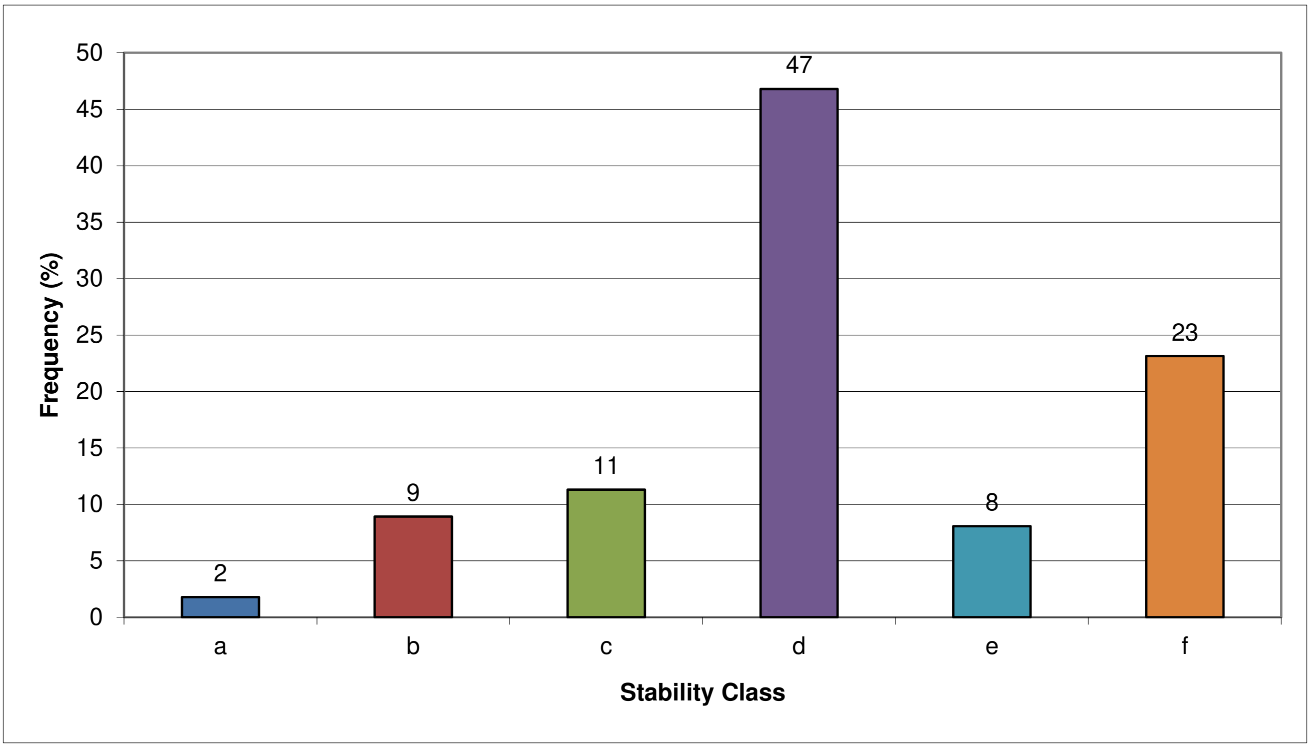


Figure 5-4: Stability Class Percentages for the TAPM-CALMET Derived Data, 2025

5.1.1.3 Mixing Height

Mixing height is defined as the height of the layer adjacent to the ground over which an emitted or entrained inert non-buoyant tracer will be mixed (by turbulence) within a time scale of about one hour or less. Diurnal variations in mixing depths are illustrated in Figure 5-5. As would be expected, an increase in the 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 the growth of the convective mixing layer.

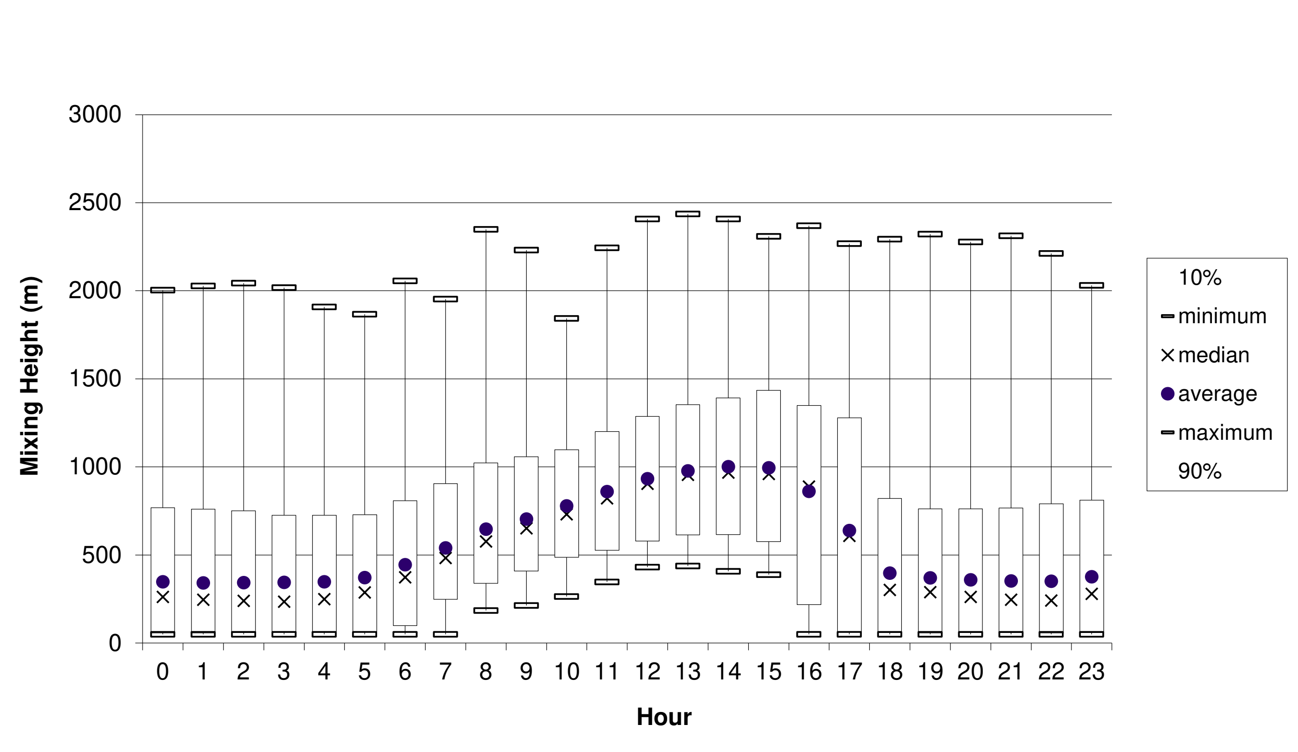


Figure 5-5: Mixing Height of the TAPM-CALMET Derived Data, 2025

5.2 Existing Air Quality

An extensive network of NATA-accredited air quality monitoring stations (AQMS) which use Standards Australia methods, where available is operated by the NSW EPA.

A number of the monitoring sites are operated within the Lower Hunter and Newcastle region, however are expected to be influenced by urban emissions (such as road traffic), industrial and mining activities and port operations associated with the Port of Newcastle.

Background air quality data were obtained from the Wallsend NSW EPA AQMS located approximately 33.8 km to the southwest of the project site. The station was selected as one of the closest monitoring stations to the Project Site at Bobs Farm, is located at a broadly similar distance from the coastline, and is expected to be less impacted by industrial and port operations than other stations in the region. As such, it is considered the most representative of the project site's coastal-rural setting among the available monitoring locations.

Of the pollutants of interest, PM_{10} and $PM_{2.5}$ are measured at the site, and as with many NSW AQMS' concentration levels of these pollutants were elevated by smoke from bushfires in summer. Where available, the maximum 24 hour average data collected at this site for 2025 is outlined in Table 5-2 for a Level 1 Assessment as specified in the Approved Methods (2022). Individual 24-hour average predicted PM_{10} and $PM_{2.5}$ concentrations paired in time with the corresponding 24-hour concentration within the adopted 2025 monitoring dataset to obtain total impact at each receptor is provided for the Assessment. In addition, annual average concentration data are adopted for the background levels of pollutants requiring assessment for these periods (e.g. $PM_{2.5}$ and PM_{10}).

Where unavailable, a conservative assumption is adopted. For example, annual TSP background is derived as 2.5 x measured PM_{10} based on data collected around Australian Quarries (ACARP, 1999). No dust deposition data is available, however the results of dust deposition monitoring undertaken at similar locations in central Queensland have been utilised. The average dust deposition from monitoring at these locations is 33 mg/m^2/day. This is likely to be typical of annual average dust fallout in rural regions although higher levels may exist in the vicinity of local sources. Therefore, the average background deposition rate for the air quality impact assessment in relation to the Project has been assumed to be double the nominated monitoring result that is 2.0 g/m^2/month (67 mg/m^2/day). This methodology is consistent with the Approved Methods, which specifies criteria of 2 g/m^2/month without background and 4 g/m^2/month including background.

In lieu of any ambient air quality data of the background silica levels a report by Toxikos (2005) is referenced, which stated that data collected in Victoria estimated the respirable crystalline silica (RCS) annual average background concentration to be 0.7 µg/m3. In the absence of any local data and in respect that this approach has been used previously in NSW, it has been assumed that the annual average background concentration of 0.7 µg/m3 for RCS for the site is both reasonable and representative.

As shown in Table 5-2, the maximum measured 24 hour average PM_{10} and $PM_{2.5}$ are already above the relevant criteria of 50 µg/m^3 and 25 µg/m^3. Cumulative impacts are accounted for by adopting the background data which includes elevated concentrations of PM_{10} and $PM_{2.5}$. These are therefore considered to be an overestimation of background pollutant concentrations at the project site. Nevertheless, they are included in the assessment in accordance with the requirements specified in the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW.

Table 5-2: Assigned Background Concentrations

Parameter	Air Quality Criteria	Period	Maximum Measured	Adopted Background	Comments
TSP	90 µg/m^3	Annual	41.25 µg/m^3	41.25 µg/m^3	Conservative assumption
PM_{10}	50 µg/m^3	24 Hour	50.7 µg/m^3	varies	NSW EPA Measurement
	25 µg/m^3	Annual	16.5 µg/m^3	16.5 µg/m^3	
$PM_{2.5}$	25 µg/m^3	24 Hour	30.3 µg/m^3	Varies	NSW EPA Measurement
	8 µg/m^3	Annual	6.1 µg/m^3	6.1 µg/m^3	
RCS	14 µg/m^3	24 Hour	0.7 µg/m^3	0.7 µg/m^3	Toxicos, 2005
	3 µg/m^3	Annual	0.7 µg/m^3	0.7 µg/m^3	Toxicos, 2005
Dust Deposition	2 g/m^2/month	Month	-	-	-
	4 g/m^2/month	Month	2 g/m^2/month	2 g/m^2/month	Conservative assumption

6 Methodology

The air quality impact assessment has been carried out as follows:

- An emissions inventory of TSP, PM_{10}, $PM_{2.5}$, and deposited dust for the proposed Project was compiled using National Pollutant Inventory (NPI) and United States Environmental Protection Agency (USEPA) AP-42 emissions estimation methodology for the Project (outlined in Section 6.1).
- Estimated emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three-dimensional meteorological dataset for use in the CALPUFF dispersion model (Section 6.2).
- The atmospheric dispersion modelling results were assessed against the air quality assessment criteria described in Section 4.3 as part of the impact assessment. Air quality controls are applied to reduce emission rates where applicable.

6.1 Estimated Emissions

6.1.1 Pollution Causing Activities

The air quality assessment takes into account dust generating activities from extraction activities and disturbed surfaces within the site boundaries. The main emissions to air are dust and particulate matter generated by the onsite activities which primarily occur as a result of the following activities:

- site clearance of areas including vegetation clearance, topsoil removal and storage, and earthworks
- excavation
- loading/unloading of haul trucks
- wind erosion from disturbed areas and stockpiles
- transfer points
- conveyors
- screening
- vehicle movements

In addition, air pollutants from diesel combustion may release other air pollutants such as particulate matter, (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO) and trace quantities of volatile organic compounds. These substances are not considered to be emitted in sufficient quantities to affect air quality at sensitive receptors beyond the Project boundary; and have not been modelled in the air quality assessment.

6.1.2 Emission Estimation

Emission factors can be used to estimate emissions of TSP and PM_{10} to the air from various sources. Emission factors relate the quantity of a substance emitted from a source to some measure of activity associated with the source. Common measures of activity include distance travelled, quantity of material handled, or the duration of the activity.

Emission factors are used to estimate a facility's emissions by the general equation:

$$E_{i\,(kg/yr)} = \left[A_{(t/h)} \times OP_{(h/yr)} \right] \times EF_{i\,l(kg/t)} \times \left[1 - \frac{CE_i}{100} \right]$$

Where:

$E_{i\,(kg/yr)}$ = Emission rate of pollutant

$A_{(t/h)}$ = Activity rate

$OP_{(h/yr)}$ = operating hours

$EF_{i\,l(kg/t)}$ = uncontrolled emission factor of pollutant

CE_i = overall control efficiency for pollutant

The equations and activity rates are presented in **Appendix B.**

6.1.3 Emissions Scenarios Modelled

Two operational scenarios representing maximum daily activities were modelled. These scenarios assume concurrent extraction, haulage and processing operations occurring at the highest anticipated activity levels within the site and allow for two haul trucks operating continuously form extraction areas to processing areas for operational hours.

The assessment adopts a maximum throughput of 20,000 tonnes per week (equivalent to approximately 1.04 Mtpa), which exceeds the proposed maximum annual throughput of 530,000 tpa and is therefore considered conservative. A maximum hourly throughput of 234 tonnes per hour was adopted for the assessment and applied to all extraction, handling and processing activities.

The modelled scenarios are as follows:

Scenario 1: Extraction at Stage 8 pit with concurrent processing and associated stockpiling activities at Stage 1.

Scenario 2: Extraction at Stage 4 pit with concurrent processing and associated stockpiling activities at Stage 1.

The selection of these two scenarios for modelling is based on the proximity of the various stages to sensitive receptors. Stage 4 and Stage 8 and it is therefore anticipated that these stages would have the highest potential for air quality impacts at surrounding sensitive receptors.

Additionally, extraction, truck loading and hauling sources were modelled with their locations positioned at the boundary of the respective stage extraction boundary closest to receptors.

6.1.4 Emission Controls

Emissions controls for dust abatement were included in the emissions estimation, as summarised in **Appendix B**, Table B-1.

It should also be noted that some of the planned dust control measures are not easily quantifiable but will still serve to reduce dust emissions. The dispersion modelling study has taken a conservative approach and have not incorporated the effectiveness of these controls in the development of the emissions inventory, for example:

- Routine visual monitoring and hazard minimisation.
- Planned activities will not occur during adverse weather conditions.
- Maintaining a high level of repair and servicing for all trucks associated with the quarry.

- Miscellaneous dust sources such as spillages from trucks and silt from sediment controls are regularly cleaned up.
- The internal quarry haul route will be maintained in a good condition.

6.1.5 Emission by Source

The emission estimation for individual activities accounting for control factors (outlined in ***Appendix B***) has been derived from NPI Emission Estimation Technique manuals and US EPA AP42 documentation. The annual calculated emissions for TSP, PM_{10} and $PM_{2.5}$ are presented in Table 6-1 for each source type inclusive of adopted control factor. Further details including the activity data applied in the emissions estimations are provided in ***Appendix B.*** It should be noted that all sources are classed as fugitive and there are no point sources associated with this project.

Table 6-1: Calculated Annual Emissions by Source (kg/y)

Fugitive Source	Scenario 1			Scenario 2		
	TSP	**PM_{10}**	**$PM_{2.5}$**	**TSP**	**PM_{10}**	**$PM_{2.5}$**
Wind erosion (Pit, exposed area & Stockpiles) - Processing	1799	899	450	1799	899	450
Wind erosion (Pit, exposed area & Stockpiles) - Extraction	647	323	162	1430	715	358
Excavators/Shovels/Front-end Loaders (processing)	149	70	10	149	70	10
Excavators/Shovels/Front-end Loaders (extraction)	149	70	10	149	70	10
Miscellaneous transfer points (loading to stockpiles)	298	141	20	298	141	20
Screening	402	135	8	402	135	8
Miscellaneous transfer points (including conveying) - loading to sales trucks	298	141	20	298	141	20
Wheel generated dust (Hauling internal)	21968	5599	560	11298	2879	288
total	**25559**	**7309**	**1230**	**15822**	**5051**	**1164**

6.1.6 Respirable Crystalline Silica

Silica is silicon dioxide (SiO_2), a naturally occurring and widely abundant mineral that forms a major component of most rocks and soils. There are non-crystalline and crystalline forms of silicon dioxide. Mechanical processes such as crushing, cutting, drilling, grinding, sawing or polishing products containing silica can generate respirable particles, small enough to penetrate deep into the lungs and can cause irreversible lung damage.

