AIR QUALITY IMPACT ASSESSMENT

Air Dispersion Modelling,

Hanson Sand Quarry

Hanson Construction Materials

870-910 Westernport Road, Yannathan, Vic

April 2023

Edge Group Pty Ltd
423 City Road, South Melbourne 3205
P (03) 8625 9696
E info@edgegroup.net.au | **W** www.edgegroup.net.au

Client	**Hanson Construction Materials Pty Ltd**
Project	20200075
Document Title	Air Quality Impact Assessment
Document ID	20220075-R-01 AQ MOD_v3
Distribution	Electronic PDF

Role	Name/Title	Signature	Date
Written	Enzo De Fazio Director – Environment & OHS		8 April 2023
Reviewed	Peter Southern Director Strategy & Capability		8 April 2023
Approved	Peter Southern Director Strategy & Capability		8 April 2023

Document Revision Table

Document ID	Changes	By	Date
20220075-R-01 AQ MOD Draft	Draft	Edge Group Pty Ltd	26 Sept 2022
20220075-R-01 AQ MOD Draft 2	Draft	Edge Group Pty Ltd	30 Sept 2022
20220075-R-01 AQ MOD	Final	Edge Group Pty Ltd	4 Oct 2022
20220075-R-01 AQ MOD_v2 for letter purps	Final	Edge Group Pty Ltd	4 Oct 2022
20220075-R-01 AQ MOD_v3	Final	Edge Group Pty Ltd	8 April 2023

423 City Road, South Melbourne Victoria 3205
T: 03 8625 9696
E: info@edgegroup.net.au
W: edgegroup.net.au
ABN: 17618314104

Executive Summary

Edge Group Pty Ltd (Edge) has been engaged by Ricardo Energy Environment & Planning Pty Ltd (Ricardo) on behalf of Hanson Construction Materials Pty Ltd (Hanson) to undertake an Air Quality Impact Assessment of the extension to the existing sand quarry located at 870-910 Westernport Road, Yannathan, Victoria, 3981.

This report comprises dispersion modelling results and discussion for the extension of the Yannathan sand quarry, with the extension planned to take place at the northern section of this property ("the Site").

This report has been prepared to provide Earth Resources Regulation (ERR) with further information, being an assessment of air quality impacts:

- from expanded extractive industries *[Section 3 of the Protocol For Environmental Management (PEM): Mining And Extractive Industries, EPA Victoria, 2007*][1] and *Guideline for Assessing; and*
- in accordance with *Minimising Air Pollution in Victoria (for air pollution managers and specialists), EPA Victoria, Publication 1961, February 2022 (EPA Publication 1961)*.

This report provides the results of modelling using the Environment Protection Authority Victoria's (EPA) approved regulatory dispersion model, AERMOD and provides discussion on the predicted results. The objective of the report was to:

- Assess for air quality impacts (for parameters where there are known criteria – i.e., from EPA Victoria's Environment Reference Standard (ERS) and the PEM for a guide to deposition) from the proposed sand quarrying operations via a predictive desktop assessment for:
    - concentrations of combustion gases such as carbon monoxide (CO) and nitrogen dioxide (NO_2);
    - concentrations of Particulate Matter ($PM_{2.5}$[2]) and Particulate Matter (PM_{10}[3]); and
    - deposition of general nuisance dust also called Total Suspended Particles (TSP).

As per EPA Guidelines[4], AERMOD meteorological data were prepared for the most recent available five years (2016-2020) relevant for the Site. The modelling was run for the full five years of data for the quarrying operations.

The pollutants above were modelled under generally representative to worst-case/conservative conditions. The modelling identified that respective ERS or PEM criteria

[1] The PEM is an incorporated document of the State Environment Protection Policy (Air Quality Management) 2001 (SEPP AQM), which is no longer in force in Victoria. However, according to EPA Victoria, the PEM "may contribute to the state of knowledge to inform, as appropriate" and so therefore is still used in this assessment for reference purposes only.

[2] Particulate matter 2.5 micrometers or less in diameter.

[3] Particulate matter 10 micrometers or less in diameter.

[4] Guidance Notes for Using the Regulatory Air Pollution Model AERMOD in Victoria, EPA Publication 1551, October 2013.

adopted in this assessment were not exceeded at the nearest sensitive (residential) receptors modelled for the following parameters:

- Concentrations of combustion gases
    - CO
    - NO_2
- Concentrations of particulate matter
    - PM_{10}
- Deposition of general nuisance dust or TSP.

The dispersion modelling undertaken in this report was based on a representative to worst-case operating scenario. There were only excursions at the four sensitive receptors modelled in this investigation for one parameter being $PM_{2.5}$ (including background air quality) and for only one of the two averaging periods modelled. Accordingly, a dust risk assessment was employed in this investigation using EPA methodology. Given this risk assessment and that there have been no known external dust-related complaints due to the existing operations, it is unlikely that there will be any potential human health (or amenity) impact surrounding the site during the proposed operations, which would be operating in normal steady-state conditions almost all of the time.

Contents

Appendices

1 Introduction

Edge Group Pty Ltd (Edge) was engaged by Ricardo Energy Environment & Planning Pty Ltd (Ricardo) on behalf of the sand quarry proponent, Hanson Construction Materials Pty Ltd (Hanson) to undertake the Air Quality Impact Assessment of the extension to the existing sand quarry located at 870-910 Westernport Road, Yannathan, Victoria, 3981 (the Site).

The operations at the Site will comprise dry sand quarrying moving to dredging of the deeper layers with the resulting material being processed on-site for offsite commercial applications.

This report provides the results of modelling using the Environment Protection Authority Victoria's (EPA) regulatory recommended dispersion model, AERMOD and provides discussion on the predicted results. The objective of the assessment is to:

- Assess for air quality impacts [for parameters where there are known criteria documented in the *Protocol For Environmental Management (PEM): Mining And Extractive Industries, EPA Victoria, Publication 1191, 2007* and EPA Victoria's Environment Reference Standard (ERS)[5]] from the proposed sand quarrying operations via a predictive desktop assessment for:
    - concentrations of combustion gases such as carbon monoxide (CO) and nitrogen dioxide (NO_2);
    - concentrations of Particulate Matter ($PM_{2.5}$[6]) and Particulate Matter (PM_{10}[7]); and
    - deposition of general nuisance dust or also called Total Suspended Particles (TSP).

The PEM is an incorporated document of the State Environment Protection Policy (Air Quality Management) 2001 (SEPP AQM), which is no longer in force in Victoria. However, *Section 3 ("Assessment of air quality impacts from new or expanded mining and extractive industries")* of the PEM remains still relevant to the assessment. According to *EPA Publication 1994 (Using SEPPs and WMPs in the new environment protection framework)*, this PEM is still relevant as it "may contribute to the state of knowledge to inform, as appropriate:

- EPA regulatory activities and actions under the EP Act consistent with the EP Act, the ERS, Regulations and guidance.
- The standard of conduct expected of a person conducting an activity to meet their duties.
- Permissions applications.
- Other statutory schemes and organisations (for example, planning and local government) that currently incorporate or refer to SEPPs and WMPs as part of their activities."

Edge notes that the ERS has replaced SEPP (AAQ) and SEPP (AQM) as of 1 July 2021.

Where a SEPP or WMP provision is identified as a useful source of knowledge (as is the case with the PEM above), its suitability for such use must be:

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[5],No. S245 Victoria Government Gazette 26 May 2021, as amended by Environment Reference Standard No. S 158 29 March 2022

[6] Particulate matter 2.5 micrometers or less in diameter.

[7] Particulate matter 10 micrometers or less in diameter.

- read in the context of the new legislative framework, and
- adjusted for any reference to legislation, requirement or process that no longer applies.

As *EPA Publication 1994* represents 'point in time' guidance at the time of commencement of the EP Act, users must be aware that new guidance published by EPA or other reputable source on matters covered by a SEPP or WMP clause will be regarded as superseding the equivalent position in a SEPP or WMP. This is because the newer material will represent the current state of knowledge on risks of harm (to the environment and human health) and ways of minimising those risks.

1.1 Proposed Site and Process Description

The Site is located within a Green Wedge Zone approximately 89 kilometres southeast from Melbourne's central business district (see ***Figure 1***). The closest sensitive receptors are also shown in ***Figure 1***, their distances (from the extraction area) shown in ***Table 11*** and they feature in the contours provided in this report.

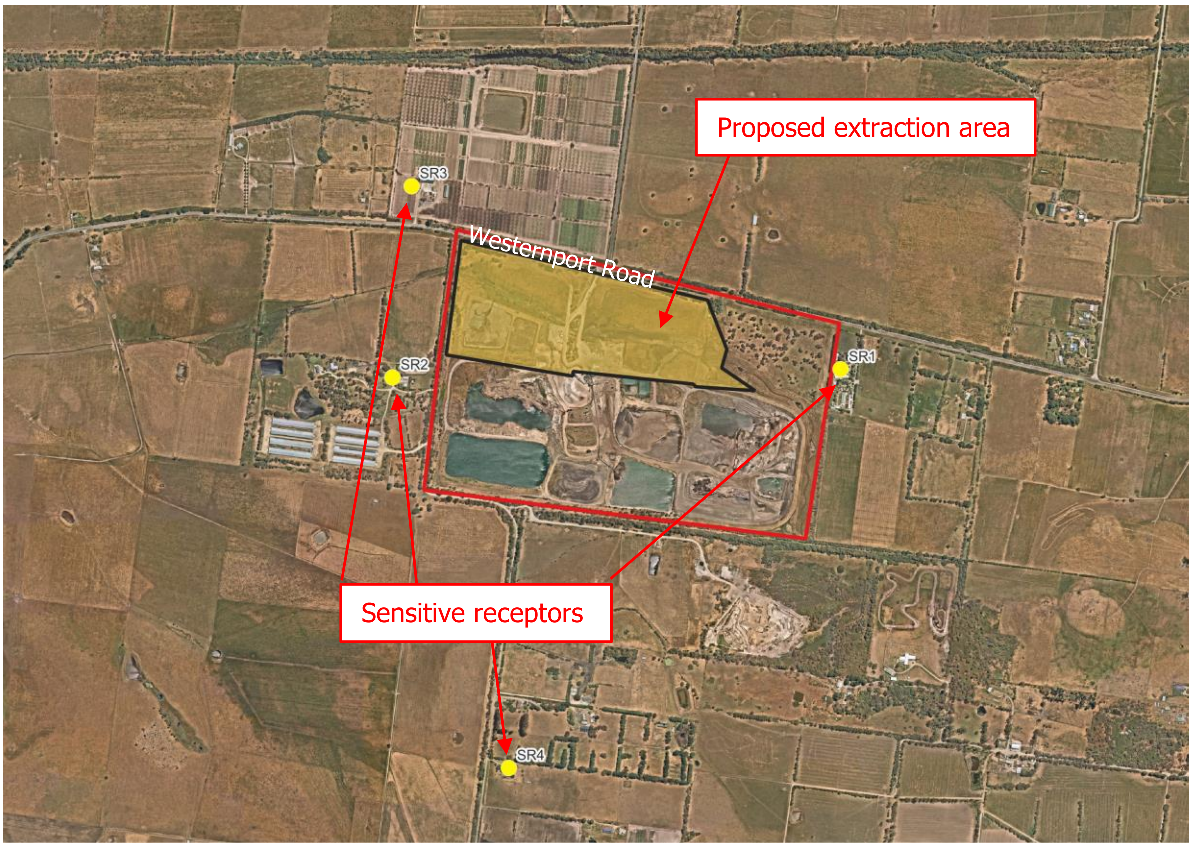

Figure 1: Red polygon is the boundary of the subject Site

The activities associated with the sand quarrying at 870-910 Westernport Road, Yannathan are predicted to be as follows:

- Removal/stripping of (approximately 0.3 metres of) surface vegetation;
- Pushing by dozer such vegetation and topsoil around the extension area to create mounds or edge bunds, which will be vegetated;
- Quarrying of sand using an excavator for shallower materials;

- Dredging will be used from approximately 9 metres Australian Height Datum (AHD), which is below groundwater level (that is approximately between 1 to 5 metres below ground level across the Site)
- Sand being transferred by dump trucks to the processing plant (approximately in the centre of the Site) until dredging commences, when sand will be predominantly pumped from a dredge via a floating pipeline to the processing plant for the deeper layers; and
- Additional equipment comprises front-end wheel loaders used primarily to load sales product and as back-up and control of raw feed material at the plant.