It is noted that no high-intensity mechanical processes such as crushing, grinding or cutting are proposed for the project. Additionally, with the application of water and the handling of wet product, the generation of RCS from particulate emissions is expected to be low. Nevertheless, as a conservative assumption, a 100% fraction of the predicted $PM_{2.5}$ emissions has been applied for the assessment.

6.2 Air Dispersion Modelling

6.2.1 TAPM

A 3-dimensional dispersion wind field model, CALPUFF, has been used to simulate the impacts from the Project. CALPUFF is an advanced non-steady-state meteorological and air quality modelling system developed and distributed by Earth Tech, Inc. The model has been approved for use in the '*Guideline on Air Quality Models*' (Barclay and Scire, 2011) as a preferred model for assessing applications involving complex meteorological conditions such as calm conditions.

To generate the broad scale meteorological inputs to run CALPUFF, this study has used the model The Air Pollution Model (TAPM), which is a 3-dimensional prognostic model developed and verified for air pollution studies by the CSIRO.

TAPM was configured as follows:-

- Centre coordinates – -32.7750015 ° S, 152.008331 ° E;

- Dates modelled – 1st January 2025 to 31st January 2025;
- Four nested grid domains of 30 km, 10 km, 3 km and 1 km;
- 41 x 41 grid points for all modelling domains;
- 25 vertical levels from 10 m to an altitude of 8000 m above sea level;
- Data assimilation using measured meteorological data from the NSW EPA Air Quality Monitoring Station at Newcastle; and
- The default TAPM databases for terrain, land use and meteorology were used in the model.

6.2.2 CALMET

CALMET is an advanced non-steady-state diagnostic three-dimensional meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system.

The CALMET simulation was run as No-Obs simulation with the gridded TAPM three-dimensional wind field data from the innermost grid. CALMET then adjusts the prognostic data for the kinematic effects of terrain, slope flows, blocking effects and three-dimensional divergence minimisation.

6.2.3 CALPUFF

CALPUFF is a non-steady-state Lagrangian Gaussian puff model. CALPUFF employs the three-dimensional meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal.

Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

The radius of influence of terrain features was set at 5 km while the minimum radius of influence was set as 0.1 km. The terrain data incorporated into the model had a resolution of 1 arc-second (approximately 30 m) in accordance with the *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'*.

6.2.4 Other Modelling Input Parameters

6.2.4.1 Particle Size Distribution

CALPUFF requires particle distribution data (geometric mass mean diameter, standard deviation) to compute the dispersion of particulates (*Table 6-2*).

Table 6-2: Particle Size Distribution Data

Particle size	Mean particle diameter (μm)	Geometric standard deviation (μm)
TSP	10	2
PM_{10}	4.88	2
$PM_{2.5}$	0.89	1

7 Assessment of Impacts

This section presents the results of the air quality impact assessment for predicted ground level concentrations of TSP, PM_{10} and $PM_{2.5}$, RCS and dust deposition for the proposed operation of the Project.

The results of the dispersion modelling include individual sensitive receptor and contour plots that are indicative of ground-level concentrations and deposition. As outlined in the *'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'* a Level 1 impact assessment is presented for pollutants without elevated background (i.e. TSP, dust deposition and annual average RCS, PM_{10} and $PM_{2.5}$) as follows:

- The incremental impact of each pollutant as per the criterion units and time periods; and
- The maximum background concentration) added to the 100th percentile model prediction.

A Level 2 impact assessment is presented for 24 hour average PM_{10} and $PM_{2.5}$ which have elevated background concentrations close to or above the relevant ambient air quality criteria (see Section 5.2) and requires the predictions to be presented as follows:

- The results of the Level 1 impact assessment for these pollutants; and
- The sum for each individual dispersion model prediction with the corresponding measured background concentration (e.g. add the first hourly average dispersion model prediction to the first hourly average background concentration) to obtain hourly predictions of total impact.

7.1 TSP

The predicted Level 1 annual average TSP concentrations for the five most impacted receptors are presented in Table 7-1 for Scenario 1 and in Table 7-2 for Scenario 2. Tabulated results presenting the incremental and cumulative predicted annual average at all modelled receptors are provided in **Appendix C.**

The model predictions for TSP are well below the criteria of 90 µg/m^3 for both modelled scenarios. TSP emissions from the proposed Project are not predicted to adversely impact upon the sensitive receptors. A contour plot illustrating the spatial distribution of the cumulative model predictions is presented in **Appendix D.**

Table 7-1: Predicted Annual Average TSP Concentrations (µg/m^3) at the Five Most Impacted Receptors – Level 1 Assessment (Scenario 1)

ID	Predicted Annual Average TSP Concentrations (µg/m^3)	
	Incremental	Cumulative
R15	3.03	44.28
R16	1.40	42.65
R14	1.37	42.62
R18	1.07	42.32
R13	1.02	42.27
Criteria	90	

Table 7-2: Predicted Annual Average TSP Concentrations (µg/m^3) at the Five Most Impacted Receptors – Level 1 Assessment (Scenario 2)

ID	Predicted Annual Average TSP Concentrations (µg/m^3)	
	Incremental	Cumulative
R14	2.23	43.48
R13	1.96	43.21
R9	0.74	41.99
R15	0.53	41.78
R16	0.36	41.61
Criteria	90	

7.2 PM_{10}

The Level 1 assessment maximum predicted 24 hour (including maximum measured background of 50.7 µg/m^3) and annual average (including measured annual background of 16.5 µg/m^3) PM_{10} are presented in Table 7-3 for Scenario 1 and in Table 7-4 for Scenario 2. Tabulated results presenting the incremental and cumulative predicted 24 hour and annual average at all modelled receptors are provided in **Appendix C.**

As shown in Table 7-3 and Table 7-4, the model predictions for annual average PM_{10} are below the criteria of 25 µg/m^3. The model predictions for cumulative 24 hour average PM_{10} are above the criterion of 50 µg/m^3. As noted in Section 5.2, the measured 24 hour background PM_{10} of 50.7 µg/m^3 is already above the criterion of 50 µg/m^3. The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* provides the following guidance when dealing with elevated background:

In some locations, existing ambient air pollutant concentrations may exceed the impact assessment criteria from time to time. In such circumstances, a licensee must demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical.

A worked example involving elevated background is also provided in the Approved Methods in which a modelling assessment is refined by adding each individual dispersion model prediction to the corresponding measured background concentration (i.e. a Level 2 assessment). Further investigation of the contemporaneous measured background and predicted data is therefore undertaken here in accordance with the worked example.

Table 7-5 and Table 7-6 provides the Level 2 assessment maximum cumulative concentrations at each receptor including contemporaneous background concentrations and associated number of exceedances of the criteria for the modelled year, for both scenarios respectively. Figure 7-1 and Figure 7-2 shows the time series data for incremental and cumulative results for the highest effected receptor for the two modelled scenarios.

As shown in Table 7-5 and Table 7-6 and Figure 7-1 and Figure 7-2, 2 exceedances of the 24 hour average PM_{10} criteria (50 µg/m^3) are predicted at the modelled receptors. These exceedances correspond to the dates of the elevated measured background which also exceed the criteria. Furthermore, the greatest contribution of the quarry emissions to the cumulative PM_{10} is relatively low (maximum of 9.55 µg/m^3 for scenario 1 and 7.45 µg/m^3 for scenario 2) in comparison with the 50 µg/m^3 criteria and the background and does not contribute to any additional exceedances of the criteria. As specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required.

The 24 hour and annual average PM_{10} emissions from the proposed Project are not predicted to cause additional exceedances of the relevant criteria, and on this basis are not expected to adversely impact upon the sensitive receptors. Contour plots illustrating the spatial distribution of the cumulative model predictions are provided in **Appendix D.**

Table 7-3: Predicted 24 Hour and Annual Average PM_{10} Concentrations (µg/m^3) at the Five Most Impacted Receptors - Level 1 assessment (scenario 1)

ID	Predicted 24 Hour Average PM_{10} Concentrations (µg/m^3)		ID	Predicted Annual Average PM_{10} Concentrations (µg/m^3)	
	Incremental	Cumulative		Incremental	Cumulative
R15	9.55	60.25	**R15**	1.20	17.70
R16	7.74	58.44	**R16**	0.64	17.14
R17	7.25	57.95	**R14**	0.59	17.09
R14	6.77	57.47	**R18**	0.57	17.07
R18	6.03	56.73	**R17**	0.45	16.95
Criteria	**50**		**Criteria**	**25**	

Table 7-4: Predicted 24 Hour and Annual Average PM_{10} Concentrations (µg/m^3) at the Five Most Impacted Receptors - Level 1 assessment (scenario 2)

ID	Predicted 24 Hour Average PM_{10} Concentrations (µg/m^3)		ID	Predicted Annual Average PM_{10} Concentrations (µg/m^3)	
	Incremental	Cumulative		Incremental	Cumulative
R14	17.45	68.15	**R14**	1.25	17.75
R13	14.92	65.62	**R13**	0.98	17.48
R9	4.62	55.32	**R9**	0.41	16.91

ID	Predicted 24 Hour Average PM_{10} Concentrations ($\mu g/m^3$)		ID	Predicted Annual Average PM_{10} Concentrations ($\mu g/m^3$)	
	Incremental	Cumulative		Incremental	Cumulative
R15	4.29	54.99	**R15**	0.36	16.86
R16	3.30	54.00	**R16**	0.25	16.75
Criteria	**50**		**Criteria**	**25**	

Table 7-5: Predicted Cumulative 24 Hour Average PM_{10} Concentrations and Number of Exceedances ($\mu g/m^3$)[a] - Level 2 assessment (Scenario 1)

ID	Predicted Cumulative 24 Hour Average PM_{10} Concentrations ($\mu g/m^3$)	Number of Exceedances [a]
R14	50.70	2
R15	50.72	2
R16	50.73	2
R17	51.05	2
R18	52.56	2
Criteria	**50**	

a Note – number of exceedances of criteria by measured background data is 2

Table 7-6: Predicted Cumulative 24 Hour Average PM_{10} Concentrations and Number of Exceedances ($\mu g/m^3$)[a] - Level 2 assessment (Scenario 2)

ID	Predicted Cumulative 24 Hour Average PM_{10} Concentrations ($\mu g/m^3$)	Number of Exceedances [a]
R14	51.12	2
R15	51.23	2
R16	51.05	2
R17	51.08	2
R18	51.52	2
Criteria	**50**	

a Note – number of exceedances of criteria by measured background data is 2

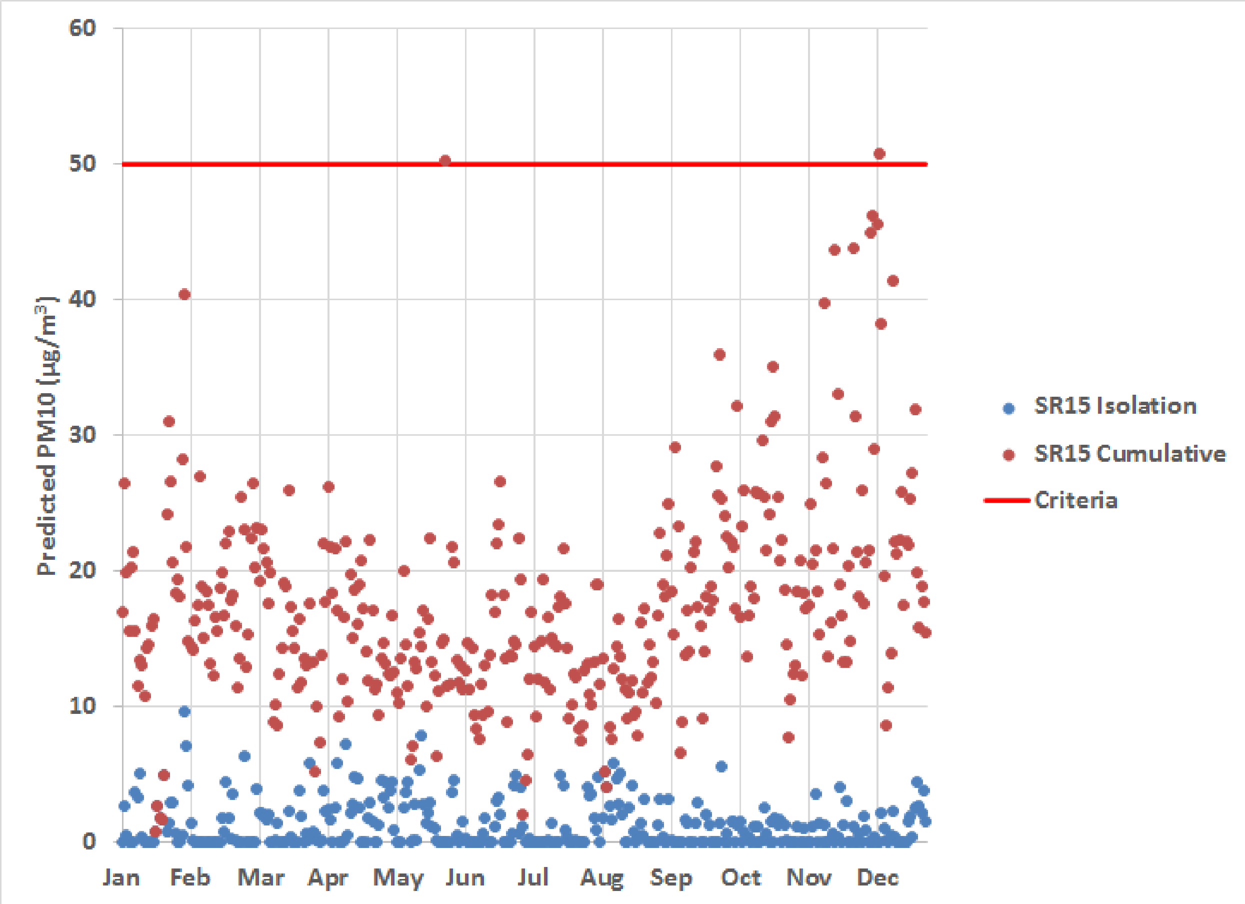


Figure 7-1: Timeseries of 24 hour predicted PM_{10} concentrations in isolation and cumulative at SR15 (Scenario 1)

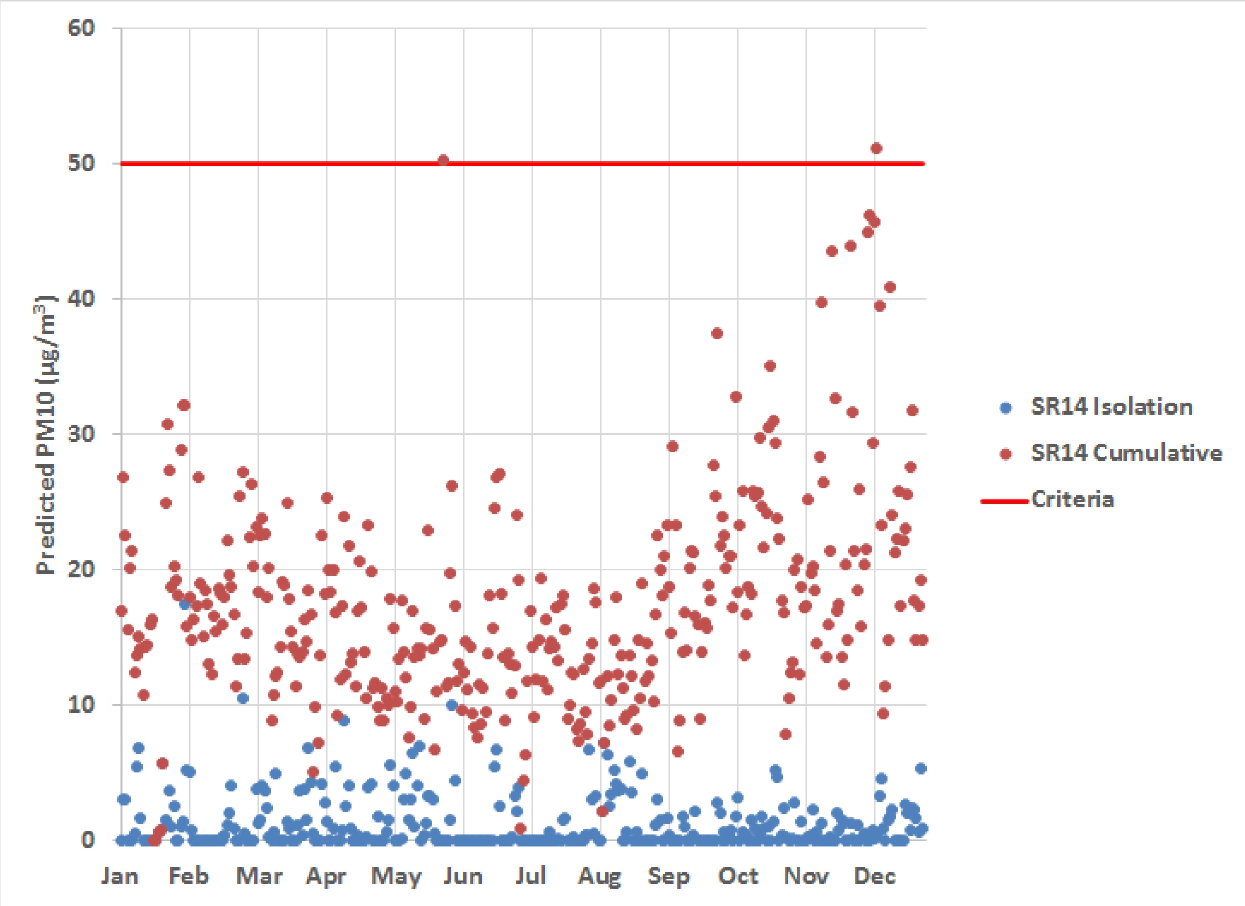


Figure 7-2: Timeseries of 24 hour predicted PM_{10} concentrations in isolation and cumulative at SR14 (Scenario 2)

7.3 $PM_{2.5}$

The Level 1 assessment maximum predicted 24 hour (including maximum measured background of 30.3 µg/m^3) and annual average (including measured annual background of 6.1 µg/m^3) $PM_{2.5}$ for both modelled scenarios at the five most impacted receptors are presented in Table 7-7 and Table 7-8. Tabulated results presenting the incremental and cumulative predicted 24 hour and annual average at all modelled receptors are provided in **Appendix C.**

The model predictions for annual average $PM_{2.5}$ are below the criteria of 8 µg/m3. As shown in Table 7-7 and Table 7-8 the cumulative model predictions for 24 hour average $PM_{2.5}$ are above the 25 µg/m^3 criteria for both scenarios, however, the measured 24 hour background $PM_{2.5}$ of 30.3 µg/m^3 is already above the criteria of 25 µg/m^3. The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* provides the following guidance when dealing with elevated background:

In some locations, existing ambient air pollutant concentrations may exceed the impact assessment criteria from time to time. In such circumstances, a licensee must demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical.

A worked example involving elevated background is also provided in the Approved Methods in which a modelling assessment is refined by adding each individual dispersion model prediction to the corresponding measured background concentration (i.e. a Level 2 assessment). Further investigation of the contemporaneous measured background and predicted data is therefore undertaken here in accordance with the worked example.

Table 7-9 and Table 7-10 provides the Level 2 assessment maximum cumulative concentrations at each receptor including contemporaneous background concentrations and associated number of exceedances of the criteria for the modelled year for both scenarios and Figure 7-3 and Figure 7-4 to shows the time series data for incremental and cumulative results for the highest effected receptor for each modelled scenario respectively.

As shown in Table 7-9 and Table 7-10 and Figure 7-3 and Figure 7-4, 4 exceedances of the 24 hour average $PM_{2.5}$ criteria (25 µg/m^3) are predicted at the modelled receptors for both modelled scenarios. These exceedances correspond to the dates of the elevated measured background which also exceed the criteria, as shown in Figure 7-3 and Figure 7-4.

Furthermore, the greatest contribution of the quarry emissions to the cumulative $PM_{2.5}$ is relatively low (maximum of 2.65 μg/m^3 for Scenario 1 and 6.22 μg/m^3 for Scenario 2) compared with the background and does not contribute to any additional exceedances of the relevant criteria.

As specified in the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, under these circumstances no additional assessment is therefore required.

The 24 hour and annual average PM10 emissions from the proposed Project are not predicted to cause additional exceedances of the relevant criteria, and on this basis are not expected to adversely impact upon the sensitive receptors. Contour plots illustrating the spatial distribution of the cumulative model predictions are provided in **Appendix D.**

Table 7-7: Predicted 24 Hour and Annual Average $PM_{2.5}$ Concentrations (μg/m^3) at the Five Most Impacted Receptors - Level 1 assessment (scenario 1)

ID	Predicted 24 Hour Average $PM_{2.5}$ Concentrations (μg/m^3)		ID	Predicted Annual Average $PM_{2.5}$ Concentrations (μg/m^3)	
	Incremental	Cumulative		Incremental	Cumulative
R15	2.65	32.95	**R15**	0.36	6.46
R16	2.25	32.55	**R18**	0.25	6.35
R18	1.90	32.20	**R16**	0.23	6.33
R14	1.89	32.19	**R14**	0.18	6.28
R17	1.70	32.00	**R17**	0.15	6.25
Criteria	**25**		**Criteria**	**8**	

Table 7-8: Predicted 24 Hour and Annual Average $PM_{2.5}$ Concentrations (μg/m^3) at the Five Most Impacted Receptors - Level 1 assessment (scenario 2)

ID	Predicted 24 Hour Average $PM_{2.5}$ Concentrations (μg/m^3)		ID	Predicted Annual Average $PM_{2.5}$ Concentrations (μg/m^3)	
	Incremental	Cumulative		Incremental	Cumulative
R14	6.22	36.52	**R14**	0.57	6.67
R13	4.17	34.47	**R13**	0.41	6.51
R15	1.93	32.23	**R15**	0.19	6.29
R18	1.49	31.79	**R9**	0.17	6.27
R9	1.33	31.63	**R16**	0.12	6.22
Criteria	**25**		**Criteria**	**8**	

Table 7-9: Predicted Cumulative 24 Hour Average $PM_{2.5}$ Concentrations and Number of Exceedances (μg/m^3)[a] - Level 2 assessment (scenario 1)

ID	Predicted Cumulative 24 Hour Average $PM_{2.5}$ Concentrations (μg/m^3)	Number of Exceedances [a]
R14	30.30	4
R15	30.30	4
R16	30.31	4
R17	30.37	4
R18	31.19	4
Criteria	**25**	

a Note - number of exceedances of criteria by measured background data is 4

Table 7-10: Predicted Cumulative 24 Hour Average $PM_{2.5}$ Concentrations and Number of Exceedances ($\mu g/m^3$)[a] - Level 2 assessment (scenario 2)

ID	Predicted Cumulative 24 Hour Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)	Number of Exceedances [a]
R9	30.30	4
R13	30.30	4
R14	30.46	4
R15	30.56	4
R18	30.74	4
Criteria	**25**	

a Note - number of exceedances of criteria by measured background data is 4

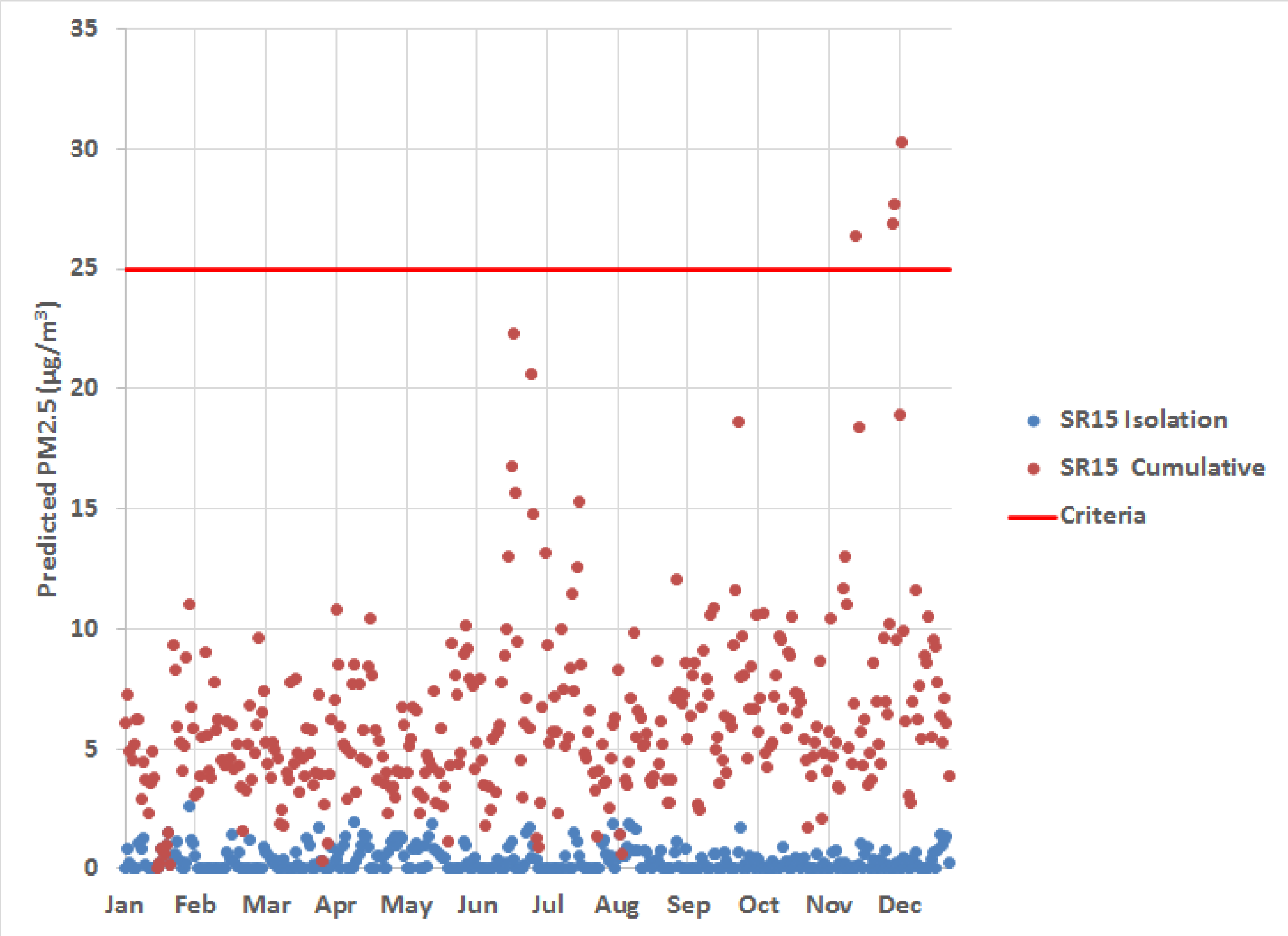


Figure 7-3: Timeseries of 24 hour predicted $PM_{2.5}$ concentrations in isolation and cumulative at R15 (Scenario 1)

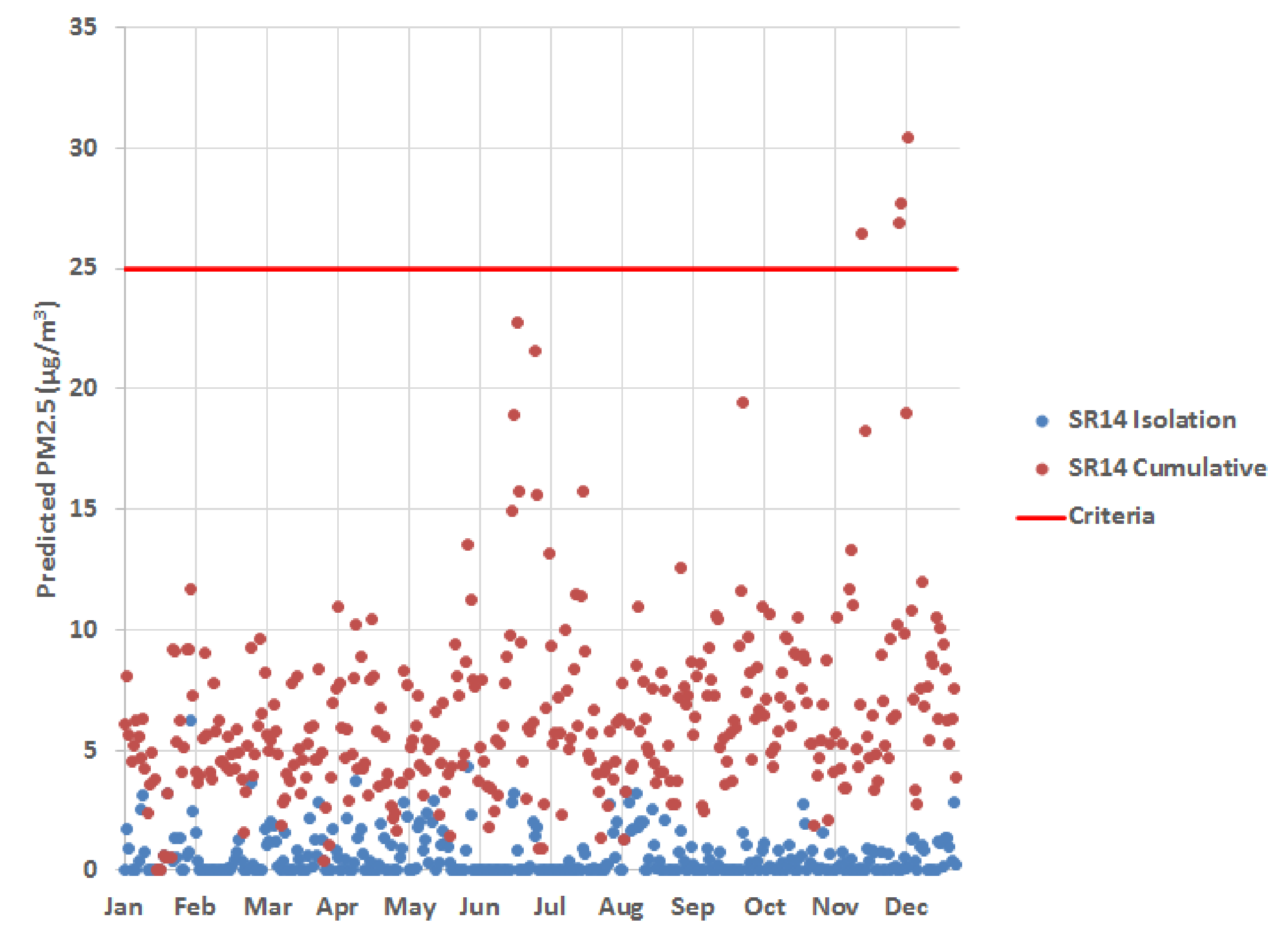


Figure 7-4: Timeseries of 24 hour predicted $PM_{2.5}$ concentrations in isolation and cumulative at R14 (Scenario 2)

7.4 Respirable Crystalline Silica

The predicted Level 1 annual average RCS concentrations for the five most impacted receptors are presented in Table 7-11 for Scenario 1 and in Table 7-12 for Scenario 2. Tabulated results presenting the incremental and cumulative predicted 24 hour and annual average at all modelled receptors are provided in **Appendix C.**

The model predictions for RCS are below the 24 hour and annual average of 14 criteria of µg/m³ and 3 µg/m³ for both modelled scenarios. RCS emissions from the proposed Project are not predicted to adversely impact upon the sensitive receptors. A contour plot illustrating the spatial distribution of the cumulative model predictions is presented in **Appendix D.**

Table 7-11: Predicted Annual Average RCS Concentrations (µg/m³) at the Five Most Impacted Receptors – Level 1 Assessment (Scenario 1)

ID	Predicted 24 Hour Average RCS Concentrations (µg/m³)		Predicted Annual Average RCS Concentrations (µg/m³)	
	Incremental	Cumulative	Incremental	Cumulative
R15	2.65	3.35	0.36	1.06
R16	2.25	2.95	0.25	0.95
R14	1.90	2.60	0.23	0.93
R18	1.89	2.59	0.18	0.88
R17	1.70	2.40	0.15	0.85
Criteria	**14**		**3**	

Table 7-12: Predicted Annual Average RCS Concentrations (µg/m³) at the Five Most Impacted Receptors – Level 1 Assessment (Scenario 2)

ID	Predicted 24 Hour Average RCS Concentrations (µg/m³)		Predicted Annual Average RCS Concentrations (µg/m³)	
	Incremental	Cumulative	Incremental	Cumulative
R14	6.22	6.92	0.57	1.27
R13	4.17	4.87	0.41	1.11
R9	1.93	2.63	0.19	1.89
R15	1.49	2.19	0.17	0.87
R16	1.33	2.03	0.12	0.82
Criteria	**14**		**3**	

7.5 Dust Deposition

The Level 1 assessment maximum predicted monthly average dust deposition are presented in Table 7-13. Tabulated results presenting the incremental and cumulative predicted monthly average at all modelled receptors are provided in **Appendix C.**

The model predictions for incremental and cumulative monthly average dust deposition are well below the criteria of 2 g/m²/month and 4 g/m²/month. Dust deposition from the proposed Project is not predicted to adversely impact upon the sensitive receptors. Contour plots illustrating the spatial distribution of the cumulative model predictions are provided in **Appendix D.**

Table 7-13: Predicted Maximum Monthly Average Dust Deposition (g/m²/month) at the Five Most Impacted Receptors - Level 1 assessment

ID	Scenario 1		ID	Scenario 2	
	Incremental	Cumulative		Incremental	Cumulative
R15	0.61	2.61	**R13**	0.50	2.50
R16	0.32	2.32	**R14**	0.43	2.43
R18	0.30	2.30	**R9**	0.17	2.17
R14	0.25	2.25	**R15**	0.09	2.09
R17	0.19	2.19	**R10**	0.06	2.06
Criteria	**2**	**4**	**Criteria**	**2**	**4**

8 Recommendations

8.1 General Dust Control Measures

While the modelling assessment indicates that exceedances of the relevant criteria are unlikely at the identified sensitive receptors (based on the 2025 meteorological year modelled and site-specific factors such as a 2% silt content of the sand) the proximity to existing and future sensitive receptors warrants consideration of the recommendations outlined in Table 8-1 to minimise potential for adverse air quality impacts.