There will be no new sand stockpile on the Site –the existing stockpile to the west of the current processing plant will continue to be used. Haul roads will be on-site around each extraction area[8] within the total extraction area as per *Figure 1* above. All heavy vehicles and extraction equipment will access the Site via the existing quarry. The main source of dust generation during the quarrying process is the excavator and dozer.

Table 1 – Dust Source Characterisation

<table>
<tr><th colspan="2">Dust Production Mechanism</th><th>Comment</th></tr>
<tr><td colspan="2"></td><td>ON-SITE</td></tr>
<tr><td colspan="2">Mechanical soil and sand extraction and/or disturbance/movement</td><td>• The lower the risk of dust emissions as mobile plant increasingly continues to work below ground level
• Dust generated during quarrying activities
• Dust generated by the placement of (moist) clay against the batters</td></tr>
<tr><td colspan="2">Wind/atmospheric conditions</td><td>• Dust generated from un-sealed surfaces during windy conditions
• Dust generated from un-vegetated areas such as stockpile west of processing plant and from surrounding mounds prior to them being vegetated
• Potentially from some haul trucks transporting sand to the processing plant although less reliance on such vehicles as the extraction method to dredging for the deeper layers will occur</td></tr>
<tr><td colspan="2"></td><td>OFF-SITE</td></tr>
<tr><td rowspan="2">Mechanical soil and/or product extraction and/or disturbance/movement (e.g. for rehabilitation</td><td>Associated with the Site</td><td>None known/anticipated as no known or recorded complaints with regards to the Site's air emissions</td></tr>
<tr><td>Not associated</td><td>A smaller quarry (about a third of the proposed extraction area of the subject Hanson Site) exists to the south.</td></tr>
</table>

[8] Each extraction area not shown in this report as one overall extraction area only has been conservatively assumed (and modelled) as shown in *Figure 1*.

Dust Production Mechanism		Comment
processes by land filling)	with the Site	Mechanical soil workings (i.e. ploughing) associated with the market garden, north and northwest of the Site.
Wind/atmospheric conditions	Not associated with the Site	• Dust generated from un-sealed surfaces during windy conditions • Wind erosion on unsealed/unconsolidated surfaces

1.2 Topography

Topography (courtesy of Vicmap Topographic Maps Online) showed contours of 30 metres AHD over the Site and its immediate vicinity. Therefore, the topographic variation from the site to the surrounding area is not significant and is not expected to play a role in the pollution dispersion from the proposed plant. Hence, for modelling purposes, the topography over the region was assumed to be relatively flat.

1.3 Climate over the region

There are no known weather stations in the radius of 10 kilometres from the Site. Therefore data was simulated for the location in question running TAPM (Air pollution Model by CSIRO) as per guidelines by EPA Victoria.

The input meteorological data files have been compiled following EPA Victoria's draft guideline: "Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD), Publication No.1550, October 2013".

The Nilma North (Warragul) weather station (085313)[9], which was appropriate to use according to EPA Victoria, was used to access climate data below including the wind roses in *Section 2* (further below). The mean maximum temperature over the area from August 2021 until 20 September 2022 accessing the Nilma North (Warragul) weather station ranges from 12.6°C to 27.6°C, the minimum mean temperature is ranging from 3.4°C to 15.8°C. Using this same weather station, the average number of days per month where there was no rain from August 2021 until August 2022 inclusive was fourteen (14). Hence, it can rain slightly more than 50 percent of the days in a month when averaged over a year.

[9] Nilma North weather station (Latitude 38.13° Longitude 145.99°E; commenced 2014) located approximately 33 kilometres northeast of the Site.

2 Conceptual Site Model

2.1 Background

The purposes of the Conceptual Site Model (CSM) are to define potential sources of dust, potential exposure pathways and potential receptors to assist in determining the most appropriate dust monitoring to be consistent with the EPA PEM (used as a "State of Knowledge" only).

The particulates (or dust) that may be generated during extraction are typically categorised as:

- Total suspended particles (TSP);
- Inspirable particulates (PM_{10}); and
- Respirable Particulates ($PM_{2.5}$).

TSP ('nuisance dust' as referred to in the EPA PEM) generally causes nose, eye and throat irritations. It doesn't typically enter the respiratory system and is also responsible for visible dust deposition due to heavier particles present (such as on vehicle surfaces, etc). It is more conventional to consider dust deposition rates rather than TSP concentrations when dealing with 'nuisance dust,' as is adopted in this report and also consistent with the EPA PEM.

Inspirable particulates usually get captured and then cleared by the upper respiratory system, while respirable particulates are small enough to penetrate deep into the lungs and can cause irreversible lung damage.[10]

2.2 Proposed Site Activities

At the time of writing this report (from September 2022 to April 2023), the Site proposed to be quarried was largely vacant, undeveloped and was largely grassed (compared to the balance/south of the Site). As the water table will be reached, sand will be pumped to the processing plant (approximately in the centre of the Site) from a dredge in the pit where quarrying is occurring. Based on planning data sighted by Edge during the preparation of this report, dry material will be extracted to approximately 9 metres AHD (currently approved extraction depth). Dredging will occur from approximately 9 metres AHD to minus (-) 9mAHD. Note that water is expected to be encountered at approximately 19-24 metres AHD. As sand is excavated, batters are formed from (moist) clay overburden which reduces groundwater ingress sufficiently to allow dry excavation to 9 metres AHD.

The clearing of vegetation (with a dozer) needs to occur to access the sand. Such materials will be pushed in mounds (which will be vegetated) to be located around the proposed extraction area shown in ***Figure 1***.

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[10] www.safeworkaustralia.gov.au

2.3 Dust Sources

The activities associated with the sand quarrying at 870-910 Westernport Road, Yannathan are predicted to be as follows:

- Removal/stripping of (approximately 0.3 metres of) surface vegetation (assumed to occur during the first two months only);
- Pushing by dozer such vegetation around the Site to create mounds (of approximately 2-3 metres in height), which will be re-vegetated
- Quarrying of sand using an excavator;
- Placement of (moist) clay against pit batters;
- Transport of sand via haul truck to the processing plant on-site (although this will be minimised as dredging will occur to access the deeper layers of sand); and
- Loading existing stockpile approximately to the west of the processing plant.

No additional sand stockpiles (other than the bunds of topsoil) to the main existing stockpile of sand, slightly west of the processing plant will be required. Temporary haul roads will be on-site for haul trucks to access when transporting any quarried material before dredging occurs.

As part of the Site's General Environmental Duty (GED as defined by EPA Victoria), a more comprehensive focus on the existing and proposed controls for any dust emission sources at the Site are provided in the Site Environmental Management Plan (SEMP) focussing on dust, which has been prepared for Ricardo (for Hanson).[11] Edge recommends reading or referring to this SEMP in conjunction with this modelling report.

Other off-site sources, which can be potential sources of dust, in the general area (either abutting the subject Site or in the immediate vicinity) are the following:

- any unsealed section of roads abutting the Site to the west and south (i.e. Milners and Burt Roads, respectively);
- agricultural with some extractive industry to the south southeast (approximately 350 metres from the Site); and
- market garden (i.e. ploughing) across Westernport Road (of the Site) and west of Heads Road.

[11] Base report reference number 20220075-R-01-SEMP_Dust.

2.4 Pathways

The dust movement pathway relevant to amenities is air-deposition. This pathway is dependent on weather conditions – i.e. strong winds and high temperature (heat) can produce more dust. Due to the influence of weather conditions on dust dispersion, annual records were reviewed as taken by the Bureau of Meteorology (BOM) at the Nilma North (Warragul) weather station at 9 am and 3 pm intervals, shown in ***Figures 2*** and ***3***, below. In correspondence with EPA, the Nilma North (Warragul) weather station was selected as it is the closest known active station to the Site (as also confirmed by EPA via email correspondence with Edge in June 2022). The Nilma North weather station data showed that the maximum recorded wind speeds at greater than 40 kilometres per hour at a frequency of at least 28% (of the time) from the east and 24% (of the time) from the west at 9am and more than 40 kilometres per hour up to approximately 35% (of the time) from the west at 3pm. In summary, it appears that the predominant wind direction between both recorded times is from the west. The sources of these data are shown in wind roses provided below:

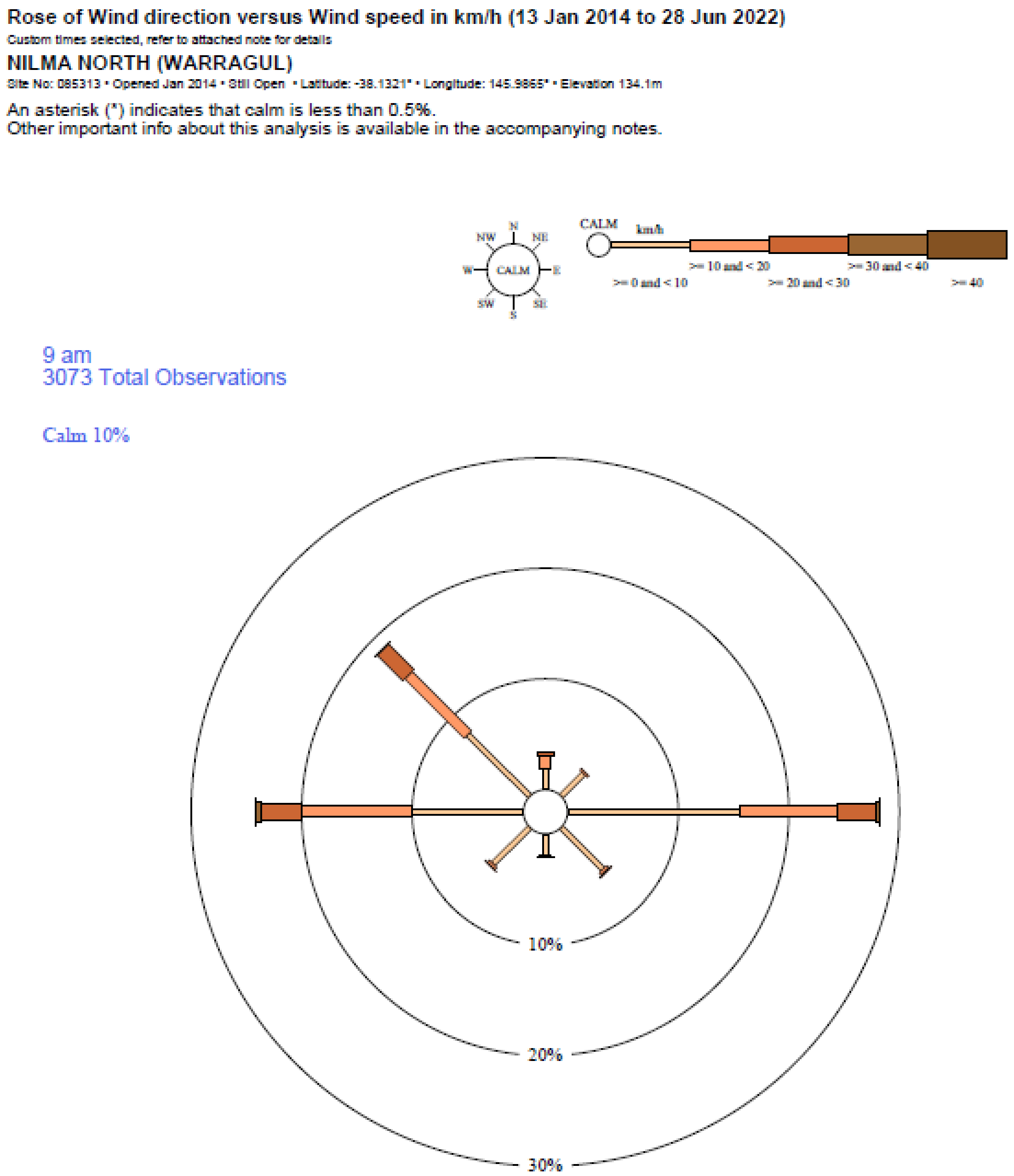

Figure 2 – Wind Rose showing 9am annual average wind speed and directions[12]