Table 8-1: Dust Mitigation Measures

Activity	Mitigation Measures
General	Include air quality requirements in site inductions and regular toolbox meetings to ensure employee awareness of potential dust impacts. Review operations in adverse weather conditions (e.g. high wind speeds) where required. Routine visual surveillance of dust generation and effectiveness of associated dust control measures.

	Review operations/mitigation measures when monitoring data exceed air quality criteria (Table 4-1).
Exposed and disturbed areas including material stockpiles	Use of water carts and/or sprays to maintain moisture in material to limit wind erosion. Adoption of progressive rehabilitation of inactive areas to minimise exposed soils. Reshape topsoil and rehabilitate completed overburden dumps as soon as practicable as far as practicable. Active maintenance of vegetation.
Handling of materials	Limit drop heights for material loading/unloading activities. Minimisation of spillage from loading/unloading and cleanup of any spillage as soon as practicable. Use of water carts and/or sprays on all materials-handling and stockpile areas to minimise dust generations as necessary and practicable.
Haul Roads	Use of water carts as necessary and practicable on all trafficked areas to minimise excessive visible dust. Enforcement of onsite vehicle speed limits < 40km/h. Regular maintenance of haul roads to maintain a smooth surface and removal of excessively fine/silty material.
Processing Plant	Maintain processing plant operations to allow effective washing of materials reducing the risk of dust generation.

8.2 Dust Monitoring Procedure

Real-time continuous dust monitoring (e.g. using a light-scattering instrument or similar) is recommended to take place prior to commencement (i.e. as a baseline) and continue following commencement of operations at location(s) adjacent to the site throughout the year. In addition, monthly dust deposition samples are recommended to be collected at the same location(s). The installation of these instruments will allow proactive dust management techniques to be employed which may reduce the likelihood of complaints and exceedances.

Monitoring locations are recommended to be positioned in the direction of the closest sensitive receptors, based on the operational stage of the project being undertaken at the time of monitoring.

8.3 Community Consultation

It is recommended that community consultation with the closest receptors is undertaken to inform potentially affected individuals about the project and the steps being taken to minimise risks.

As noted in the Scoping Report (ADW Johnson, 2025):

"Consultation with the wider community will occur as part of the SSD application. Community consultation will occur in accordance with the Department's document for Undertaking Engagement guidelines for SSD. In this regard a Social Impact Assessment Scoping Report has been prepared by Key Insights outlining the key issues identified for the proposal and proposed methodology for community consultation and preparation of the Social Impact Assessment.

The Social Impact Assessment Scoping Report outlines three key parts for undertaking the Social Impact Assessment being:

- Part One: Social Impact Scoping and Constraints Assessment;
- Part Two: Stakeholder Engagement Plan; and
- Part Three: Social Impact Assessment Methodology.

It is considered that the proposed engagement combined with the mandatory public exhibition requirements will facilitate appropriate community engagement."

9 Conclusion

An Air Quality Impact Assessment has been undertaken to determine the potential air quality impacts of the proposed sand quarry at Bobs Farm on air sensitive receptors in the surrounding area.

Table 9-1 to Table 9-4 summarise the results for the two modelled worst-case scenarios for the highest impacted receptors for the project in isolation and cumulative impacts. The results of the modelling demonstrate that the TSP, PM_{10}, $PM_{2.5}$, RCS and dust deposition predictions comply with the relevant criteria and averaging periods at all sensitive receptors modelled for the Project in isolation.

TSP, RCS, dust deposition and annual average PM_{10} and $PM_{2.5}$ predictions are also less than criteria for the Project including background at all sensitive receptors modelled. Whilst the 24 hour average PM_{10} and $PM_{2.5}$ predictions are above the criteria, the exceedances are driven by the elevated background adopted for the assessment, which are already above their respective criteria. No additional exceedances of the criteria at these receptors are predicted to occur as a result of the proposed quarry operations. Additionally, a range of mitigation and management measures are provided and recommended to be implemented to minimise emissions as far as is practical, including the implementation of air quality monitoring. In the absence of the elevated background therefore, we would anticipate no exceedances of the criteria at the sensitive receptors. As specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required at these receptors.

It is therefore concluded that air quality should not be a constraint for the proposed Project.

Table 9-1: Summary of Results at the Most Impacted Receptors – Project in Isolation – Scenario 1

ID	Predicted Concentrations (µg/m³)							Dust deposition (g/m²/mth)	Compliant
	PM_{10}		$PM_{2.5}$		TSP	RCS			
	24 h	Annual	24 h	Annual	Annual	24 h	Annual	Month	
R13	5.78	0.45	1.39	0.14	1.02	1.39	0.14	0.18	✓
R14	6.77	0.59	1.89	0.18	1.37	1.89	0.18	0.25	✓
R15	9.55	1.20	2.65	0.36	3.03	2.65	0.36	0.61	✓
R16	7.74	0.64	2.25	0.23	1.40	2.25	0.23	0.32	✓
R17	7.25	0.45	1.70	0.15	1.01	1.70	0.15	0.19	✓
R18	6.03	0.57	1.90	0.25	1.07	1.90	0.25	0.30	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**14**	**3**	**2**	

Table 9-2: Summary of Results at the Most Impacted Receptors – Project in Isolation – Scenario 2

ID	Predicted Concentrations (µg/m³)							Dust deposition (g/m²/mth)	Compliant
	PM_{10}		$PM_{2.5}$		TSP	RCS			
	24 h	Annual	24 h	Annual	Annual	24 h	Annual	Month	
R9	4.62	0.41	1.33	0.17	0.74	1.33	0.17	0.17	
R10	2.91	0.12	0.66	0.05	0.22	0.66	0.05	0.06	
R13	2.38	0.98	4.17	0.41	1.96	4.17	0.41	0.50	✓
R14	2.70	1.25	6.22	0.57	2.23	6.22	0.57	0.43	✓
R15	14.92	0.36	1.93	0.19	0.53	1.93	0.19	0.09	✓

ID	Predicted Concentrations (µg/m³)							Dust deposition (g/m²/mth)	Compliant
	PM_{10}		$PM_{2.5}$		TSP	RCS			
	24 h	Annual	24 h	Annual	Annual	24 h	Annual	Month	
R16	17.45	0.25	1.29	0.12	0.36	1.29	0.12	0.06	✓
R18	4.29	0.22	1.49	0.12	0.31	1.49	0.12	0.06	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**14**	**3**	**2**	

Table 9-3: Summary of Results at the Most Impacted Receptors – Cumulative – Scenario 1

ID	Predicted Concentrations (µg/m³)							Dust deposition (g/m²/mth)	Compliant
	PM_{10}		$PM_{2.5}$		TSP	RCS			
	24 h[1]	Annual	24 h[1]	Annual	Annual	24 h	Annual	Month	
R13	56.48	16.95	31.69	6.24	42.27	2.09	0.84	2.18	✓
R14	57.47	17.09	32.19	6.28	42.62	2.59	0.88	2.25	✓
R15	60.25	17.70	32.95	6.46	44.28	3.35	1.06	2.61	✓
R16	58.44	17.14	32.55	6.33	42.65	2.95	0.93	2.32	✓
R17	57.95	16.95	32.00	6.25	42.26	2.40	0.85	2.19	✓
R18	56.73	17.07	32.20	6.35	42.32	2.60	0.95	2.30	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**14**	**3**	**4**	

1 the exceedances are driven by the elevated background, which is already above the criteria. No additional exceedances of the criteria at these receptors are predicted to occur as a result of the proposed quarry operations and as specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required at these receptors.

Table 9-4: Summary of Results at the Most Impacted Receptors – Cumulative – Scenario 2

ID	Predicted Concentrations (µg/m³)							Dust deposition (g/m²/mth)	Compliant
	PM_{10}		$PM_{2.5}$		TSP	RCS			
	24 h	Annual	24 h	Annual	Annual	24 h	Annual	Month	
R9	55.32	16.91	31.63	6.27	41.99	2.03	0.87	2.17	
R10	53.61	16.62	30.96	6.15	41.47	1.36	0.75	2.06	
R13	65.62	17.48	34.47	6.51	43.21	4.87	1.11	2.50	✓
R14	68.15	17.75	36.52	6.67	43.48	6.92	1.27	2.43	✓
R15	54.99	16.86	32.23	6.29	41.78	2.63	0.89	2.09	✓
R16	54.00	16.75	31.59	6.22	41.61	1.99	0.82	2.06	✓
R18	53.65	16.72	31.79	6.22	41.56	2.19	0.82	2.06	✓
Criteria	**50**	**25**	**25**	**8**	**90**	**14**	**3**	**4**	

1 the exceedances are driven by the elevated background, which is already above the criteria. No additional exceedances of the criteria at these receptors are predicted to occur as a result of the proposed quarry operations and as specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, under these circumstances no additional assessment is therefore required at these receptors.

10 Reference List

EPA Victoria. (2022). *Guideline for assessing and minimising air pollution in Victoria*.

Toxikos (2005) Health Risk Assessment of Crystalline Silica from Alex Fraser's proposed Recycling/Transfer Station of Construction Waste, Clarinda", Prepared by Toxikos Pty Ltd, February 2005, TR080105 RF.

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

ADW Johnson. (2025). Scoping Report: 3631 Nelson Bay Road, Bobs Farm. Prepared for Newcastle Sands. Project No. 240856. October 2025.

Appendix A Selection of Representative Meteorological Year

Meteorological data collected over the period 2021-2025 at Newcastle AQMS, located approximately 28.5 km to the southwest of the proposed site, was analysed to select a single representative year for dispersion modelling.

The analysis compared the annual and monthly data distributions against the 5-year averages for key parameters, including wind rose patterns (direction and speed), average monthly wind speed, and average monthly temperature.

The results showed that data collected during the 2025 calendar year exhibited the closest similarity with the 5-year averages.

Supporting analysis is presented in Figures A1 to A3.

Figure A1 presents the average monthly wind speeds for each year as well as the 5-year monthly average, Figure A2 presents the average monthly temperature for each year along with the 5-year monthly averages, and Figure A3 presents the annual wind roses for each year (2021 – 2025) for the Newcastle AQMS.

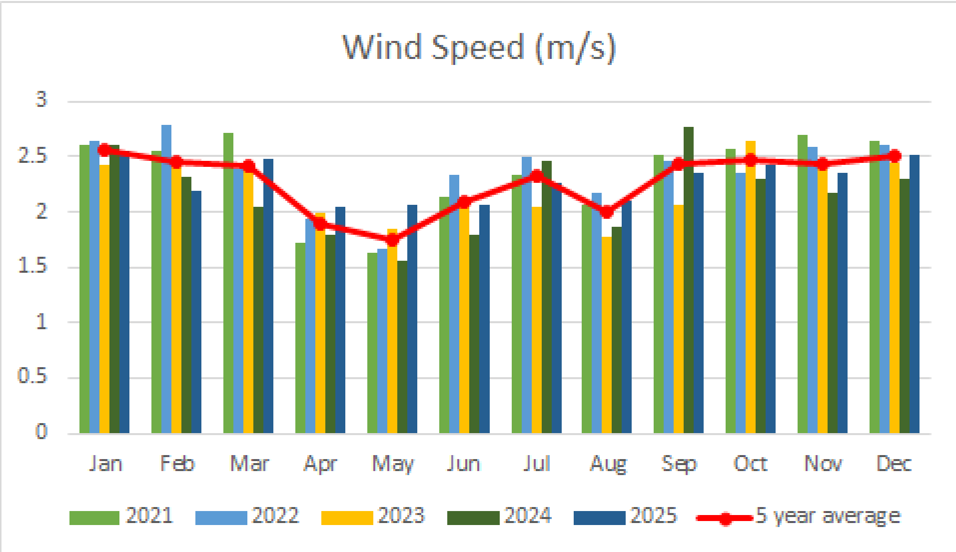


Figure A-1: Monthly Average Wind Speeds at Newcastle AQMS*, 2021-2025*

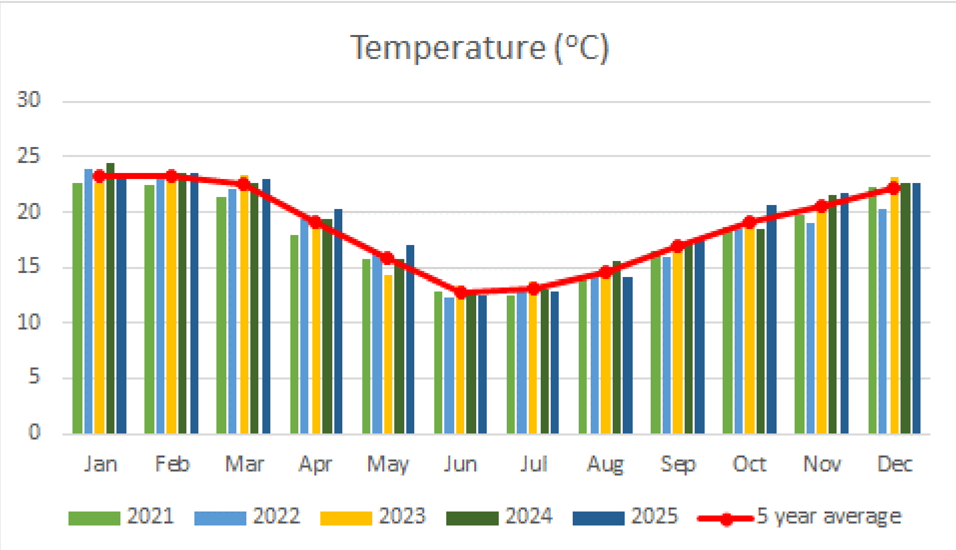
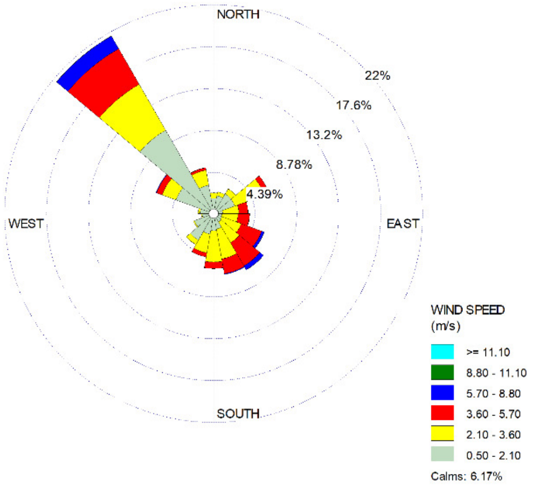
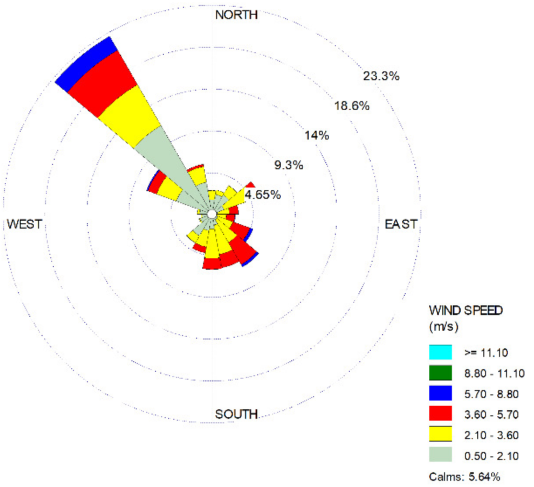


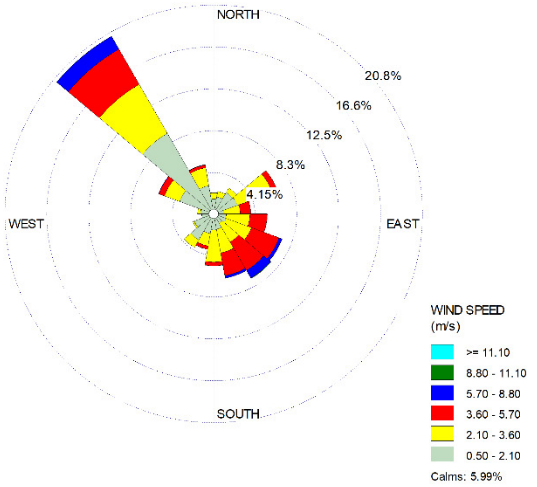
Figure A-2: Monthly Average temperatures at Newcastle AQMS*, 2021-2025*



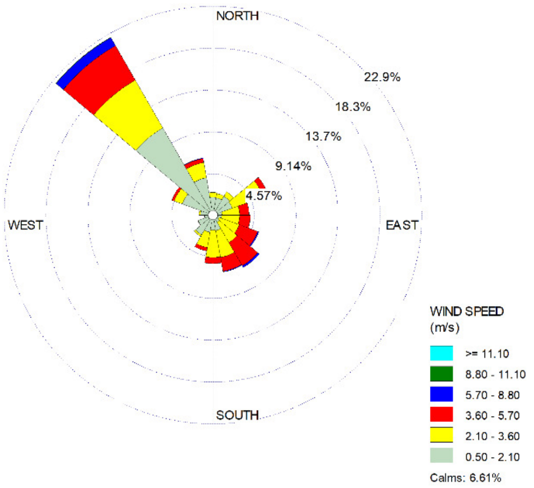
2021 - 2025



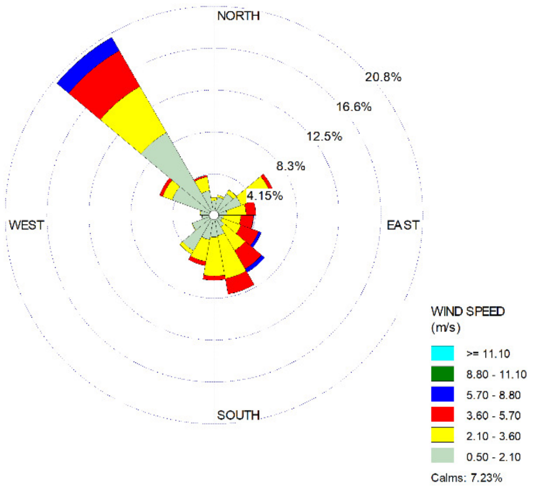
2021



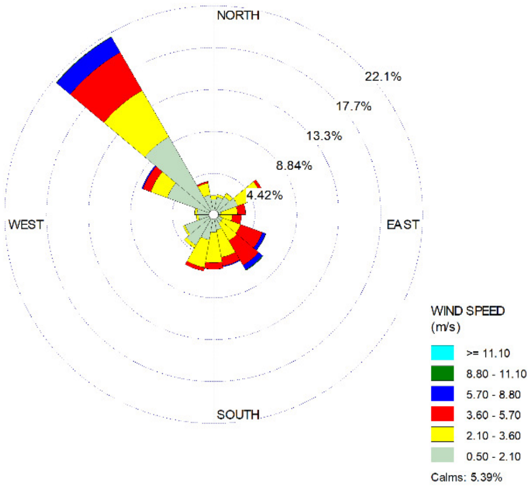
2022



2023



2024



2025

Figure A-3: Annual Wind Rose for Newcastle AQMS, 2021-2025

Appendix B Emissions Estimation

B.1 Emission Estimation Equations

The major air emission from extraction activities is fugitive dust. Emission factors can be used to estimate emissions of TSP, PM_{10} and $PM_{2.5}$ to the air from various sources. Emission factors relate the quantity of a substance emitted from a source to some measure of activity associated with the source. Common measures of activity include distance travelled, quantity of material handled, or the duration of the activity.

The National Pollutant Inventory Emission Estimation Technique Manual for Mining (January 2012) provide the equations and emission factors to determine the emissions of TSP and PM_{10} from mining and quarrying activities. These emission factors incorporate emission factors published by the USEPA in their AP-42 documentation.

Silt Content

Silt content data for Bobs Farm was derived from borehole testing data. For topsoil, the silt content was 10% and the sand 2% based on testing data. Haul road silt content of 4.8% was obtained from AP42 13.2 for sand and gravel processing.

Excavators and Front-End Loaders (Extraction and Processing)

Emission rates for Front end loaders and Excavators on overburden has been calculated using the following equation from AP42 (chapter 13.2.4):

$$E = k(0.0016)\ \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\ \text{(kg/megagram [Mg])}$$

where:

E = emission factor

K= 0.74 for TSP, 0.35 for PM_{10}, and 0.053 for $PM_{2.5}$

U = mean wind speed of 2.6 m/s

M = material moisture content of 5%

Crushing and Screening

The default emission rates in the NPI EET for Mining and AP42 11.19.2 for controlled screening have been used, where:

TSP = default of 0.0011

PM_{10} = default of 0.00037

$PM_{2.5}$ = default of 0.000024

Drilling and Blasting

No drilling or blasting is proposed.

Haul Roads

The dust emission rate from haul roads has been calculated using the following equation:

$$Emissions = \left(\frac{0.4536}{1.6093}\right) x\ k\ x \left(\frac{s_{(\%)}}{12}\right)^{\alpha} x \left(\frac{W_{(t)}}{3}\right)^{0.45} \text{ kg /VKT}$$

Where:

k = 4.9 for TSP, 1.5 for PM_{10} and 0.15 for $PM_{2.5}$.

$s_{(\%)}$ = surface material silt content of 2%

W = mean vehicle weight (tons converted to tonnes)

a = 0.7 for TSP, 0.9 for PM_{10} and $PM_{2.5}$

Miscellaneous transfer points (including conveying)

The dust emission rate from miscellaneous transfers including conveyor transfer points has been calculated using the following equation:

$$Emissions = k\ x\ 0.0016\ \frac{\left(U/_{2.2}\right)^{1.3}}{\left(M/_{2}\right)^{1.4}}\ \text{kg /transfer point}$$

Where:

k = 0.74 for TSP, 0.35 for PM_{10}, 15% of PM_{10} is $PM_{2.}$

U = mean wind speed (2.60 m/s)

M = material moisture content (5%)

Wind Erosion

The emission rate for dust from stockpile has been calculated using the following equation for TSP:

$$Emissions = 1.9\ x\ \left(\frac{s_{(\%)}}{1.5}\right)\ x\ 365\ x\ \left(\frac{365-p}{235}\right)\ x\ \left(\frac{f_{(\%)}}{15}\right)\ \text{kg /ha /yr}$$

Where:

$s_{(\%)}$ = silt content (10%).

P = number of days per year when rainfall is greater than 0.25 mm. A review of the long term BoM metrological data measured at Maryville has determined there are 98 days where rainfall is greater than 1 mm, which has been conservatively adopted for the assessment.

$f_{(\%)}$ = percentage of time that wind speed is greater than 5.4 m/s at the mean height of the stockpile. The frequency of wind speed >5.4 m/s has been determined to be 2.60%, based upon a review of the TAPM-CALMET processed metrological data.

The fraction of PM_{10} in TSP is 50% and $PM_{2.5}$ is 50% of PM_{10}.

B.2 Activity Overview

Tables B-1 and B-2 summarise the emission factors and key parameters applied in the emissions estimation.

Table B-1: Source Type Emission Factors Applied

Source type	Default TSP Emission factor	Derived TSP Emission factor	PM_{10}/TSP ratio	$PM_{2.5}$/TSP ratio	Units	Controls applied
Pit Activities						
Front End Loaders/Excavator on Overburden	-	0.0004	0.47	0.072	kg/t	Water sprays and wet material, 50%
Wind erosion:						
stockpiles/pits/haul roads	-	0.104	0.5	0.25	kg/ha/h	Water sprays and wet material, 50%
Processing & Handling:						
Screening	0.0011	-	0.36	0.022	kg/t	Water sprays, 50%
Miscellaneous transfers including conveyors	-	0.0004	0.47	0.072	kg/t	Water sprays, 50%
Wheel generated dust:						
Unpaved roads	-	3.14	0.26	0.026	kg/VKT	Watering Level 2 + speed limit < 40 km/h (86%)

Table B-2: Parameters applied in emissions estimation

Parameter ID	Value	Units	Description	Data source
U	2.6	m/s	mean wind speed	TAPM-CALMET processed meteorological data, nudged with NSW EPA AQMS meteorological data
W	39	t	Truck capacity	client supplied
p	98	days	rainfall > 0.25mm	BoM meteorological data
f	2.6	%	% time winds > 5.4m/s	TAPM-CALMET processed meteorological data, nudged with NSW EPA AQMS meteorological data
s	2 and 10	%	Silt content	Client supplied
M	5	%	Moisture	Default
t	3,333	t/day	Maximum material moved	Client supplied
a	53,700	m^2	Area of land subject to wind erosion (stage 1 + 8)	Client supplied
a	70,900	m^2	Area of land subject to wind erosion (stage 1 + 4)	Client supplied

Operating Hours

Extraction and processing of material has been modelled as 7 am to 5 pm on weekdays and 7 am to 4 pm on Saturdays.

Haul Roads

Haul road locations provided and incorporated into the model are summarised below.

Scenario	Total Haul Road	Modelled Parameter (km each way)	VKT (laden + unladen)
1	External[1] & Internal	1.33	159.99 VKT/day
2	External[1] & Internal	0.69	82.28 VKT/day

[1] excludes paved roads

Appendix C Results

C.1 TSP

ID	Predicted Annual Average TSP Concentrations (µg/m³)			
	Scenario 1		Scenario 2	
	Incremental	Cumulative	Incremental	Cumulative
R1	0.14	41.39	0.15	41.40
R2	0.03	41.28	0.03	41.28
R3	0.03	41.28	0.03	41.28
R4	0.03	41.28	0.03	41.28
R5	0.03	41.28	0.03	41.28
R6	0.03	41.28	0.03	41.28
R7	0.04	41.29	0.04	41.29
R8	0.10	41.35	0.12	41.37
R9	0.52	41.77	0.74	41.99
R10	0.20	41.45	0.22	41.47
R11	0.21	41.46	0.20	41.45
R12	0.69	41.94	0.31	41.56
R13	1.02	42.27	1.96	43.21
R14	1.37	42.62	2.23	43.48
R15	3.03	44.28	0.53	41.78
R16	1.40	42.65	0.36	41.61
R17	1.01	42.26	0.27	41.52
R18	1.07	42.32	0.31	41.56
R19	0.40	41.65	0.20	41.45
R20	0.06	41.31	0.07	41.32
R21	0.05	41.30	0.05	41.30
R22	0.03	41.28	0.03	41.28
R23	0.02	41.27	0.02	41.27
R24	0.02	41.27	0.02	41.27
R25	0.02	41.27	0.02	41.27
R26	0.08	41.33	0.08	41.33
R27	0.11	41.36	0.11	41.36
R28	0.05	41.30	0.05	41.30
Max	**3.03**	**44.28**	**2.23**	**43.48**
Criteria	**90**			

C.2 PM_{10}

ID	Predicted 24 Hour Average PM_{10} Concentrations (µg/m^3)			
	Scenario 1		Scenario 2	
	Incremental	Cumulative	Incremental	Cumulative
R1	0.91	51.61	1.23	51.93
R2	0.28	50.98	0.34	51.04
R3	0.22	50.92	0.24	50.94
R4	0.22	50.92	0.24	50.94
R5	0.22	50.92	0.25	50.95
R6	0.21	50.91	0.25	50.95
R7	0.24	50.94	0.27	50.97
R8	0.70	51.40	1.02	51.72
R9	4.33	55.03	4.62	55.32
R10	1.32	52.02	2.91	53.61
R11	1.39	52.09	2.38	53.08
R12	3.30	54.00	2.70	53.40
R13	5.78	56.48	14.92	65.62
R14	6.77	57.47	17.45	68.15
R15	9.55	60.25	4.29	54.99
R16	7.74	58.44	3.30	54.00
R17	7.25	57.95	2.66	53.36
R18	6.03	56.73	2.95	53.65
R19	2.47	53.17	1.52	52.22
R20	0.48	51.18	0.67	51.37
R21	0.36	51.06	0.40	51.10
R22	0.18	50.88	0.24	50.94
R23	0.17	50.87	0.21	50.91
R24	0.19	50.89	0.20	50.90
R25	0.29	50.99	0.32	51.02
R26	1.27	51.97	1.17	51.87
R27	1.76	52.46	1.54	52.24
R28	0.45	51.15	0.57	51.27
Max	**9.55**	**60.25**	**17.45**	**68.15**
Criteria	**50**			

ID	Predicted Annual Average PM_{10} Concentrations (µg/m³)			
	Scenario 1		Scenario 2	
	Incremental	Cumulative	Incremental	Cumulative
R1	0.08	16.58	0.10	16.60
R2	0.02	16.52	0.02	16.52
R3	0.02	16.52	0.02	16.52
R4	0.02	16.52	0.02	16.52
R5	0.02	16.52	0.02	16.52
R6	0.02	16.52	0.02	16.52
R7	0.02	16.52	0.02	16.52
R8	0.05	16.55	0.07	16.57
R9	0.28	16.78	0.41	16.91
R10	0.09	16.59	0.12	16.62
R11	0.10	16.60	0.11	16.61
R12	0.28	16.78	0.19	16.69
R13	0.45	16.95	0.98	17.48
R14	0.59	17.09	1.25	17.75
R15	1.20	17.70	0.36	16.86
R16	0.64	17.14	0.25	16.75
R17	0.45	16.95	0.18	16.68
R18	0.57	17.07	0.22	16.72
R19	0.23	16.73	0.15	16.65
R20	0.03	16.53	0.04	16.54
R21	0.03	16.53	0.03	16.53
R22	0.02	16.52	0.02	16.52
R23	0.01	16.51	0.02	16.52
R24	0.01	16.51	0.01	16.51
R25	0.01	16.51	0.02	16.52
R26	0.05	16.55	0.06	16.56
R27	0.07	16.57	0.08	16.58
R28	0.03	16.53	0.03	16.53
Max	**1.20**	**17.70**	**1.25**	**17.75**
Criteria	**25**			

C.3 RCS

ID	Predicted 24 Hour Average RCS Concentrations (µg/m³)			
	Scenario 1		Scenario 2	
	Incremental	Cumulative	Incremental	Cumulative
R1	0.38	1.08	0.50	1.2
R2	0.13	0.83	0.20	0.9
R3	0.11	0.81	0.15	0.85
R4	0.10	0.8	0.14	0.84
R5	0.10	0.8	0.14	0.84
R6	0.09	0.79	0.13	0.83
R7	0.10	0.8	0.14	0.84
R8	0.17	0.87	0.26	0.96
R9	1.18	1.88	1.33	2.03
R10	0.31	1.01	0.66	1.36
R11	0.30	1	0.58	1.28
R12	0.70	1.4	1.02	1.72
R13	1.39	2.09	4.17	4.87
R14	1.89	2.59	6.22	6.92
R15	2.65	3.35	1.93	2.63
R16	2.25	2.95	1.29	1.99
R17	1.70	2.4	1.12	1.82
R18	1.90	2.6	1.49	2.19
R19	0.73	1.43	0.75	1.45
R20	0.11	0.81	0.17	0.87
R21	0.12	0.82	0.14	0.84
R22	0.08	0.78	0.12	0.82
R23	0.08	0.78	0.11	0.81
R24	0.10	0.8	0.14	0.84
R25	0.12	0.82	0.19	0.89
R26	0.53	1.23	0.52	1.22
R27	0.70	1.4	0.66	1.36
R28	0.19	0.89	0.27	0.97
Max	**2.65**	**3.35**	**6.22**	**6.92**
Criteria	**14**			

ID	Predicted Annual Average RCS Concentrations (µg/m³)			
	Scenario 1		Scenario 2	
	Incremental	Cumulative	Incremental	Cumulative
R1	0.04	0.74	0.05	0.75
R2	0.01	0.71	0.01	0.71
R3	0.01	0.71	0.01	0.71
R4	0.01	0.71	0.01	0.71
R5	0.01	0.71	0.01	0.71
R6	0.01	0.71	0.01	0.71
R7	0.01	0.71	0.01	0.71
R8	0.02	0.72	0.03	0.73
R9	0.10	0.8	0.17	0.87

ID	Predicted Annual Average RCS Concentrations (µg/m³)			
	Scenario 1		Scenario 2	
	Incremental	Cumulative	Incremental	Cumulative
R10	0.03	0.73	0.05	0.75
R11	0.03	0.73	0.04	0.74
R12	0.08	0.78	0.09	0.79
R13	0.14	0.84	0.41	1.11
R14	0.18	0.88	0.57	1.27
R15	0.36	1.06	0.19	0.89
R16	0.23	0.93	0.12	0.82
R17	0.15	0.85	0.09	0.79
R18	0.25	0.95	0.12	0.82
R19	0.10	0.8	0.08	0.78
R20	0.01	0.71	0.02	0.72
R21	0.01	0.71	0.01	0.71
R22	0.01	0.71	0.01	0.71
R23	0.01	0.71	0.01	0.71
R24	0.01	0.71	0.01	0.71
R25	0.01	0.71	0.01	0.71
R26	0.02	0.72	0.03	0.73
R27	0.03	0.73	0.04	0.74
R28	0.01	0.71	0.02	0.72
Max	**0.36**	**1.06**	**0.57**	**1.27**
Criteria	**3**			