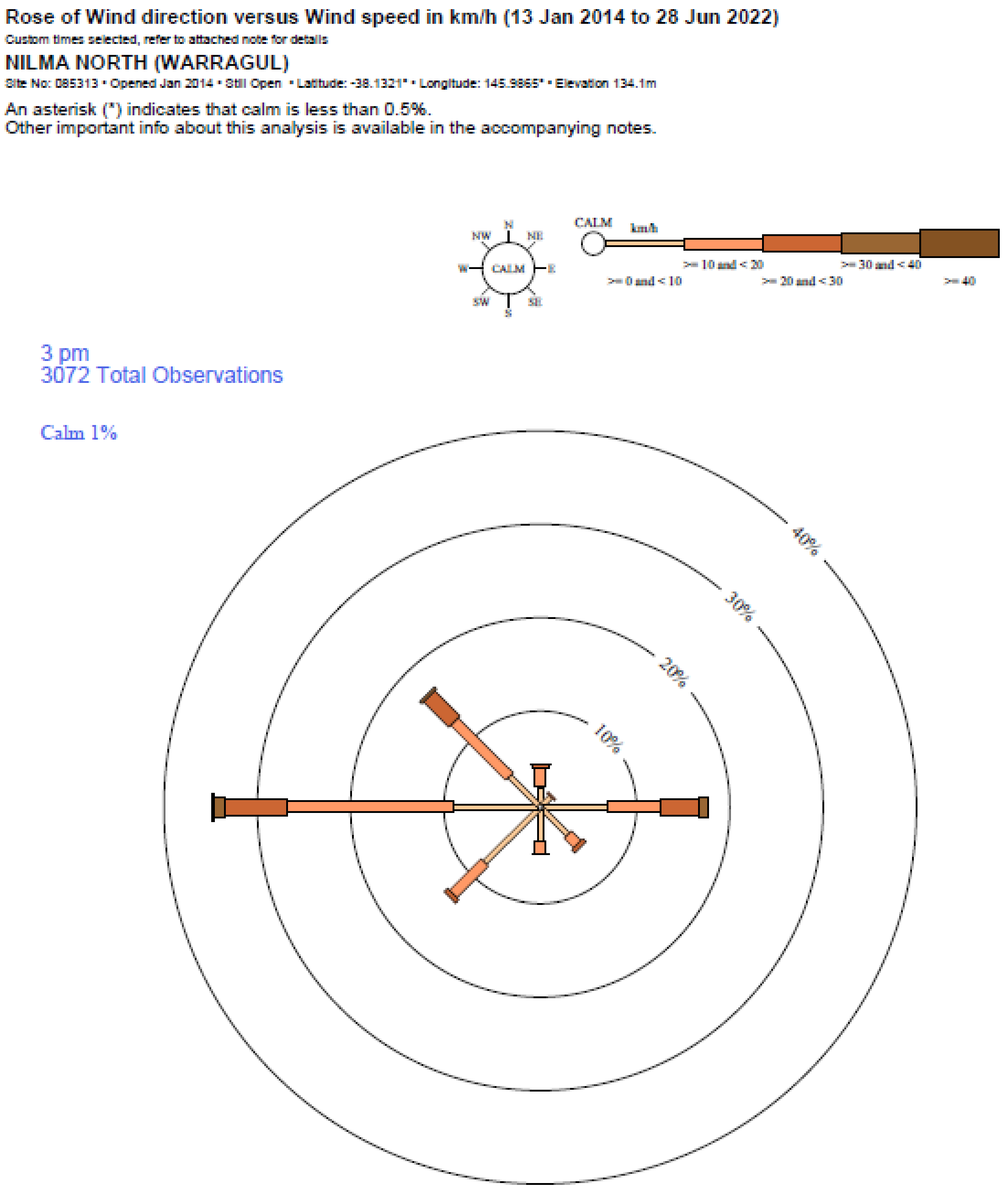

Figure 3 – Wind Rose showing 3pm annual average wind speed and directions[13]

As the pathway for dust dispersion is primarily atmospheric, nuisance dust emissions from site can settle rapidly and can have effect on the immediate surroundings of the site (both human and environmental).

As a general guide, particle sizes of 50 microns (μm) or more tend not to become airborne[14]. The hazard information provided in the Hanson "Aggregates, Road Base, Sand and fill" Safety Data Sheet (2020) applies to the dusts with silica sand and particularly inhalable dust particles

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[14] https://www.der.wa.gov.au/images/documents/your-environment/air/publications/Guideline_for_managing_impacts_of_dust.pdf. Appendix 2.

with a diameter less than 75 microns. This does not appear to mean that all particulate matter are less than 75 microns at the Site. Based on Particle Size Distribution (Technical Services Clarinda) NATA laboratory results (April and June 2022) for Yannathan, respirable crystalline silica is not required to be monitored (as part of ongoing Site management) based on at least 98% of the sampled material being equal or greater than 75 microns. This is also consistent with the "Product Grading" (in *Table 1*) data in the Yannathan Sand Quarry, Assessment of Potential Dust Impacts, May 2013 (GHD for Hanson Construction Materials) where zero (0) to three (3) percent of particles passed through a pan size of 0.075 millimetres (75 microns). Given the above, it is presumed that sand will not be at a particle size of 4 microns, which was the size (or lower) that was reported to be responsible for silicosis according to the occupational hygiene department in WorkSafe Victoria as per the Silicosis Summit on 27 February 2020.

Therefore, the Particle Size Distribution results show that almost all of the particles tested were greater than 50 microns. This is consistent with a literature search that sand particles range in diameter from 63 µm to 2 millimetres (mm).

2.5 Receptors

The neighbours to the subject site are:

- North and northwest: Agricultural (market garden) uses property with an office that has a room where the caretaker occasionally sleeps and therefore considered a residence.
- East: Yannathan Park – Boarding Kennels and Cattery which is an accommodation facility for cats and dogs (owner resides on-site)
- South: Agricultural with some extractive industry
- West: Egg layer or broiler farm west of the quarry (farm manager residence on site).

Specific off-site locations are described below, where the receptors are workers, residents and visitors to the site or off-site that could potentially be impacted by any airborne nuisance dust. Specifically, sensitive receptors to nuisance dust can include vulnerable persons, flora and fauna or sensitive industrial processes where dust particle introduction can cause equipment failure. For the purposes of this report, sensitive receptors include off-site persons (residential), grazing animals (presumed), natural site flora, cars and drivers (e.g. Westernport, Milners and Burt Roads).

Table 2 – Receptors surrounding the Site

Direction	Location	Receptor	Approx. distance to receptor from closest Site boundary and extraction zone (m)
North, Northeast	Office and room (for occasional sleeping – i.e. caretaker residence)	• Workers • Visitors	• 215 m (boundary) and 235 m (extraction zone)

Direction	Location	Receptor	Approx. distance to receptor from closest Site boundary and extraction zone (m)
or Northwest	Westernport Road	• Drivers • Aesthetic impacts on vehicles	• 10 m (boundary) and 30 m (from extraction zone)
	Vacant land (north and northeast)	• Grazing animals (unknown) • Natural site flora	• 15 m (boundary) and 35 m (from extraction zone)
East	Residence abutting the eastern edge of the non-extraction area	• Residents • Visitors	• 0 m Boarding Kennels and Cattery abuts the Site (and 250 m from extraction zone)
	Vacant land	• Grazing animals (unknown) • Natural site flora	• 0 m abuts the Site and 250 m from extraction zone
South, Southeast or Southwest	Residence	• Residents	• 805 m (boundary) • 1.2 km (extraction zone)
	Agricultural with some extractive industry	• Workers	• 350 m (boundary) • 580 m (extraction zone)
	Burt Road (unmade road; doesn't take regular traffic)	• Drivers • Aesthetic impacts on vehicles	• 10 m (boundary) and 410 m (from extraction zone)
	Vacant Land (south, southeast and southwest)	• Grazing animals (unknown) • Natural site flora	• 10 m (boundary) and 420 m (from extraction zone)
West	Egg layer or broiler farm west abuts the overall Site but is southwest of the extraction area. Farm manager residence of broiler farm is set back from the extraction area.	• Residents • Workers	• 125 m Broiler Farm residence (boundary) and 160 m (extraction zone) • 140 m Broiler Farm workers from Site boundary and 290 m from extraction zone
	Milners Road	• Drivers	• 10 m (boundary) and 30 m (from extraction zone)

Direction	Location	Receptor	Approx. distance to receptor from closest Site boundary and extraction zone (m)
		• Aesthetic impacts on vehicles	
	Vacant Land	• Grazing animals (unknown) • Natural site flora	• 10 m (boundary) and 30 m (from extraction zone)

Note: 0 m indicates the 'receptor' shares a boundary with the Site.

2.6 Factors Influencing Dust Generation

The major factors that influence dust emissions are:

- The percentage of fine particles in the material on the surface *(note this is less of an issue for the proposed sand quarry given that almost all sand particles would be greater than 50 µm as discussed in **Section 2.4** above)*;
- Wind speed across exposed surfaces; the critical wind speed for pickup of dust from surfaces is 5 m/s and the dust pickup increase rapidly above 10 m/s *(as most of the sand is above 50 microns, these wind speeds are likely to over-estimate the quantity of dust pickup)*;
- Moisture content of the material on the surface (i.e. the lower the moisture content, the more chance of dust being wind-blown). *As discussed in **Section 1.3** above, it can rain slightly more than 50% of the time in the local area over an average month;*
- The area of exposed surface (i.e. the greater the area of exposed surface, the more chance of dust being wind-blown);
- Disturbances such as traffic, excavation, loading and unloading of materials (i.e. the greater the number/frequency of these operations, the more chance of dust being wind-blown);
- The elevation of the source above the surrounding ground level. That is, sand (at height) is tipped into the hopper at the processing plant. However, this will be generally moist sand so not expected to result in an ongoing airborne dust emission;
- The smaller the particle size of the material on the surface of a road or an exposed surface, the more easily the particles are able to be picked up and entrained in the wind. *This is less of an issue for the Site as the product is a coarse sand for concrete manufacture and that almost all sand particles would be greater than 50 µm as discussed in **Section 2.4** above.* Further; Westernport Road*;* the main road in the area, is a sealed road so dust issues are not expected from this road and nor were any significant or ongoing dust emissions observed during Edge's Site visit in March 2022;
- Moisture content of the exposed surfaces, moisture binds particles together minimising them from being disturbed by wind or vehicle movements. *As discussed in **Section 1.3***

above, it can rain slightly more than 50% of the time in the local area over an average month;

- The larger the area of exposed material, the more potential there will be for dust emissions (however, there will be no additional stockpiles of sand generated as part of the operation);
- Vehicles travelling over exposed surfaces tend to pulverise any surface particles; the particles are lifted and dropped from the rolling wheels and the road surface is exposed to strong air currents due to turbulence between the wheels and the surface. However, this will typically not be the case as the number of mobile plant with wheels will be minimal given the dredging process after the material will be dry excavated to approximately 9 metres AHD. Therefore, the common plant on-site would be the excavator and dozer, which are both moved by rolling track and therefore minimising dust emissions compared to haul trucks; and
- Dust can also be entrained into the turbulent wake created behind moving vehicles (although this will unlikely be the case given the relatively low speeds that will be travelled on-site compared to other mobile plant like trucks, which are planned not to be commonly present on-site).

3 AERMOD Model and Inputs

This section provides an overview of the model inputs and any assumptions made by Edge.

In general, the modelling was undertaken for a 12-month period under a representative to worst-case scenario in accordance with the PEM. Worst-case conditions are those for the periods when the maximum emissions are predicted to occur under normal operating conditions (for example when maximum earth moving activities are occurring or large areas of exposed land are expected on site) and/or where an expansion or development has maximum impact on sensitive receptors. The modelling was undertaken for a number of scenarios including and combining:

- Activities undertaken (i.e. topsoil stripping) during the development of the site; and
- Operational phase of the quarry.

3.1 Averaging Periods

The outputs from AERMOD are 1, 8 and 24-hour average concentration predictions that are determined using lateral dispersion values. For the purposes of this modelling and consistent with the EPA PEM, combustion gases such as NO_2 and CO were expressed as 1-hour and 8-hour averages, respectively; and particulate matter ($PM_{2.5}$ and PM_{10}) were expressed as 24-hour averages.

3.2 Modelling Sources and Inputs

Based on the interpretation of the *Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists), EPA Victoria, Publication 1961, February 2022 (EPA Publication 1961); the PEM* and the Site location; a *Level 2* assessment is required. That is, consistent with a *Level 2* assessment, the subject proposed operation will be a "Medium quarry" with no more than 500,000 tonnes/year extraction (of sand), which is the upper limit for a Level 2 assessment. Similarly, consistent with a Level 2 assessment, the Site is in a rural area close to residences (less than 500 metres) from the extraction area.

Given that no direct data for the parameters modelled in this assessment could be obtained from EPA Victoria or ERR, Edge Group conducted a literature review for the search of input data that could be used for this assessment. The following report was identified in which relevant data was used for the proposed quarry Site to be operated by Hanson: *Air Quality Assessment – Lots 1 And 2 Dp732708 Old Telegraph Road, Maroota Proposed Sand Quarry, Job ID. 08915, Pacific Air Environment for PF Formation (04 September 2014).* This report will be referred to as the *"Maroota Report."*

This *Maroota Report* contains a quarry rate of 100,000 tonnes/year and for the purposes of the subject site and consistent with Level 2 (EPA) assessment, this rate has been factored up to 500,000 tonnes/year.

The dust emissions (extrapolated from the *Maroota Report*) during operation of the proposed Hanson quarry have been estimated based on activities and equipment operating as follows:

- Dozer clearing vegetation/topsoil; and
- Wind erosion from active extraction area.

The maximum daily production scenario (worst case) was modelled in the *Maroota Report* based on maximum product transport of 660 tonnes per day. Even though there will be a combination of hauling (shallow material) and pumping (to the processing plant, located approximately in the centre of the Site), Edge scaled up this *Maroota Report* value up to a conservative 1800 tonnes/day (i.e. a factor of 2.73).[15]

Like in the *Maroota Report*, the maximum daily emissions were applied for each day of the modelled year(s) so that a range of meteorological conditions could be tested. This does not represent a realistic estimate of annual dust emissions, although they could potentially reach these emissions levels on a daily basis based on a worst-case scenario.

The subject Site's activities are assumed to occur between 6am and 10pm Monday to Saturday (there are no quarrying operations conducted on Sundays, Good Friday, Christmas Day and Boxing Day). There are no quarrying operations and off-site truck movements after 6pm (i.e. the processing plant will be in operation until 10pm).

The Power, Emission Factor and Load Factor values in ***Table 3** and **4*** were obtained from *National Pollutant Inventory, Emission Estimation Technique Manual for Combustion Engines, Version 3.0, Australian Government, Department of the Environment, Water, Heritage and the Arts, June 2008*. The average (293 kW) power rating was conservative[16] and it was based on the average of the Volvo A35FFS articulated hauler (SAE J1995 Gross)[17] and the Komatsu PC450 excavator, which are typical/average equipment that could be used on-site.[18]

3.2.1 Exhaust Emissions

Table 3 – Estimated bulldozer exhaust emissions

Substance	**Power (kW)**	**Operating hrs (h/y)**	**Emission Factor (kg/kWh)** [from *Appendix B, Table 26]*	**Load Factor** *[from Table 5]*	**Emissions (t/y)**
CO	293	3,255 (over 310 days/yr)	0.0029	0.55	1.5
NOx	293	3,255 (over 310 days/yr)	0.01	0.55	5.2
PM_{10}	293	3,255 (over 310 days/yr)	0.00093	0.55	0.5
$PM_{2.5}$	293	3,255 (over 310 days/yr)	0.00085	0.55	0.4

[15] This was based on the quarry operating up to 310 days (Monday to Saturday) per year accounting for no quarry operation on Sundays, Christmas Day, Boxing Day and Good Friday (i.e. 365 days minus 52 x 3 x Public Holidays). Operation by mobile plant on each working day has been assumed at 10.5 hours accounting for start-up, breaks and shutdown (thus 3,255 hours).
[16] Conservative in that the kW ratings for other plant modelled on other Hanson similar sites (e.g. Langwarrin) had a lower reported power rating.
[17] https://www.volvoce.com/-/media/volvoce/global/products/articulated-haulers/brochures/brochure_a35ffs_a40ffs_t4i_en_21_20026508_c.pdf?v=jnxHPw
[18] https://www.komatsu.jp/en/worldwide/PDF/PC450_450LC-8.pdf

Table 4 – Estimated excavator exhaust emissions

Substance	Power (kW)*	Operating hrs (h/y)	Emission Factor (kg/kWh) [from *Appendix B, Table 32]*	Load Factor *[from Table 5]*	Emissions (t/y)
CO	293	3,255 (over 310 days/yr)	0.003	0.5	1.4
NOx	293	3,255 (over 310 days/yr)	0.012	0.5	5.7
PM_{10}	293	3,255 (over 310 days/yr)	0.00088	0.5	0.4
$PM_{2.5}$	293	3,255 (over 310 days/yr)	0.00081	0.5	0.4

3.2.2 Quarry Operation: Particulate Emissions

Table 5 - Particle emissions from the bulldozer during the quarry's operation for the topsoil stripping operation and then during quarrying activity

Substance	Emission Factor *[Table 7.2, Maroota Report]*	Scaling factor	Emission (kg/yr)	Operation hours
PM_{10}	507	2.73	1,400	Mon-Sat: 06:00-18:00 (quarrying) Mon-Sat: 18:00-22:00 (processing only)
$PM_{2.5}$	196		540	
TSP	1,869		5,100	

Table 6 - Particle Emissions from the excavator during the quarry's operation

Substance	Emission Factor *[Table 7.2, Maroota Report]**	Scaling factor	Emission (kg/yr)	Operation hours
PM_{10}	45	2.73	123	Mon-Sat: 06:00-18:00 (quarrying) Mon-Sat: 18:00-22:00 (processing only)
$PM_{2.5}$	7		19	
TSP	95		260	

** Maroota: Excavator/front end loader loading sand to trucks for haulage to processing site*
Hanson: using Maroota's data, we have assumed this to cover the excavator operations on-Site

3.2.3 Quarry Operation: Wind Erosion Emission - Dust

Table 7 – Estimated annual dust emissions based on maximum daily production scenario (worst case)

Substance	Wind Erosion Emission Factor *[Table 7.2, Maroota Report]*	Scaling factor	Total Emission (kg/yr)	Tonnes/Yr	Total quarrying area (m^2)	Emission Flux ($t/m^2/yr$)
PM_{10}	876	2.73	2,400	2.4	193,518	0.0000340
$PM_{2.5}$	131		360	0.36		0.0000051
TSP	1752		4,800	4.8		0.0000680

Wind erosion is assumed to occur 24 hours per day. TSP, PM_{10} and $PM_{2.5}$ emission rates were calculated using emissions factors derived from US EPA (1995).

The subject facility has been modelled to extract up to 500,000 tonnes per annum, which is the maximum that can be extracted based on the criteria of a Level 2 assessment under EPA Publication 1961 *(and the PEM)*.

4 Air Quality Assessment Criteria

This section describes the compliance obligations that relate to the proposed subject operation. It includes general terminology and definitions relevant to the project and a summary of the statutory and policy framework for the area including EPA Publication 1961 and the ERS. That is, the SEPPs have been removed as subordinate instruments and ceased to have a formal legal status in Victoria's new environment protection framework when the *Environment Protection Act 2017 (EP Act)* commenced on 1 July 2021.

The EP Act's environment protection framework includes the ERS. This identifies environmental values, air indicators and objectives that set the benchmark for the quality of the air environment needed to protect the environmental values. The ERS is a reference standard, not a 'compliance standard' for businesses. However, some government decision-makers must take the ERS into account when making certain decisions. ERS objectives for air are health-based and as such, some are incorporated into this Standard, with the aim of informing how to assess and control risks from air emissions.

The ERS replaces *State Environment Protection Policy (Air Quality Management) 2001* (SEPP AQM) and generally adopts the objectives in the National Environment Protection Measure (Ambient Air Quality) (NEPM AAQ) with some modifications. The ERS also contains other environmental values, indicators and/or objectives that are not in the NEPM AAQ.

4.1 Protocol For Environmental Management (PEM): Mining and Extractive Industries, EPA Victoria, 2007

This PEM is an incorporated document of the SEPP AQM, which has now been replaced by the ERS. It supports the interpretation of the former SEPP AQM and sets out the statutory requirements for the management of emissions to the air environment arising from activities undertaken in the operation of mining and extractive sites.

Best Practice is the main guiding principle in controlling air emissions and meeting the requirements of this PEM. For particular hazardous air pollutants (Class 3 indicators in the former SEPP AQM), are now replaced by *Regulation 4* and *Schedule 4* of the *Regulations*.

The PEM was developed in consultation with Government agencies and key stakeholders. It is important that this PEM be read in conjunction with the SEPP AQM (where still relevant – i.e. as "State of Knowledge" only) and the ERS. EPA Publication 1994 says that the PEM may contribute to the state of knowledge for clause 40 (*Management of Large Line and Area-Based Sources of Emissions* – the latter being relevant to this assessment) in the SEPP (AQM). In addition, it should be noted that the Department of Jobs, Precincts and Regions (DJPR) regulates the mining and extractive industries under the *Mineral Resources (Sustainable Development) Act 1990*. Edge understands that the PEM will still be used by DJPR as a guide in the management of air quality impacts by mines and quarries.

4.2 Environment Reference Standard, EPA Victoria

Under the EPA Victoria's Environment Reference Standard, objectives (***Table 8***) are applied in the assessment of a proposal or activity to ensure that there will be no adverse impacts to the ambient air environment.

Table 8: Adopted Air Pollution Assessment Criteria (APAC) in this investigation

Indicator	Objectives (maximum concentrations)	Averaging Period
CO	9.0 ppm	8 hours
NO_2	0.08 ppm	1 hour
	0.015 ppm	1 year
PM_{10}	50 µg/m^3	1 day
	20 µg/m^3	1 year
$PM_{2.5}$	25 µg/m^3	1 day
	8 µg/m^3	1 year

ppm = parts per million
µg/m^3 = micrograms per cubic metre

4.3 Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists), EPA Victoria, Publication 1961, February 2022

The Guideline for Assessing and Minimising Air Pollution in Victoria provides a framework to assess and control risks associated with air pollution. It is a technical guideline for air quality practitioners and specialists with a role managing pollution discharges to air.

Under the EP Act, all risks to human health and environment from pollution and waste must be minimised so far as reasonably practicable. The contents of this guideline constitute guidance under the EP Act. This guideline provides duty holders with an approach to minimising risks in a proportionate way.

This guideline provides a tiered approach to the assessment of risks from air pollution, with three levels of assessment in order of increasing complexity.

- Level 1 assessments are qualitative or semiquantitative. They are used to assess risks from activities that either have intrinsically low risks, or have common, well-understood risks that can be controlled without extensive assessment.

- Level 2 assessments are the most common type of risk assessment. They usually involve the use of dispersion modelling or monitoring. Predicted or measured pollutant concentrations are benchmarked against pre-defined air pollution assessment criteria (APACs) to understand risks. *This is the level adopted in this assessment.*

- Level 3 assessments are detailed risk assessments. These are only used when a simple comparison of a pollutant's concentration to an APAC cannot adequately assess risks.

4.4 Deposition Design Criteria (DC)

As per the PEM, monitoring is conducted with dust deposition gauges that should be located both upwind and downwind of the site to reflect the impact of the quarry operations during the most predominant wind directions [see Edge Group's Site Environmental Management Plan (Dust) in regard to dust monitoring]. Results of monitoring should not exceed 4g/m^2/month (no more than 2g/m^2/month above background) as a monthly average. More recent advice from EPA Victoria is that these criteria are less commonly used and they are not criteria to "pollute up to" (see also the final paragraph in this section).

The above two criteria have been adopted in this modelling assessment for TSP. However, PM_{10} and $PM_{2.5}$ must be modelled as though they behave as a gas, which has been the case in this assessment (i.e. modelled as concentrations). Therefore, depositions for these latter size fractions were not included in the deposition modelling as they were not required by the PEM.

According to EPA Publication 1961, dispersion modelling and monitoring (for example dust deposition gauges which are present on the subject Site) can be useful and more affordable for smaller operators. Such information can help:

- characterise temporal or spatial trends.
- identify key problematic sources, or groups of sources on larger more complex sites.
- identify where dust sensitivities may occur.
- test the effectiveness of dust minimisation, control and management measures.

However, caution needs to be applied in using dust dispersion modelling and depositional monitoring results because they present some significant challenges due to uncertainty in emission source estimations, and the difficulties in setting acceptable threshold levels for nuisance dust risks.