C.4 $PM_{2.5}$

ID	Predicted 24 Hour Average $PM_{2.5}$ Concentrations (µg/m^3)			
	Scenario 1		Scenario 2	
	Incremental	Cumulative	Incremental	Cumulative
R1	0.38	30.68	0.50	30.80
R2	0.13	30.43	0.20	30.50
R3	0.11	30.41	0.15	30.45
R4	0.10	30.40	0.14	30.44
R5	0.10	30.40	0.14	30.44
R6	0.09	30.39	0.13	30.43
R7	0.10	30.40	0.14	30.44
R8	0.17	30.47	0.26	30.56
R9	1.18	31.48	1.33	31.63
R10	0.31	30.61	0.66	30.96
R11	0.30	30.60	0.58	30.88
R12	0.70	31.00	1.02	31.32
R13	1.39	31.69	4.17	34.47
R14	1.89	32.19	6.22	36.52
R15	2.65	32.95	1.93	32.23
R16	2.25	32.55	1.29	31.59
R17	1.70	32.00	1.12	31.42
R18	1.90	32.20	1.49	31.79
R19	0.73	31.03	0.75	31.05
R20	0.11	30.41	0.17	30.47
R21	0.12	30.42	0.14	30.44
R22	0.08	30.38	0.12	30.42
R23	0.08	30.38	0.11	30.41
R24	0.10	30.40	0.14	30.44
R25	0.12	30.42	0.19	30.49
R26	0.53	30.83	0.52	30.82
R27	0.70	31.00	0.66	30.96
R28	0.19	30.49	0.27	30.57
Max	**2.65**	**32.95**	**6.22**	**36.52**
Criteria	**25**			

ID	Predicted Annual Average $PM_{2.5}$ Concentrations (µg/m³)			
	Scenario 1		Scenario 2	
	Incremental	Cumulative	Incremental	Cumulative
R1	0.04	6.14	0.05	6.15
R2	0.01	6.11	0.01	6.11
R3	0.01	6.11	0.01	6.11
R4	0.01	6.11	0.01	6.11
R5	0.01	6.11	0.01	6.11
R6	0.01	6.11	0.01	6.11
R7	0.01	6.11	0.01	6.11
R8	0.02	6.12	0.03	6.13
R9	0.10	6.20	0.17	6.27
R10	0.03	6.13	0.05	6.15
R11	0.03	6.13	0.04	6.14
R12	0.08	6.18	0.09	6.19
R13	0.14	6.24	0.41	6.51
R14	0.18	6.28	0.57	6.67
R15	0.36	6.46	0.19	6.29
R16	0.23	6.33	0.12	6.22
R17	0.15	6.25	0.09	6.19
R18	0.25	6.35	0.12	6.22
R19	0.10	6.20	0.08	6.18
R20	0.01	6.11	0.02	6.12
R21	0.01	6.11	0.01	6.11
R22	0.01	6.11	0.01	6.11
R23	0.01	6.11	0.01	6.11
R24	0.01	6.11	0.01	6.11
R25	0.01	6.11	0.01	6.11
R26	0.02	6.12	0.03	6.13
R27	0.03	6.13	0.04	6.14
R28	0.01	6.11	0.02	6.12
Max	**0.36**	**6.46**	**0.57**	**6.67**
Criteria	**8**			

C.5 Dust Deposition

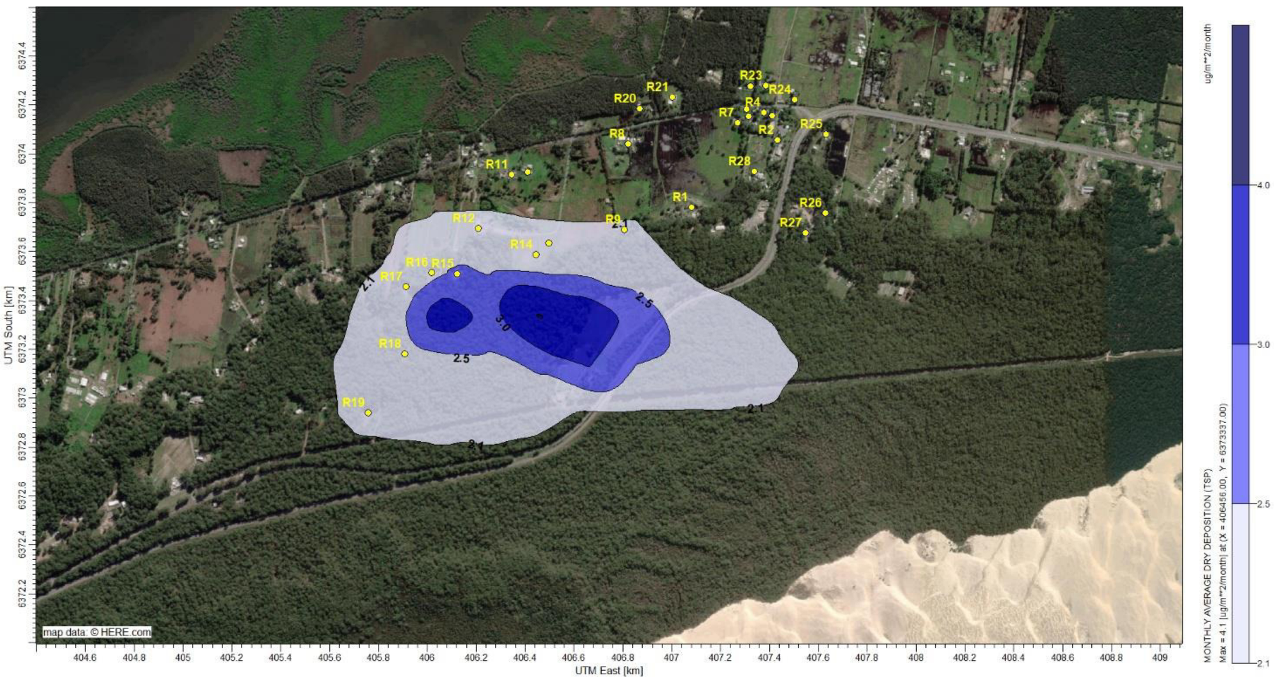
ID	Predicted Monthly Average Dust Deposition ($g/m^2/month$)			
	Scenario 1		Scenario 2	
	Incremental	Cumulative	Incremental	Cumulative
R1	0.03	2.03	0.03	2.03
R2	0.01	2.01	0.01	2.01
R3	0.01	2.01	0.01	2.01
R4	0.01	2.01	0.01	2.01
R5	0.01	2.01	0.01	2.01
R6	0.01	2.01	0.01	2.01
R7	0.01	2.01	0.01	2.01
R8	0.03	2.03	0.03	2.03
R9	0.14	2.14	0.17	2.17
R10	0.04	2.04	0.06	2.06
R11	0.04	2.04	0.05	2.05
R12	0.15	2.15	0.06	2.06
R13	0.18	2.18	0.50	2.50
R14	0.25	2.25	0.43	2.43
R15	0.61	2.61	0.09	2.09
R16	0.32	2.32	0.06	2.06
R17	0.19	2.19	0.04	2.04
R18	0.30	2.30	0.06	2.06
R19	0.12	2.12	0.05	2.05
R20	0.02	2.02	0.02	2.02
R21	0.01	2.01	0.02	2.02
R22	0.01	2.01	0.01	2.01
R23	0.01	2.01	0.01	2.01
R24	0.00	2.00	0.00	2.00
R25	0.00	2.00	0.00	2.00
R26	0.02	2.02	0.01	2.01
R27	0.02	2.02	0.02	2.02
R28	0.01	2.01	0.01	2.01
Max	**0.61**	**2.61**	**0.50**	**2.50**
Criteria	**2**	**4**	**2**	**4**

Appendix D Contour Plots

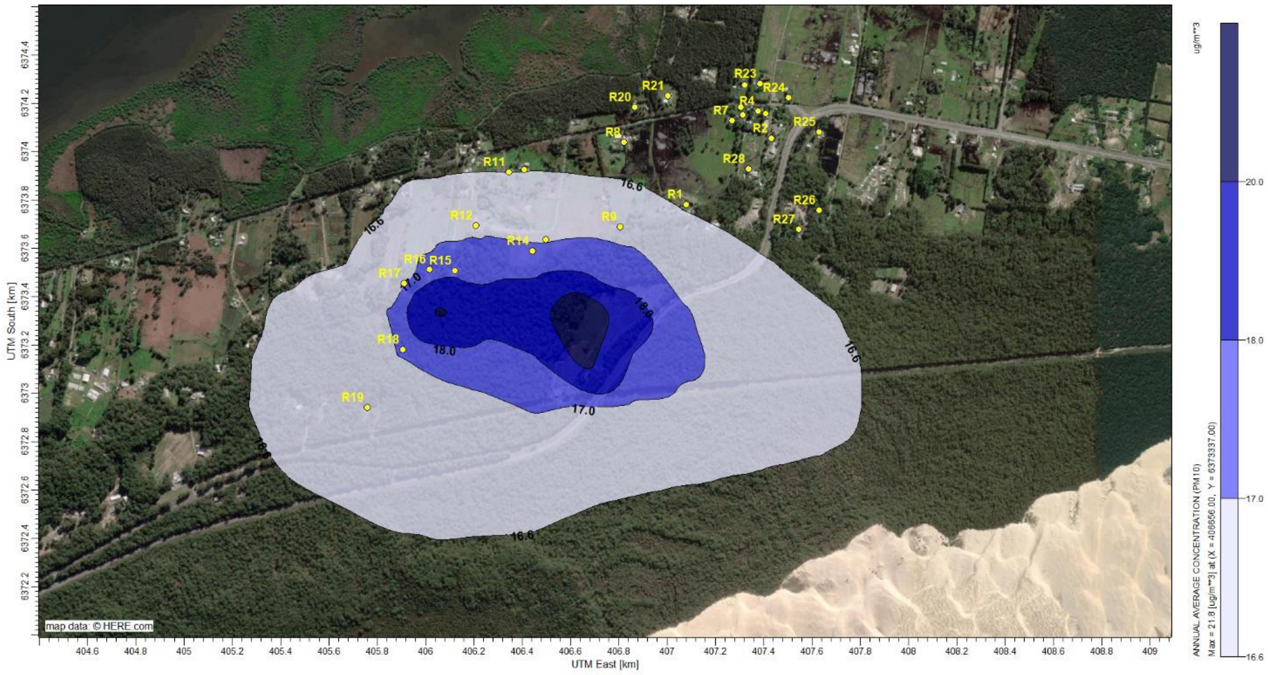
The contour plots are created from the predicted ground-level concentrations at the network of gridded receptors within the modelling domain at frequent intervals. These gridded values are converted into contours using triangulation interpolation in the CALPOST post-processing software within the CALPUFF View software (Version 10.0.0).

Contour plots illustrate the spatial distribution of ground-level concentrations across the modelling domain for each time period of concern. However, this process of interpolation causes a smoothing of the base data that can lead to minor differences between the contours and discrete model predictions.

D.1 Scenario 1

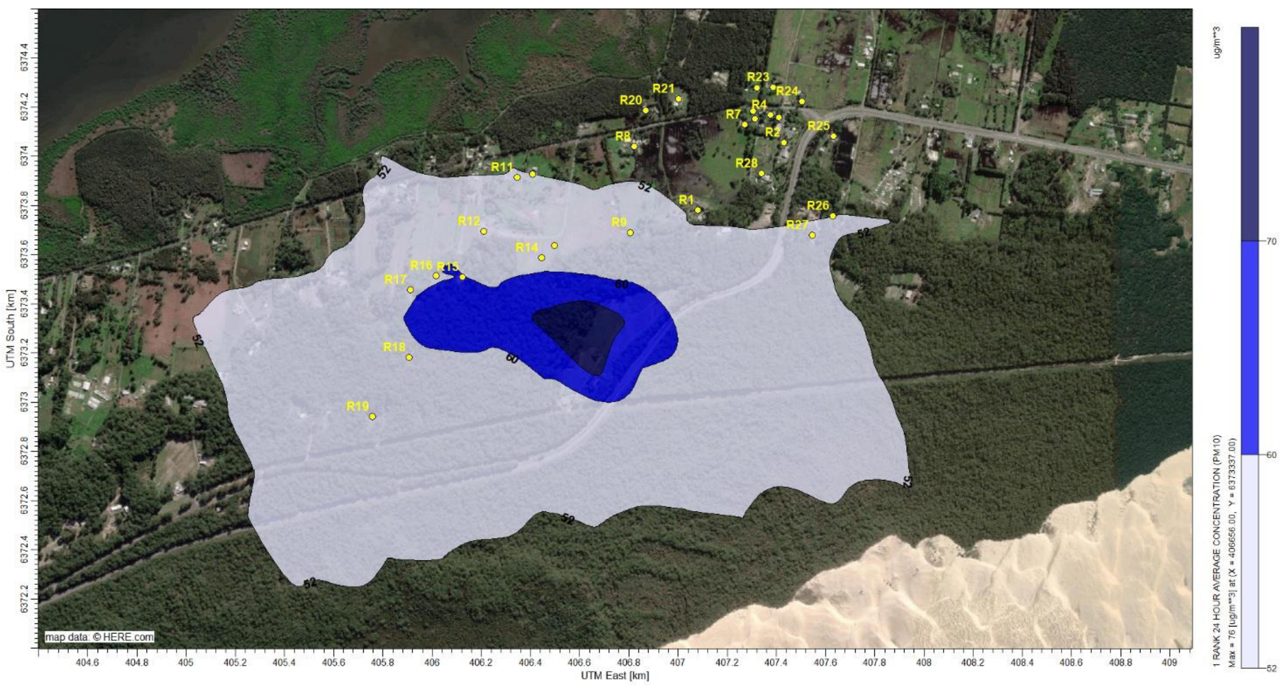


Pollutant: Dust Deposition	Averaging Period: Month	Percentile: 100th	Criteria: 4 g/m²/month
Comment: Cumulative – Scenario 1			



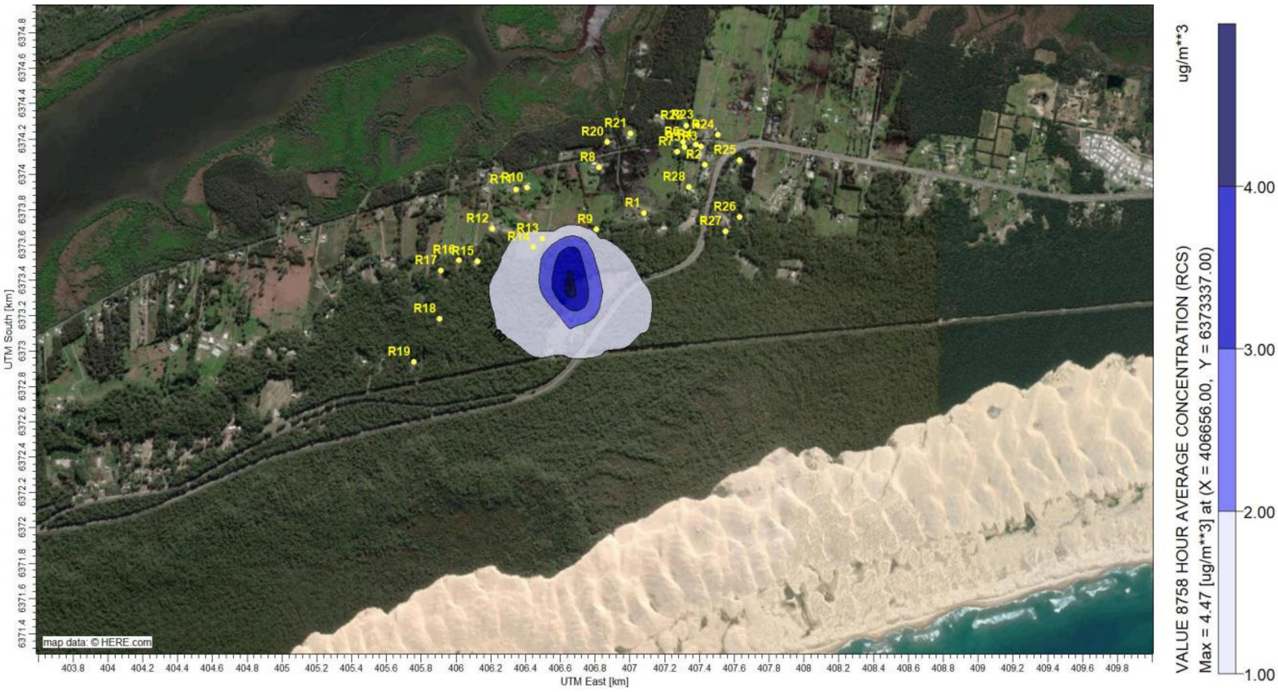
Pollutant: PM$_{10}$	Averaging Period: Annual	Percentile: Average	Criteria: 25 µg/m^3