Historically and as discussed above, threshold figures of 4 g/m^2/month (no more than 2 g/m^2/month above background), as a monthly average, taken at the boundary of an industrial premises, have been used. These figures can be continued to be used as a *rule of thumb* level for requiring further investigation and addressing dust issues, but not as a level up to which industry is allowed to pollute up to. This monitoring only partially contributes to meeting the GED, because the focus and emphasis needs to be on reviewing operation controls and management practices to prevent and minimise dust nuisance as far as reasonably practicable.

4.5 Buffer Distance

Buffer distances are a means of separating industrial, residential and other sensitive land uses thereby minimising any potential adverse air emissions impacts.

It is important to recognise that buffer distances are only relevant where amenity impacts, rather than health impacts, are involved and where there are compliance obligations to prescribe these. In particular, the buffer distance is usually implemented to protect the immediate area from ongoing emissions and accidental emissions that may occur due to equipment failure, accidents and abnormal weather conditions.

There appears to be no directly related recommended separation distance (for the Site) outlined in the *Recommended Separation Distances for Industrial Residual Air Emissions, Publication 1518, March 2013* for the type of activities at the subject Site. The recommended separation distance for *"Quarrying, crushing and screening, stockpiling and conveying of rock"* is 250 metres (with no blasting). Such "Industry activity/definition" does not match what is occurring on-site.

Based on the location of the proposed extraction zone area, residential buildings will be setback at least 250 metres east and west of this quarrying activity. Given the modelling results (and risk assessment) included in this report and the dust management controls (both inherent to the operations and those to be put in place by Hanson) outlined in the *Site Environmental Management Plan (Dust) prepared by Edge Group for Ricardo (for Hanson) for the proposed* *quarrying operation,* the quarrying operations are not expected to have an air quality amenity impact on the nearest residents (east and west) and the market garden residence to the northwest (approximately 215 metres and 220 metres from the Site boundary and extraction area, respectively).

5 Air Quality Methodology

Gaussian plume dispersion models, such as AERMOD, assumes that the meteorological conditions are uniform spatially over the entire modelling domain for any given hour. While this may be valid for some applications, in complex topographical situations the meteorological conditions may be more accurately simulated using a 3D wind field model and puff modelling approach should be followed.

Over this project area, the topography is not considered to be complex no – i.e. mountains or valleys that trap and stagnate pollutants. We do not expect long range transport and all sources are ground based (no significantly high stacks that are incompatible with the surrounds).

The site is situated amongst generally flat topography, without significant localised meteorological effects from coastal or estuarine conditions, and as such it is considered appropriate that the modelling be undertaken through the use of AERMOD, EPA Victoria's approved regulatory air model.

AERMOD is an approved atmospheric dispersion model for use in Victoria. It is a steady-state plume model that incorporates air dispersions based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain, with the modelling system comprising three components:

- AERMOD (dispersion model) – *used in this assessment;*
- AERMET (meteorological pre-processor) – *the use of two meteorological files, a 'surface' data file and a 'profile' data file, have been used in this assessment as per EPA Victoria requirements;*
- AERMAP (terrain pre-processor) – *not featured as part of this assessment as the subject site and its surrounds included in the modelling were observed to be generally flat.*

As such, ground level concentrations and deposition of parameters in this assessment have been calculated using the current EPA Victoria (recommended) regulatory air pollution model, AERMOD, Version 18081 (version 7) as needed in the current form of this report. The following sections provide summaries of the input data and any assumptions used to predict ground level concentrations and deposition and therefore impacts associated with the processes within the operation.

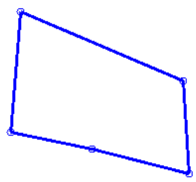
It has been identified that three volume sources; in the form of a dozer, loader and an excavator, in the AERMOD model will exist on the Site. An area source was also modelled, which was the entirety of the proposed quarry extraction area.

For cases involving a high degree of spatial variability of the flow within the boundary layer, such as upslope or downslope flows or flows along a winding river valley, the straight-line, steady-state assumption may not be valid beyond even a few kilometres, and a puff model may be more appropriate. Another consideration in deciding whether a puff or plume model is more appropriate for a particular application is whether the full spatial and temporal distribution of pollutant impacts is important, such as when using the model results for a risk assessment, or whether the results are to be used for a criteria pollutant analysis where only the high end of the concentration distribution is important, regardless of time or space. Again, this is not the case on this assessment.[19] Further, based on pDs Consultancy (involved in the modelling in this assessment), significantly more topographic variation that what is the case across the Site and immediate surrounds would need to be the case before Calpuff was to be used.

5.1 Characteristics of Emission Sources

Volume and area sources were modelled in this assessment as per the following table:

Table 9 – Dimensions of the sources modelled

Source Type	Source Modelled	Height	Vertical Spread	Horizontal Spread
Volume	Excavator and Loader*	1.59	0.79	0.86
	Bulldozer**	1.61	0.81	1.28
Area	Active mine area	0 *(terrain not incorporated in the modelling as flat terrain was conservatively assumed)*	3m *[used for the SigmaZ (vertical dispersion/dilution) in AERMOD modelling and not related to topography]*	
	Windblown dust predicted Wind Speed> 5m/s			

** Average excavator dimensions used on other Hanson sites*
https://www.cat.com/en_AU/products/new/equipment/excavators/large-excavators/227227255575189.html

- *Shipping Height - Top of Cab 3,170 mm*
- *Transport Width 3,440 mm*

*** Average dozer dimensions used on other Hanson sites*
https://s7d2.scene7.com/is/content/Caterpillar/CM20181217-51568-10948

- *Width across end bits 5,100 mm*
- *Machine Height 3.222 m*

In summary, the following sources were modelled:

- three (3) volume sources (excavator, loader and bulldozer) centred at the eastern edge, which would be at its closest to the Boarding Kennels and Cattery owner's residence as compared to the other three sensitive receptors had these volume sources been modelled at the western centre edge; and
- one (1) area source (whole proposed extraction area) for windblown dust.

The following sources were discounted from the modelling due to the following listed controls (in *italic*) being in place by Hanson on-site:

- trucks carrying the excavated sand to the processing plant:
  - *the extracted sand will generally be moist;*
  - *the weather conditions are such that on average, rain falls on slightly more than 50 percent of the days in a month when averaged over a year[20]; and*

[19] http://www.src.com/calpuff/FAQ-answers.htm
[20] Based on Nilma North BOM weather data from Aug 2021 to Aug 2022 inclusive.

- *new diverted haul roads to/from the proposed extraction area shall be sprayed regularly with water to reduce airborne dust, with a water cart on standby (that was seen to be in operation by Edge during the existing Site operations in March 2022)*
- Processing plant:
  - *Material received is largely moist due to the shallow water table;*
  - *Loaders to hopper through various screens to remove the oversize material and then the sand is placed through a wet scrubber (attrition cell);*
  - *Material is wet after the attrition cell; and*
  - *Water spraying of stockpile slightly west of the processing plant to keep it such that no continual visible dust emissions occur.*
- Sales trucks:
  - *As above on any internal roads being sprayed by water where and when needed;*
  - *All loads will be tarped prior to leaving the quarry;*
  - *All trucks will use the wheel washer when exiting the quarry; and*
  - *Use of street sweeper, if required on sealed roads (primarily Westernport Road).*[21]

In general, any particulates greater than 30 microns in diameter, which is typically the case for the subject Site, are sufficiently large to settle in a comparatively short distance(s) from their source (s) and may cause amenity impacts, such as dust deposition on window sills.[22] This could be the case on-site rather than off-site as based on Particle Size Distribution data referred to in the SEMP_Dust, the sand particles quarried from the Site are generally greater than this size.

Based on the subject operation and the sources that were modelled, the 'Building Wake' effect (as part of AERMOD) was not needed to be incorporated in the modelling.

5.2 Terrain

Terrain variation is not considered to be significant across the modelling domain and therefore it was assumed to be flat.

5.3 Computational Grid

The grid was designed with a 50 metre (grid) resolution with a size extending to 5 kilometres by 5 kilometres to capture other sensitive land use in the surrounding area of the Site as per requirements outlined in *EPA Guidance Notes, Publication No. 1551*. This is also consistent with other air dispersion modelling projects that Edge has worked on, which have resulted in submission to (and approval by) EPA.

5.4 Site Boundary Receptors

Table 10 shows the coordinates of the Site boundary receptors included in the dispersion modelling in this assessment. See also ***Figure 4***.

[21] As advised by Site management (20 Sept 2022), there have been no material on external road or any resulting dust emission issues to date.
[22] https://www.hanson.com.au/media/3445/calga-air-quality-management-plant-2017.pdf

Table 10: Site Boundary Receptor Locations

Site Boundary Receptor ID (*Refer to Figure 4*)	Boundary Location	X Coordinate	Y Coordinate
SB1	Boundary (NW corner)	380288	5765938
SB2	Boundary (mid-northern)	380906.2	5765794
SB3	Boundary (NE corner)	381418.6	5765689
SB4	Boundary (mid-eastern)	381382.5	5765333
SB5	Boundary (SE corner)	381334.6	5765015
SB6	Boundary (mid-southern)	380800.4	5765070
SB7	Boundary (SW corner)	380186.9	5765158
SB8	Boundary (mid-western)	380233.3	5765578

5.5 Sensitive/Discrete Receptors

Table 11 shows the coordinates of the discrete receptors included in the dispersion modelling in this assessment and shows their distances from the extraction area. The discrete receptors, SR1 to SR4, are residential dwellings. See also ***Figure 4***.

Table 11: Discrete Receptors

Sensitive Receptors	Discrete Receptor ID	X Coordinate	Y Coordinate	Approximate distance (m) and orientation from extraction area*
Residential	SR1	381439.8	5765521	250 m E
	SR2	380093.4	5765496	160 m W
	SR3	380150.8	5766071	235 m NW
	SR4	380442.9	5764322	300 m S

**Nearest point of extraction area*

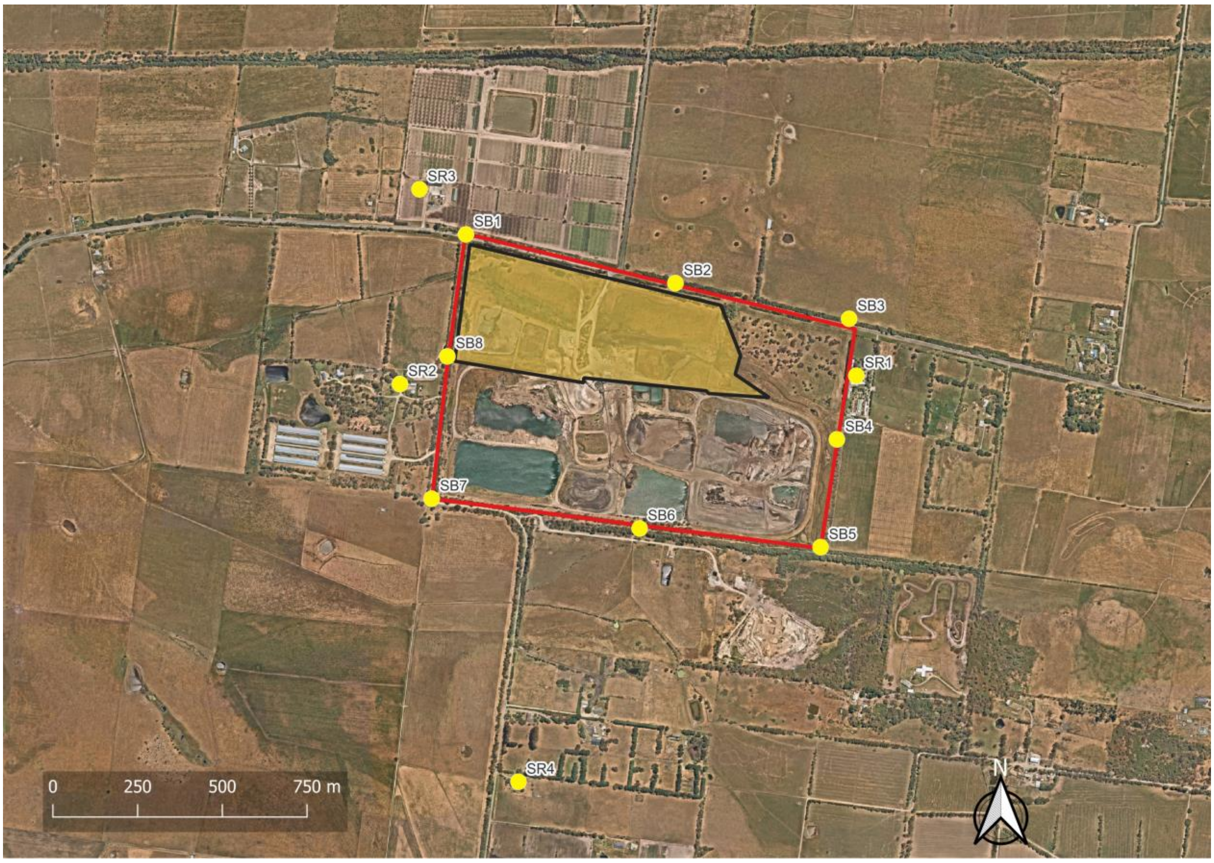


Figure 4: Location of sensitive (including 4 x residential) receptors: SR01-SR04 and boundary receptors: SB1-SB8 and Site boundary (red outline)

5.6 Representative Meteorological Year

A representative meteorological year which governs the dispersion of the pollutants emitted from the sources modelled was determined running AERMOD with the meteorological data for the recent five (5) years (2016 to 2020). The year 2016 was found to be representative (see results in ***Table 12*** and other coordinate modelled data not presented in this report) considering that no significant events that could have significantly affected the background air quality was known in this period [e.g. bushfires in eastern Victoria (2019-20)[23] and COVID (2020)].

5.7 Background Concentrations

Maximum background concentrations of PM_{10} and $PM_{2.5}$ were obtained from EPA Victoria air monitoring stations for the regions of Traralgon and Moe, respectively for the year 2016, to be consistent with a representative meteorological year identified from the modelling. Model scenarios for PM_{10}, and $PM_{2.5}$ were run with Time Varying Background (TVB) as directed by the PEM and in discussion with EPA during this assessment. The air monitoring stations were

[23] In the 2019-20 fire season (November 2019 until February 2020), Victoria endured extreme fire conditions with over 1.5 million hectares burnt, immeasurable impact on unique environments, 420 houses lost, and five fatalities. Communities in East Gippsland were isolated for weeks as thousands of kilometres of roads and critical infrastructure were rendered unserviceable. In addition, the bushfires have had a significant impact on wildlife and biodiversity. *Source:* *https://www.ffm.vic.gov.au/history-and-incidents/past-bushfires*

permitted to be used as a contingency (or an alternative to) real-time background monitoring for PM_{10} and $PM_{2.5}$ given that the Site was still exploring opportunities, respectively, at the time of writing this report (liaising with suppliers, obtaining quotes, understanding the lead-times involved of many months in accessing such equipment, etc).

In summary, this above background considerations were known to EPA Victoria at the time of preparation of this report.

Background concentration data for NO_2 and CO were not required for the purposes of this modelling in accordance with the PEM or any other known EPA compliance obligation (and not advised by the EPA at the time of reporting).

5.8 Background Deposition

In accordance with the PEM, maximum background deposition data was needed to be obtained to ensure that the modelling results for TSP did not exceed the background by more than 2 grams/square metre/month. Given that there was none in the immediate local area, Edge obtained TSP measured (via dust deposition gauges) data from Hanson's similar operations in the township of Lang Lang, approximately five kilometres south from the Site. For the purposes of this assessment, such data was assumed to be the background in the Yannathan area in the locality of the subject Site.

6 Modelling Results

6.1 Concentrations

6.1.1 PM_{10}

PM_{10} emission scenario (base scenario) was run with five years of meteorology (2016-2020) in order to demonstrate five-year compliance. Therefore, results demonstrate five-year compliance for PM_{10} in general (for all years modelled) against the respective adopted criterion (50 µg/m³ for a 24-hour averaging period) even though technically such data needs to be compared against when respective background data is considered (i.e. as shown in ***Table 13,*** which compliance is still achieved at the sensitive receptors modelled).

Table 12: Predicted impacts by year for PM_{10} over five years

Pollutant	PM_{10} µg/m³ (without background)											
Year/ Receptor	SR1	SR2	SR3	SR4^	SB1	SB2	SB3	SB4	SB5	SB6	SB7	SB8
2016	1.2	0.3	0.4	<0.3	0.5	4.1	1.8	1.8	0.7	0.6	0.3	0.6
2017	1.3	0.4	0.3	<0.3	0.6	4.2	1.5	1.3	0.5	0.5	0.3	1.1
2018	2.0	0.9	0.4	<0.4	0.9	3.7	1.4	1.4	0.9	0.5	0.3	2.1
2019	1.4	0.4	0.5	<0.4	0.7	3.6	2.0	1.6	0.9	0.6	0.3	0.8
2020	1.6	0.5	0.4	<0.4	0.7	4.9	2.1	1.6	0.8	0.6	0.4	1.1

**24 hour averaging time*
^ Receptor inserted post modelling

Given the base scenario in this section, Scenario 1 was modelled using PM_{10} emissions being run with a Time Varying Background (TVB) as directed by the PEM. ***Table 13*** shows the predicted values at Sensitive Receptors modelled.

Table 13: PM_{10} prediction at sensitive receptors

Pollutant	PM10 µg/m³ (with TVB)		APAC µg/m³	Compliance
Averaging Time/ Receptor ID	1 day	1 year	1 day/1 year	
SR1	49.4	14.3	50/20	Yes
SR2	49.2	14.1		
SR3	49.2	14.1		
SR4	49.2^	14.1^		
SB1	49.2	14.1		
SB2	49.7	14.6		
SB3	49.4	14.3		
SB4	49.5	14.3		
SB5	49.3	14.2		
SB6	49.3	14.2		
SB7	49.2	14.1		
SB8	49.2	14.1		

^ Conservative values as receptor added post modelling

Due to compliance being achieved for the PM_{10} adopted APAC for this investigation, no time series plot was prepared for the most affected sensitive receptor showing the background data for PM_{10} modelled and the contribution from the extractive operation alone and the combined predicted concentrations over an entire year.

The contour plot for PM_{10} is provided below in ***Figure 5*** showing the geographic extent of maximum concentrations arising from the extractive industry plus background. No excursions above the criterion were identified at the boundary and sensitive receptors modelled.

Within the Site, the percentage statistics for non-compliances noted for a minority of coordinates across both averaging periods for PM_{10} are as follow and can be seen in the contouring as per ***Figure 5*** below:

- 1 year averaging: 0.02% (2 coordinates out of total 10,213 coordinates modelled); and
- 1 day averaging: 0.46 % (47 coordinates out of total 10,213 coordinates modelled)

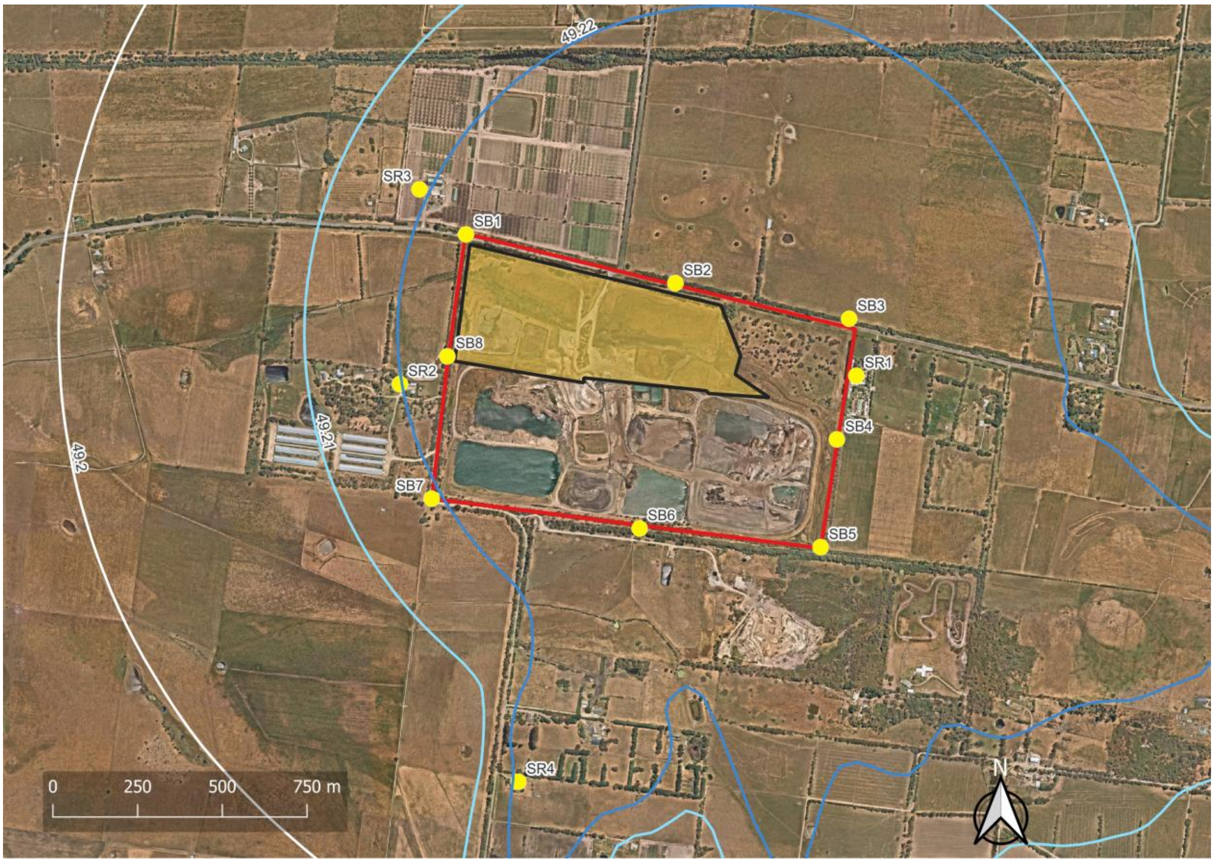


Figure 5: Contour plot of PM_{10} (24 hr average) with background showing compliance with the boundary and residential receptors

6.1.2 $PM_{2.5}$

Given the base scenario in this section, Scenario 2 was modelled using $PM_{2.5}$ emissions being run with a Time Varying Background (TVB) as directed by the PEM. ***Table 14*** shows the predicted values at the sensitive receptors modelled.

Table 14: $PM_{2.5}$ prediction at sensitive receptors

Pollutant	PM2.5 µg/m³ (with TVB)		APAC µg/m³	Compliance
Averaging Time/ Receptor ID	1 day	1 year	1 day/1 year	
SR1	31.2	7	25/8	No (1 day) Yes (1 year)
SR2	31.2	7		
SR3	31.2	7		
SR4	31.2^	7^		
SB1	31.2	7		
SB2	31.3	7		
SB3	31.2	7		
SB4	31.2	7		
SB5	31.2	7		
SB6	31.3	7		
SB7	31.3	7		
SB8	31.3	7		

^ Conservative values as receptor added post modelling

Time series plots in ***Figures 6 and 7*** for $PM_{2.5}$ for the discrete receptor SR2 was prepared to demonstrate that the highest predicted value is due to the background of $PM_{2.5}$ in the representative 2016 year modelled. This plot shows the combined background data for $PM_{2.5}$ modelled and the contribution from the extractive operation predicted concentrations over an entire year. This is designed to indicate the frequency of predicted concentrations and any exceedances of the assessment criteria (which occurred in February and April of 2016). Based on the data, this demonstrates that $PM_{2.5}$ excursions should not occur for a majority of a given year.

Within the Site, the percentage statistics for non-compliances noted for a minority of coordinates across both averaging periods for $PM_{2.5}$ are as follow and can be seen in the contouring as per ***Figure 8*** below:

- 1 year averaging: 0.02% (2 coordinates out of total 10,213 coordinates modelled); and
- 1 day averaging: 100 % (10,213 coordinates out of total 10,213 coordinates modelled).