Comment:
Cumulative - Scenario 1



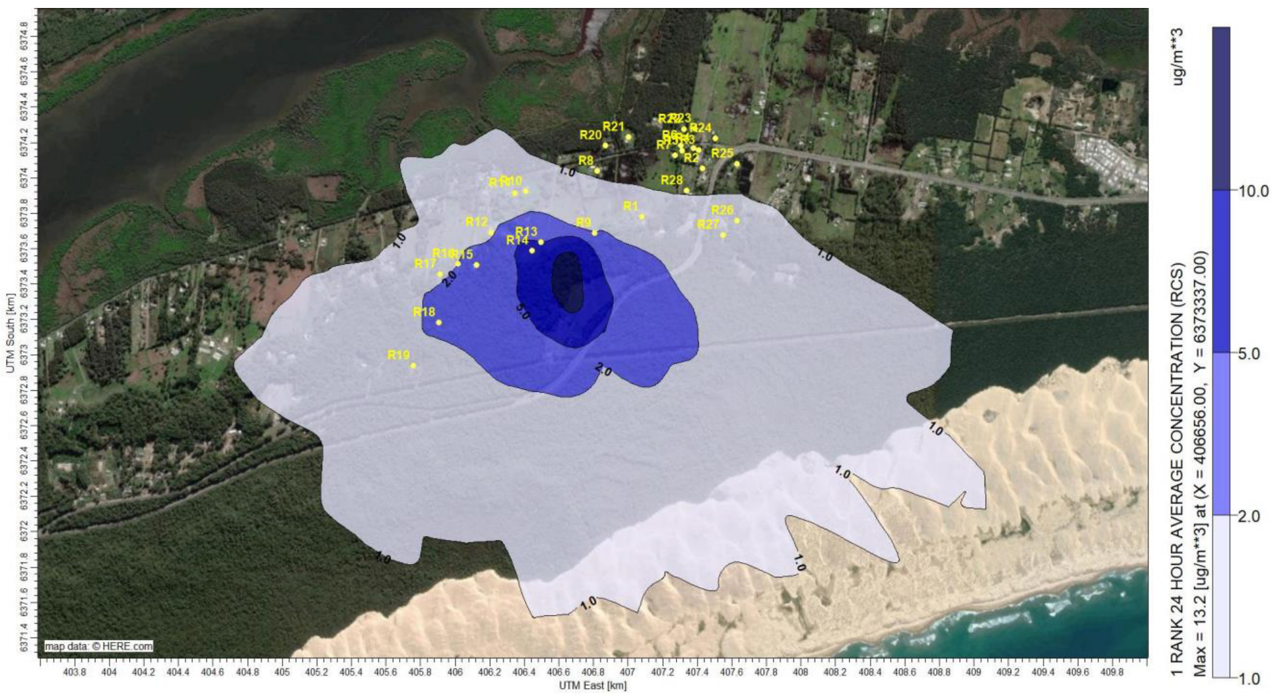
Pollutant: PM_{10}	**Averaging Period:** 24 Hour	**Percentile:** 100th	**Criteria:** 50 µg/m^3

Comment:
Cumulative – Scenario 1 - Level 1 Assessment



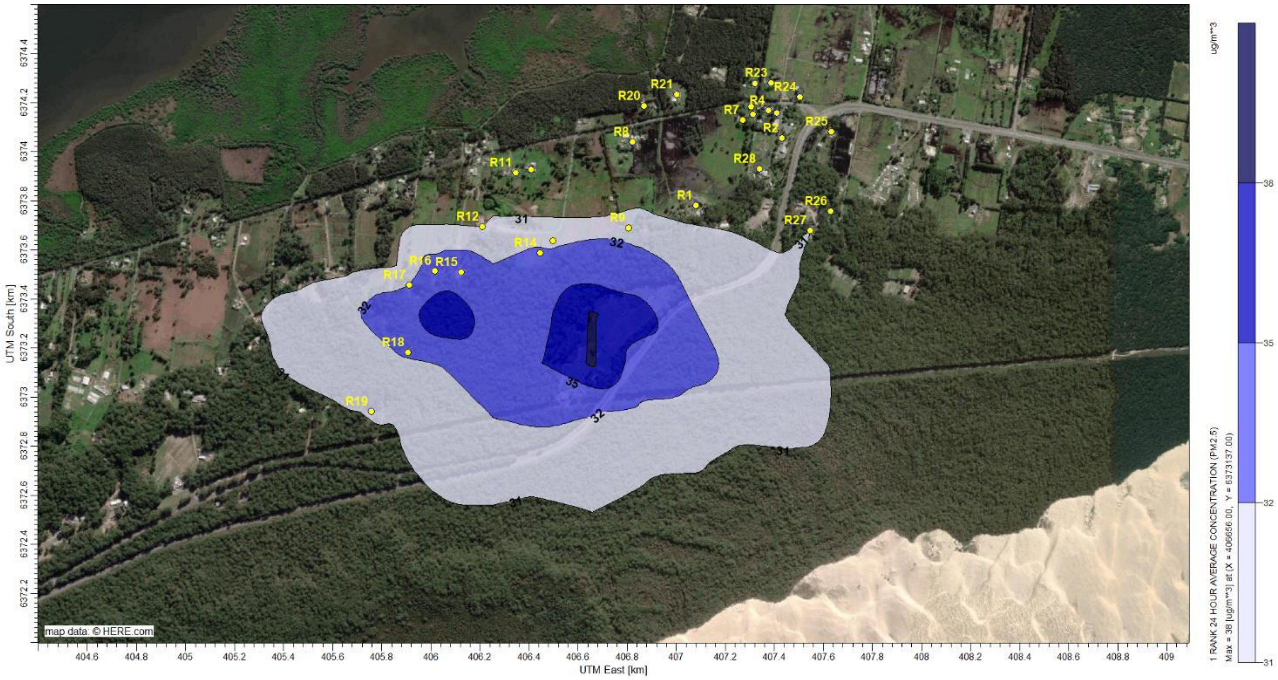
Pollutant:	Averaging Period:	Percentile:	Criteria:
RCS	Annual	100th	3 µg/m^3

Comment:
Cumulative – Scenario 1



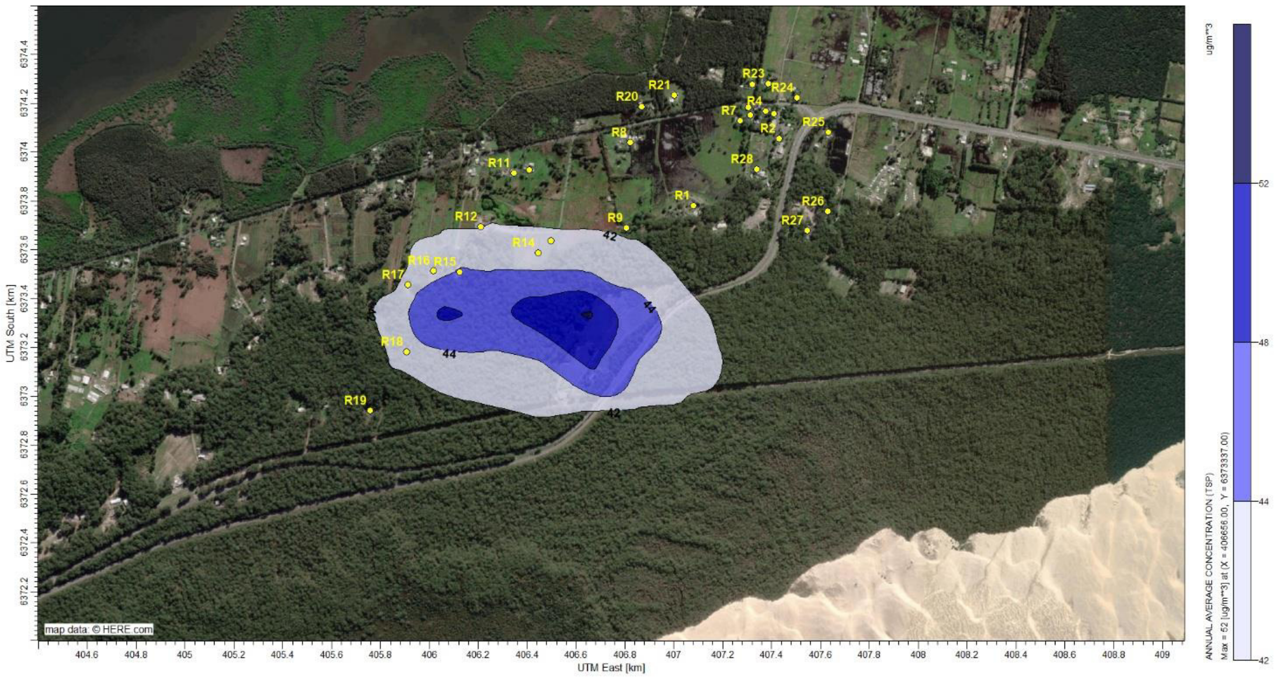
Pollutant:	Averaging Period:	Percentile:	Criteria:
RCS	24 HOUR	100th	14 µg/m³

Comment:
Cumulative – Scenario 1



Pollutant:	Averaging Period:	Percentile:	Criteria:
$PM_{2.5}$	24 Hour	100th	25 μg/m^3

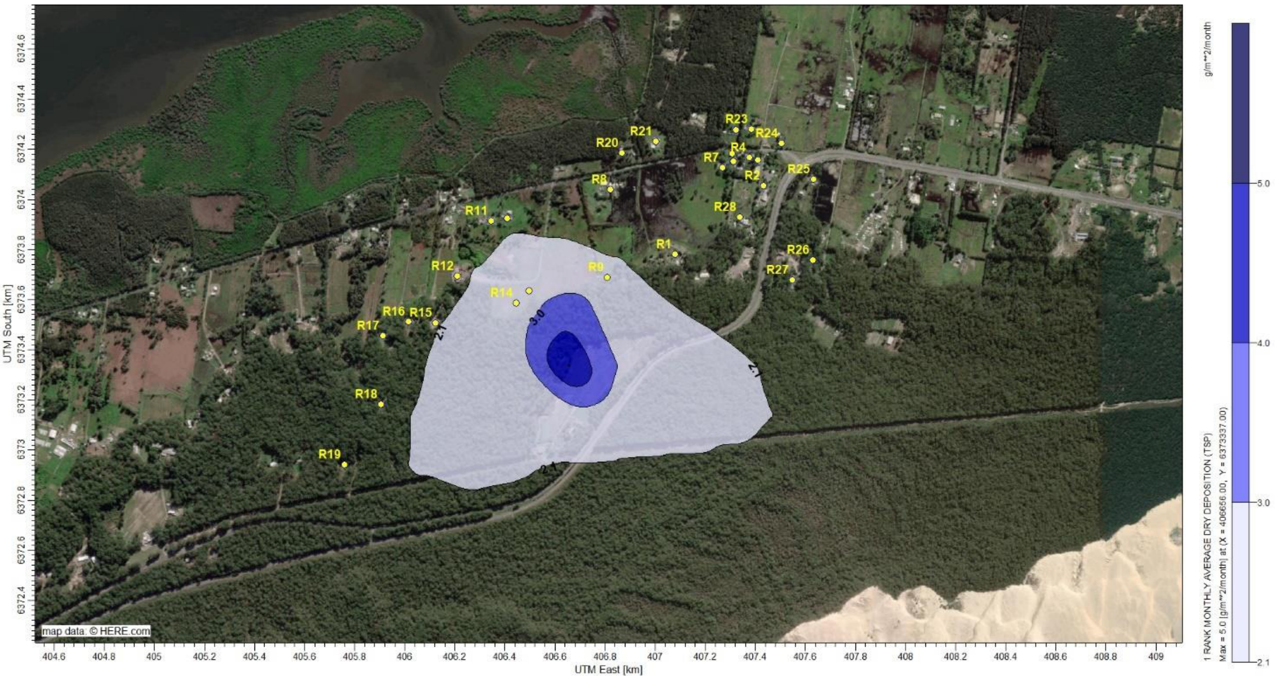
Comment:
Cumulative – Scenario 1 - Level 1 Assessment



Pollutant:	Averaging Period:	Percentile:	Criteria:
TSP	Annual	100th	90 μg/m^3

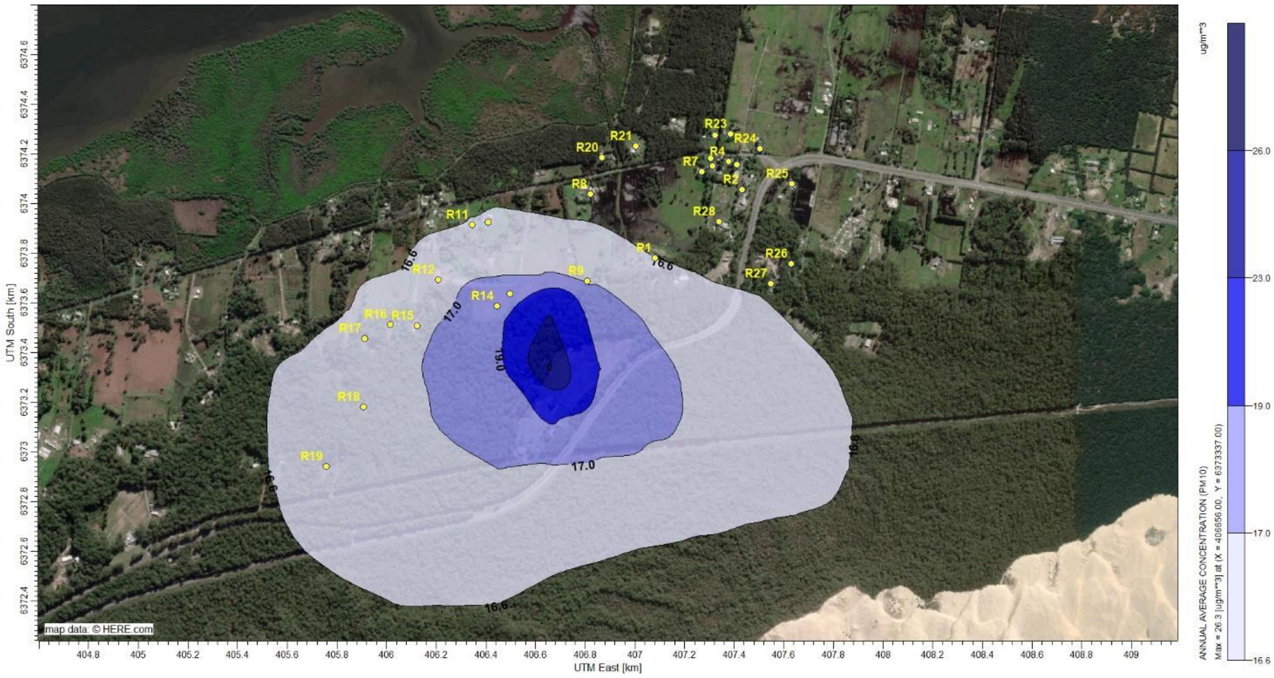
Comment:
Cumulative – Scenario 1

D.2 Scenario 2



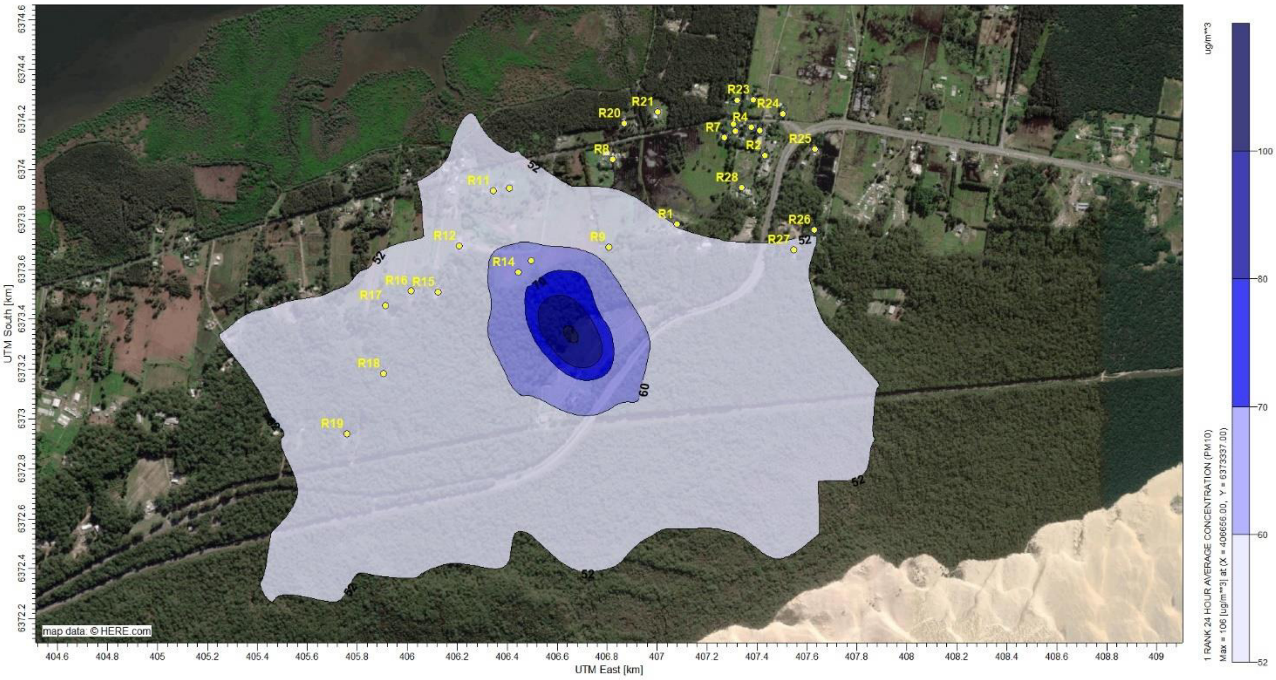
Pollutant: Dust Deposition	**Averaging Period:** Month	**Percentile:** 100th	**Criteria:** 4 g/m^2/month