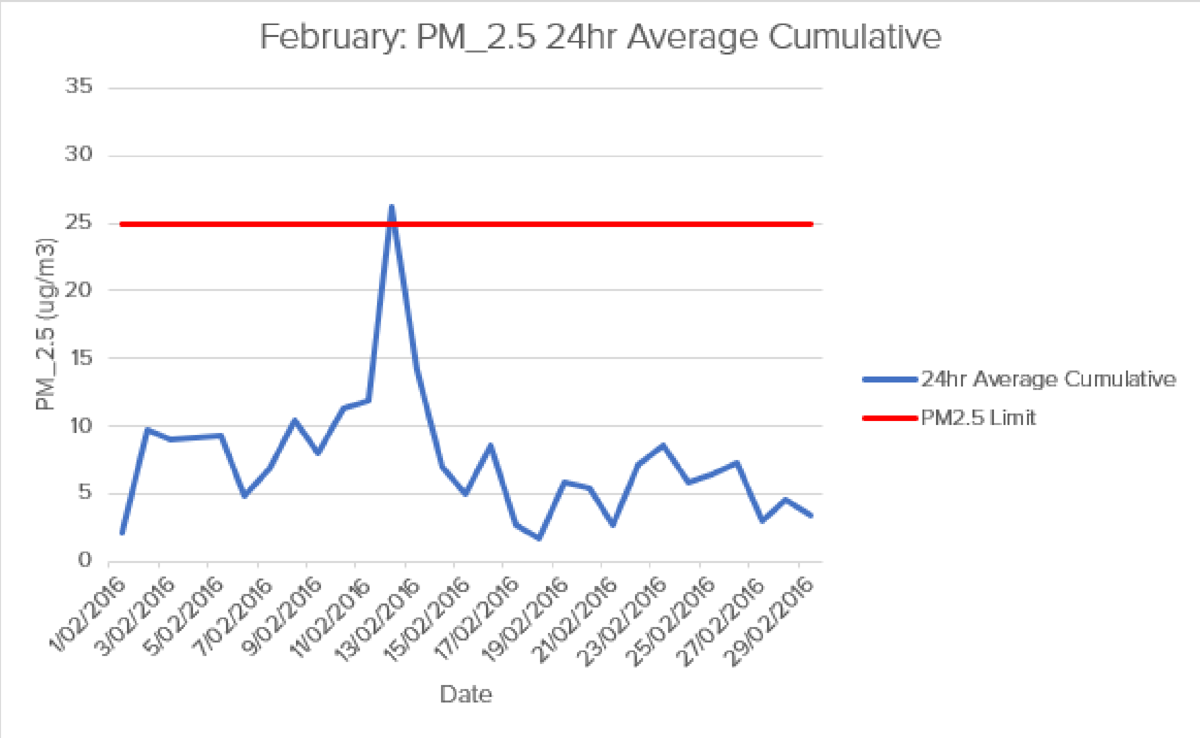


Figure 6: Time series plot for $PM_{2.5}$ (based on February 2016)

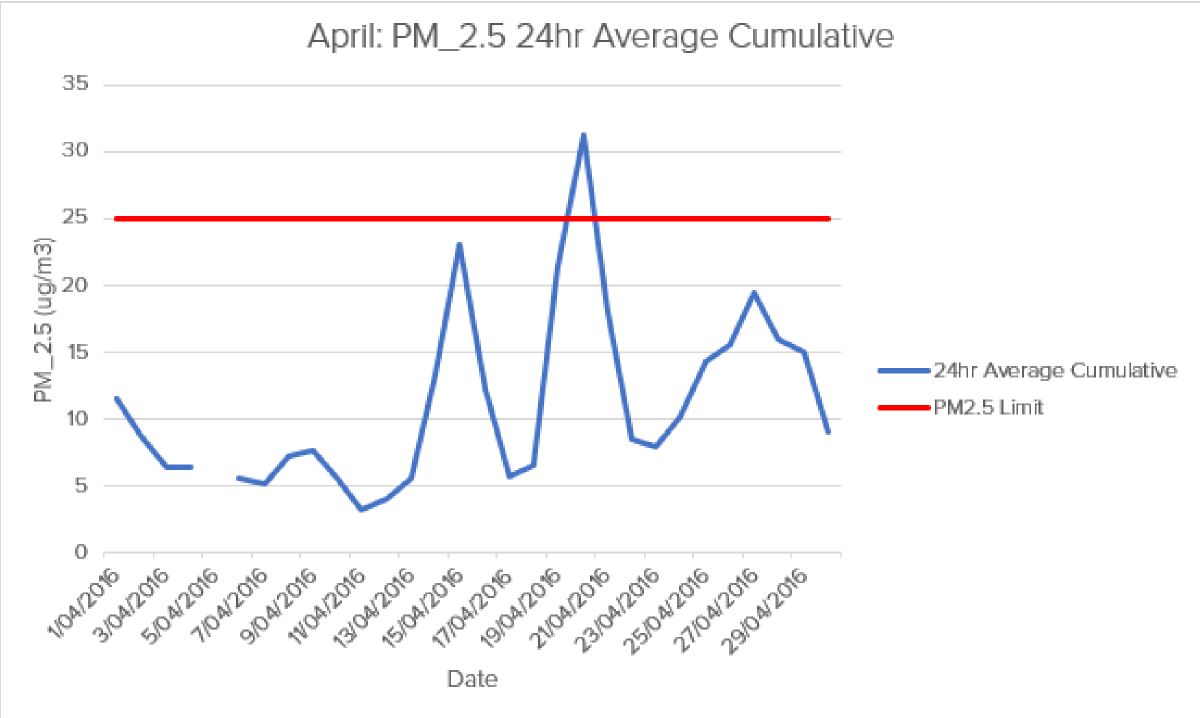


Figure 7: Time series plot for PM2.5 (based on April 2016)[24]

The contour plot in ***Figure 8*** shows that the predicted levels of $PM_{2.5}$ at the nearest residential receptors modelled arising from the extractive industry plus background concentrations obtained exceeded the APAC adopted in this investigation. In summary, the

[24] Gap in data on the plot is where no data was recorded.

background concentrations played a significant part in the predicted $PM_{2.5}$ cumulative concentrations.

Figure 8: Contour plot of $PM_{2.5}$ (24 hr average) with background; unable to show contouring that demonstrates the APAC being exceeded at the nearest residential receptors

6.1.3 NO_2

Scenario 3 comprised the NO_2 emission run without background as per the PEM. ***Table 15*** shows the predicted values at the sensitive receptors modelled.

Table 15: NO_2 prediction at sensitive receptors

Pollutant	NO_2 µg/m³		APAC µg/m³	Compliance
Averaging Time/ Receptor ID	1 hour	1 year	1 hour/1 year	
SR1	21.1	0.7	151/28	Yes
SR2	7.3	0.1		
SR3	4.3	0.1		
SR4	< 4.3^	< 0.1^		
SB1	4.8	0.1		
SB2	43.9	1.8		
SB3	17.5	0.8		
SB4	15.0	0.7		

Pollutant	NO_2 µg/m³		APAC µg/m³	Compliance
Averaging Time/ Receptor ID	1 hour	1 year	1 hour/1 year	
SB5	6.7	0.3		
SB6	9.4	0.2		
SB7	5.4	0.1		
SB8	9.2	0.2		

^ Conservative values as receptor added post modelling

The contour plot in ***Figure 9*** shows that there are no unacceptable levels of NO_2 at the nearest residential receptors. As per the PEM, modelling of this combustion gas did not require this assessment to consider respective background concentrations.

Within the Site, the percentage statistics for non-compliances noted for a minority of coordinates across both averaging periods for NO_2 are as follow and can be seen in the contouring as per ***Figure 9*** below:

- 1 year averaging: 0.06% (6 coordinates out of total 10,213 coordinates modelled); and
- 1 hour averaging: 0.13 % (13 coordinates out of total 10,213 coordinates modelled).

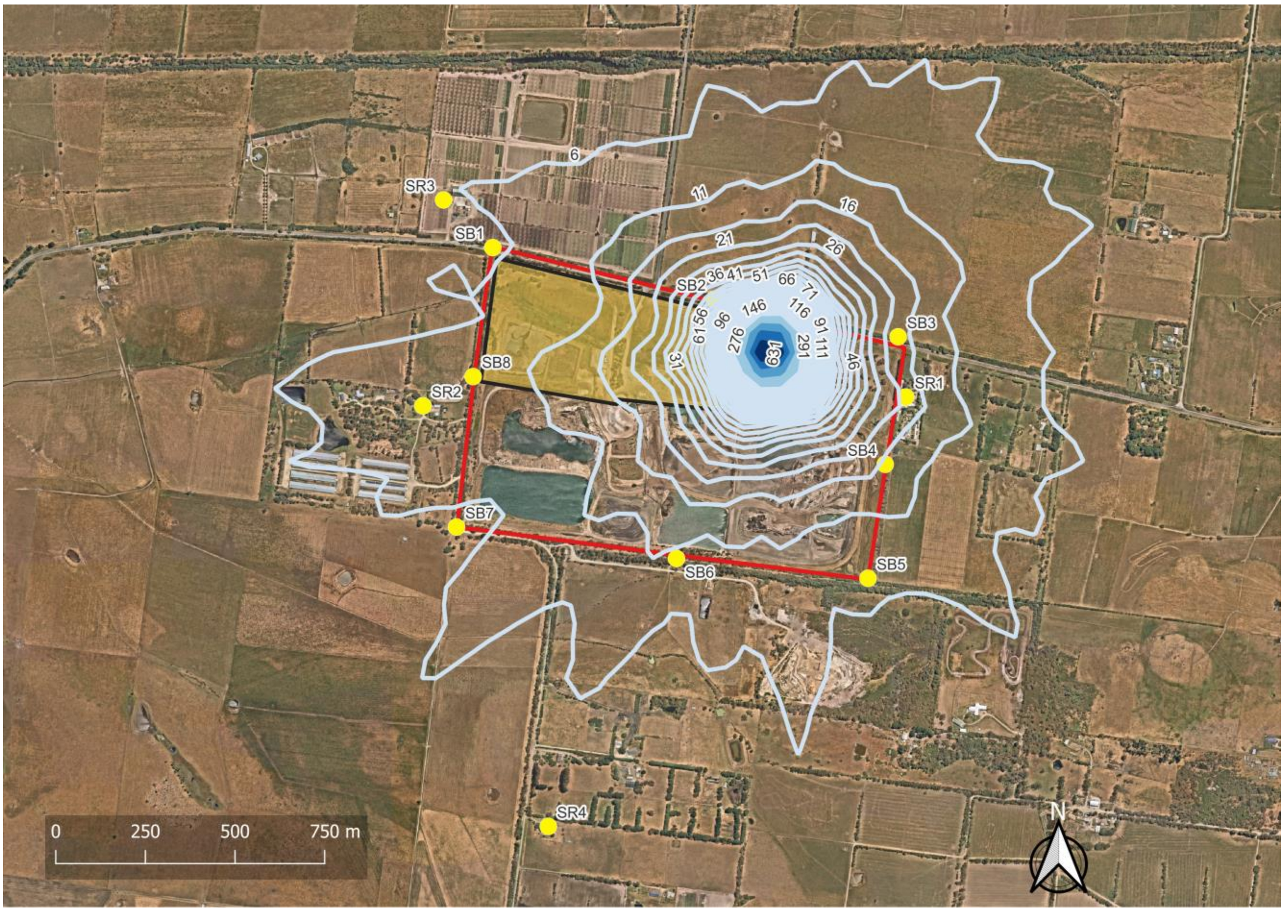


Figure 9: Contour plot of NO_2 (1 hr average) showing compliance with the residential receptors

Compliance with the adopted NO_2 criteria for the two average time durations are likely to still be achieved at the broiler farm residence (SR2) and the market garden residence (SR3) had the mobile plant sources been modelled to the centre western edge of the extraction area.

6.1.4 CO

Scenario 4 comprised the CO emission run without background as per the PEM. ***Table 16*** shows the predicted values at the sensitive receptors modelled.

Table 16: CO prediction at sensitive receptors

Pollutant	CO µg/m³	APAC µg/m³	Compliance
Averaging Time/ Receptor ID	8 hours	8 hours	
SR1	3.0	10,310	Yes
SR2	0.6		
SR3	0.9		
SR4	<0.6^		
SB1	0.6		
SB2	7.3		
SB3	2.6		
SB4	3.2		
SB5	1.2		
SB6	1.2		
SB7	0.7		
SB8	0.8		

^ Conservative value as receptor added post modelling

The contour plot in ***Figure 10*** shows that there are no unacceptable levels of CO at the nearest residential receptors and at any other coordinates modelled in the grid. This resulted in not having to show the criterion contour of 10,310 µg/m³. As per the PEM, modelling of this combustion gas did not require this assessment to consider respective background concentrations.