Comment:
Cumulative – Scenario 2



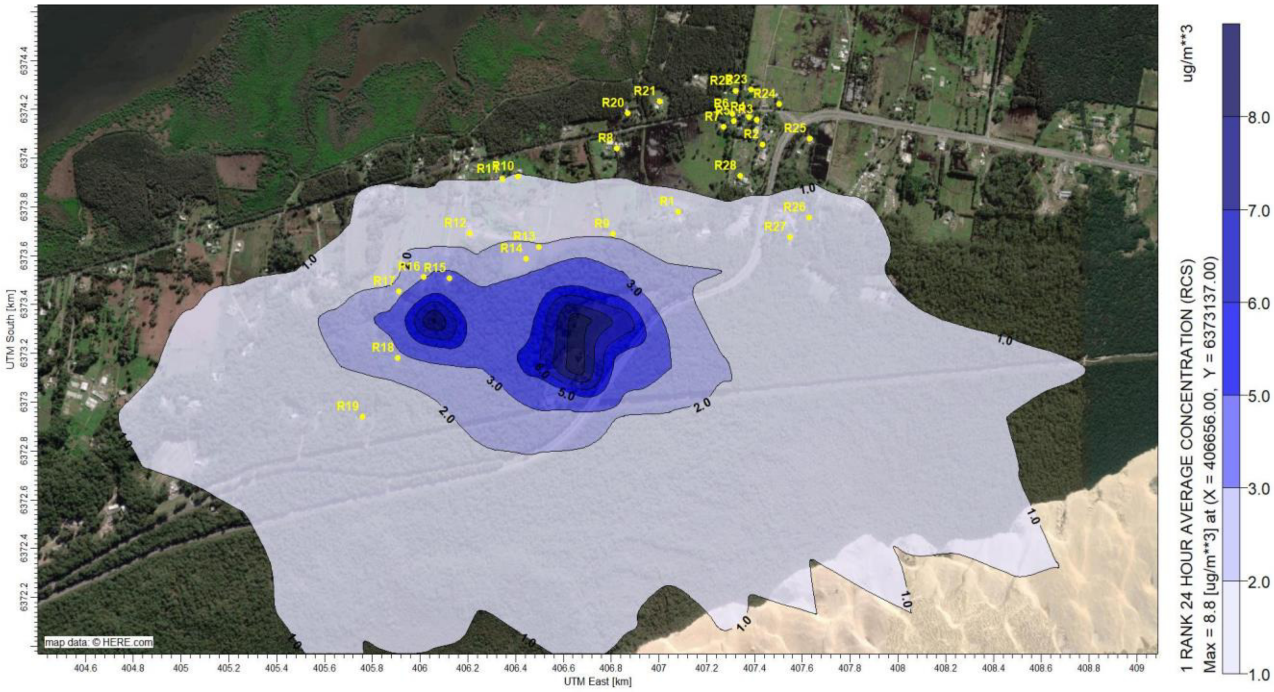
Pollutant:	Averaging Period:	Percentile:	Criteria:
PM_{10}	Annual	Average	25 µg/m^3

Comment:
Cumulative - Scenario 2



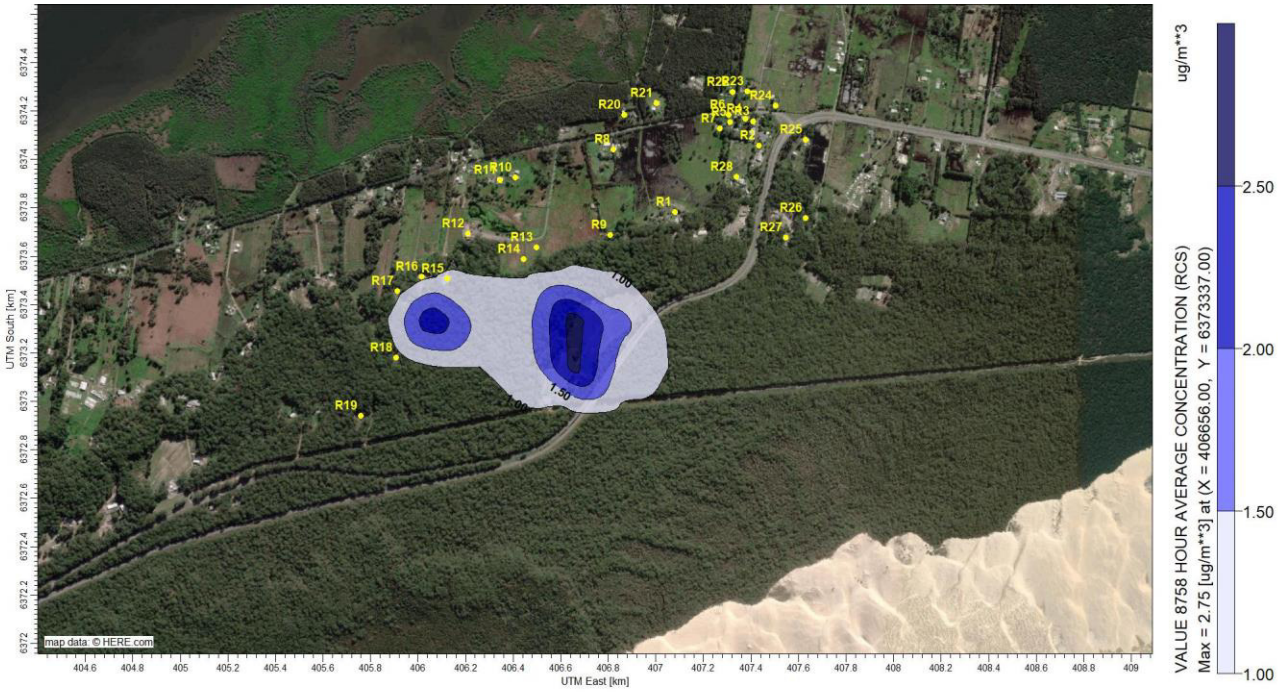
Pollutant:	Averaging Period:	Percentile:	Criteria:
PM_{10}	24 Hour	100th	50 µg/m^3

Comment:
Cumulative – Scenario 2 - Level 1 Assessment



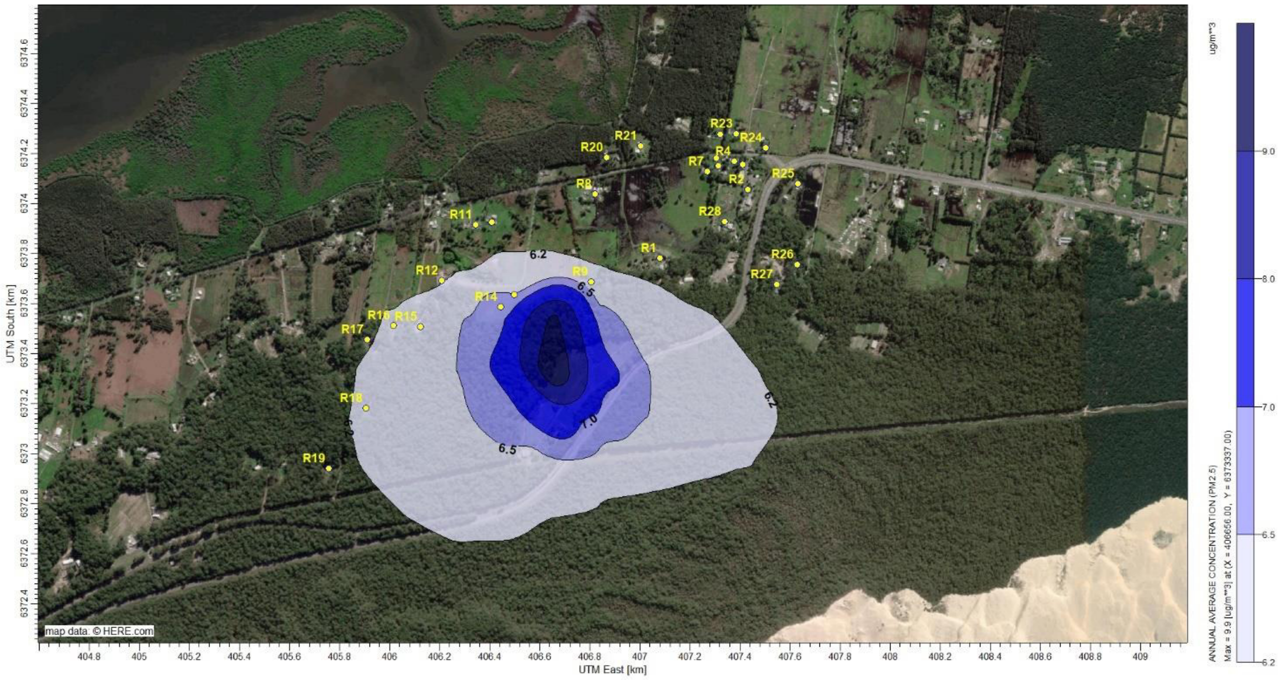
Pollutant: RCS	Averaging Period: 24 HOUR	Percentile: 100th	Criteria: 14 µg/m^3

Comment:
Cumulative – Scenario 2



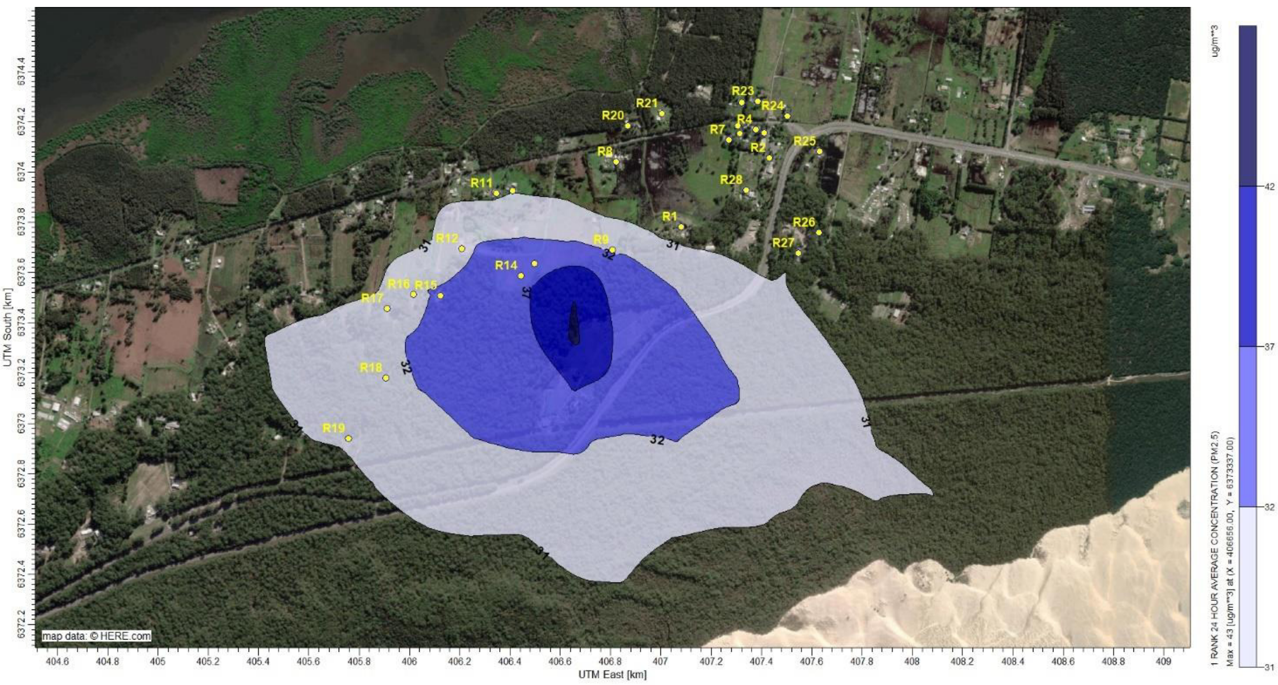
Pollutant:	Averaging Period:	Percentile:	Criteria:
RCS	Annual	100^{th}	3 µg/m^3

Comment:
Cumulative – Scenario 2



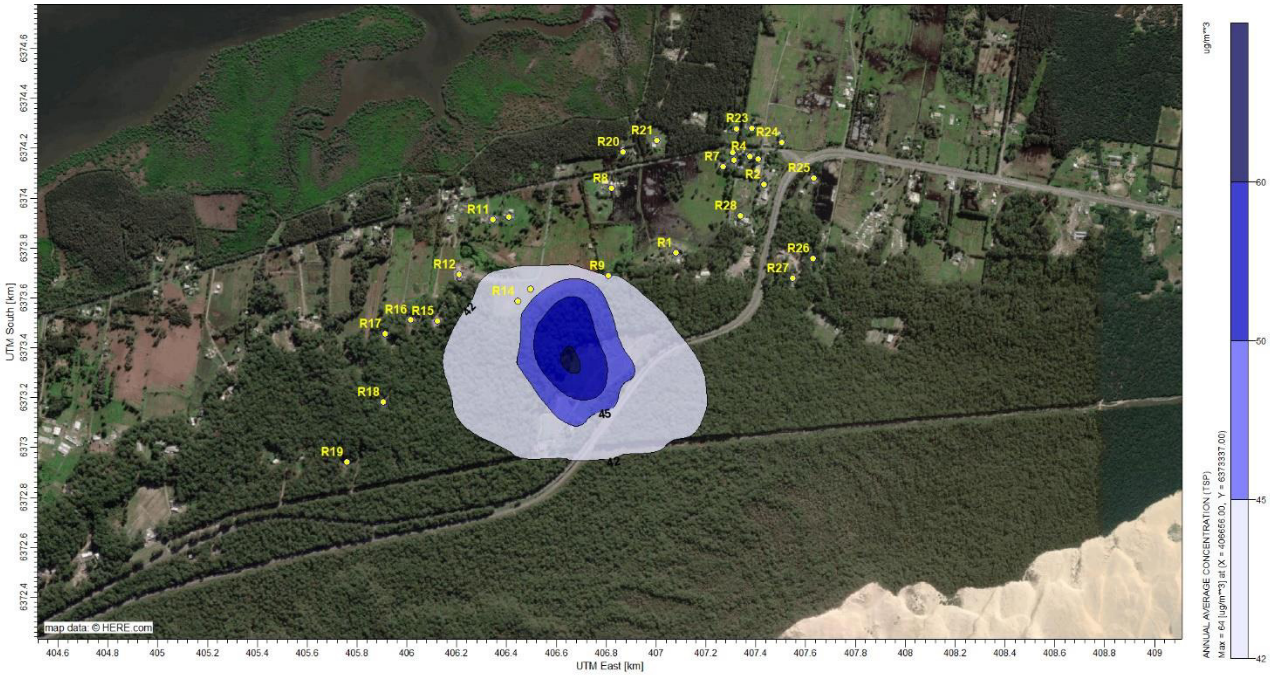
Pollutant:	Averaging Period:	Percentile:	Criteria:
$PM_{2.5}$	Annual	Average	8 µg/m^3

Comment:
Cumulative – Scenario 2



Pollutant: $PM_{2.5}$	Averaging Period: 24 Hour	Percentile: 100^{th}	Criteria: 25 μg/m^3

Comment:
Cumulative – Scenario 2 - Level 1 Assessment



Pollutant: TSP	Averaging Period: Annual	Percentile: 100th	Criteria: 90 µg/m³

Comment:
Cumulative – Scenario 2