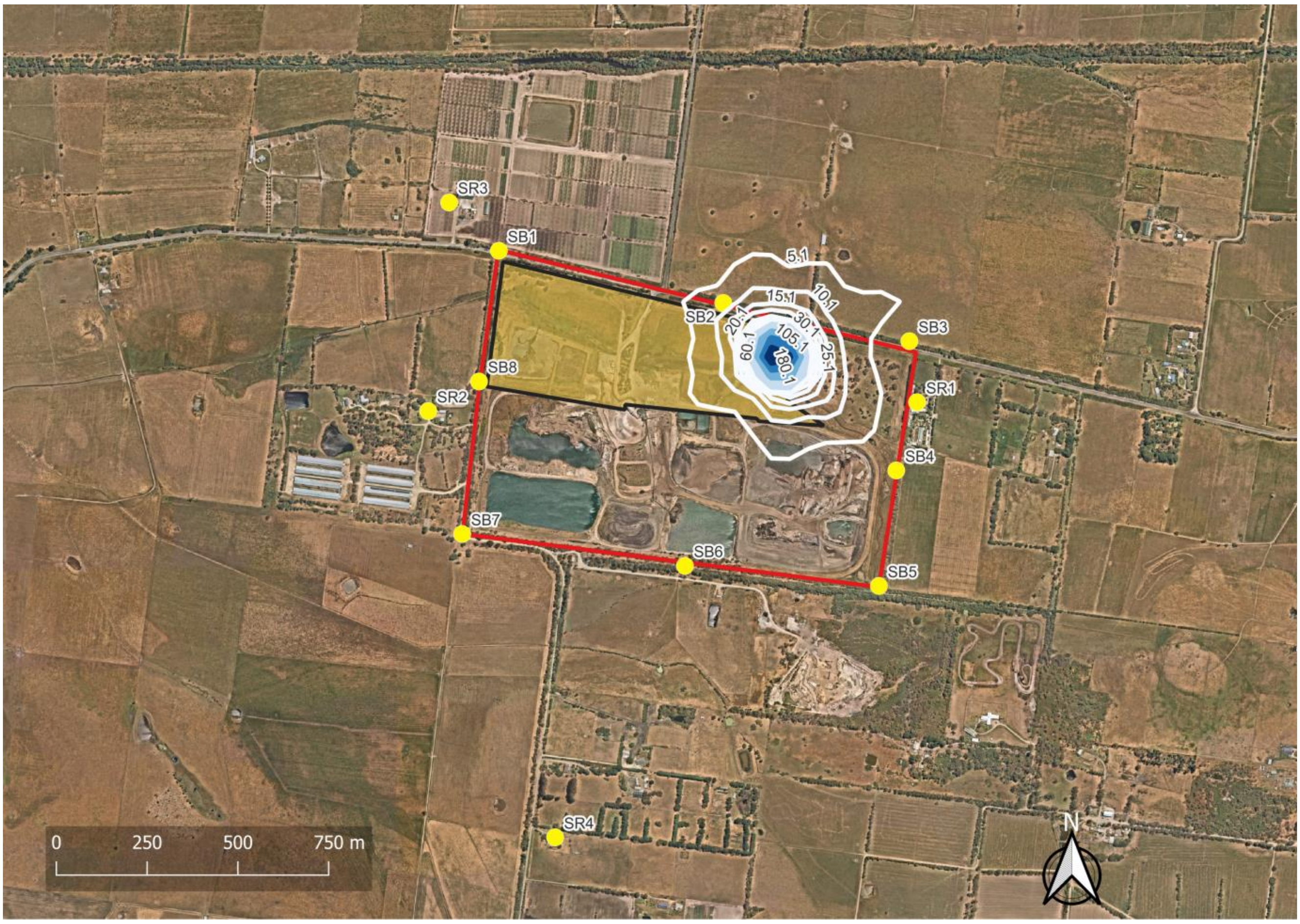


Figure 10: Contour plot of CO (1 hr average) showing compliance with all coordinates modelled in the grid

6.2 Deposition

Scenario 5 comprised the TSP emission run without background as per the PEM. ***Table 17*** shows the predicted values at the sensitive receptors modelled.

Table 17: TSP prediction at sensitive receptors

Pollutant	TSP µg/m²/month	APAC µg/m²/month	Compliance
Averaging Time/ Receptor ID	1 hour	1 hour	
SR1	21.4	2,000 (above background) or 4,000 (no background)	Yes
SR2	2.9		
SR3	3.2		
SR4	<2.1^		
SB1	7.1		
SB2	46		
SB3	21.3		
SB4	30.6		
SB5	15.4		
SB6	6.3		
SB7	2.1		
SB8	8.4		

^ Conservative value as receptor added post modelling

The contour plot in ***Figure 11*** shows that there are no unacceptable levels of nuisance dust /or TSP at the nearest residential receptors.

However, assuming there are background levels of TSP as detailed in the SEMP_Dust prepared by Edge (for Ricardo for Hanson), the APAC becomes 2,000 µg/m^2/month (rather than the 4,000 µg/m^2/month with no background in the area). It was predicted that two (2) out of 10,213 values (0.02 percent of the coordinates), identified to be within the Site, exceeded 2,000 µg/m^2/month.

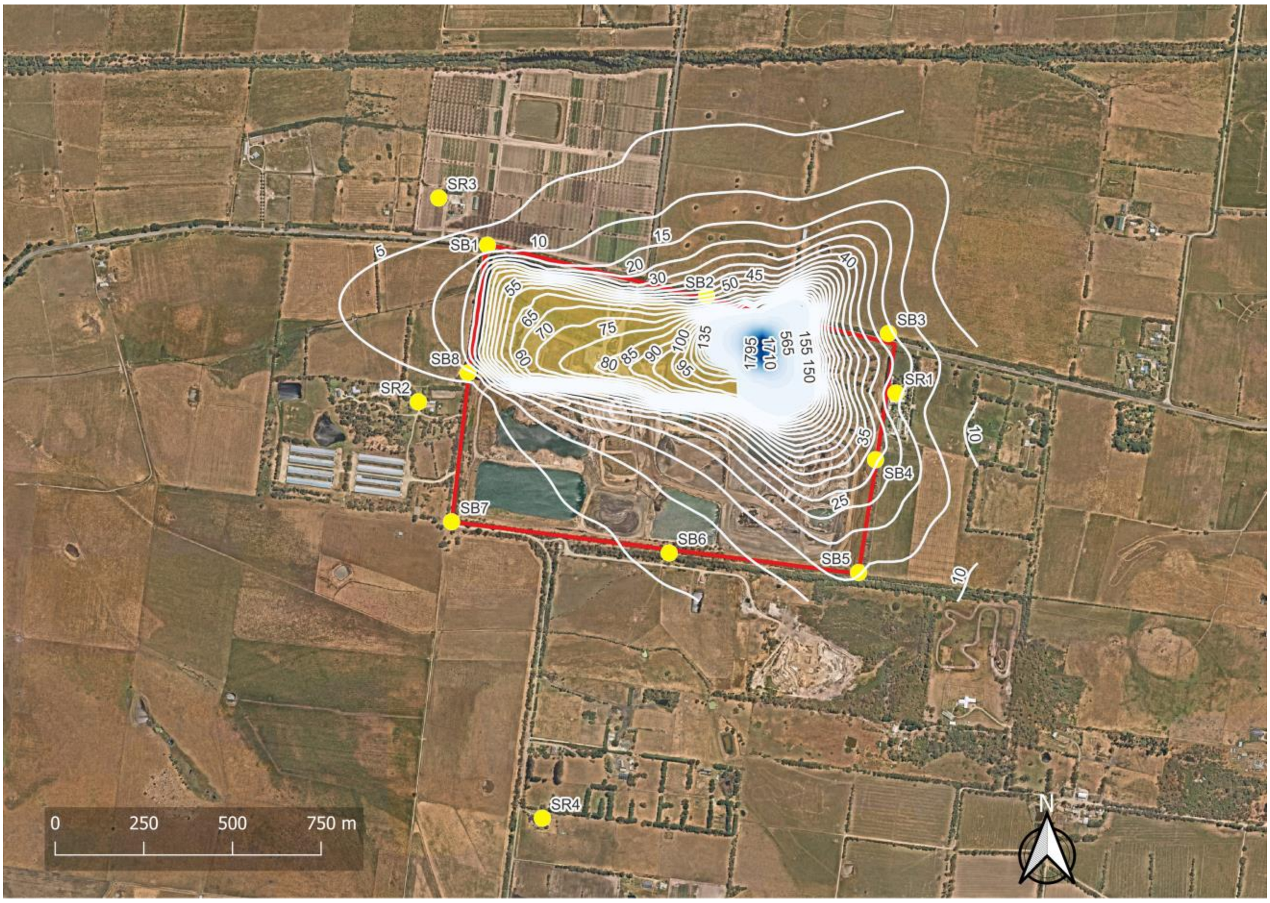


Figure 11: Deposition contour plot of TSP (µg/m^2/month) showing compliance with the 2,000 µg/m^2/month criterion at every coordinate except for two coordinates (inside the Site) modelled in the grid

7 Risk Assessment

7.1 $PM_{2.5}$

This section has been added to this report to deal with any excursions above the adopted APAC especially to the nearest sensitive (residences) receptors. In this assessment, we have determined this to be $PM_{2.5}$.

As per the *Guidance for assessing nuisance dust, EPA Victoria, June 2022, Publication 1943,* the risk assessment consists of four steps (***Figure 12***):

- Step 1: Determine the hazard potential of the **source**.
- Step 2: Determine the effectiveness of the exposure **pathway** between the source and receiving environment.
- Step 3: Determine the sensitivity of the **receiving environment** at the receptor.
- Step 4: Determine the overall risk of nuisance dust impact occurring based on the risk of the exposure and the sensitivity of the receiving environment.

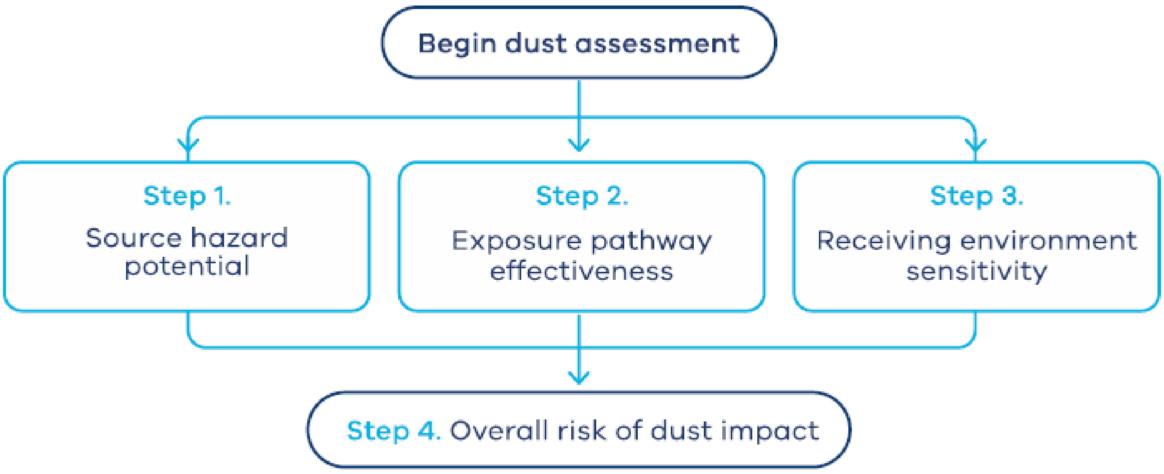


Figure 12: Nuisance dust – risk assessment process (Source: EPA Publication 1943)

The overall risk of dust impacts likely to occur is then determined by adding up the scores for each category of Steps 1 to 3 above and then assessed as per ***Table 18*** (which is ***Table 4*** from EPA Publication 1943) To reduce risk as you move up the scale, the level of control and intervention required increases.

Subsequently, the addition of scores in Steps 1 to 3 added to **twenty (20)**,[25] which identified as **Moderate Risk**. Please refer to the definition in this section below.

[25] Each of the ten hazard categories from Steps 1, 2 and 3 received a score of **two (2).**

Table 18: Overall risk of dust impact (Source: EPA Publication 1943)

Score	Descriptor	Comment
32-36	very high	Dust impacts almost certain
27-31	high	Dust impacts highly likely to occur
22-26	medium	Dust impacts likely
17-21	moderate	Dust impacts only likely to occur on rare occasions
12-16	Low	Dust impacts are not likely

Very high risk	indicates that nuisance dust will occur. Any interventions to reduce risk in either the source, pathway or receiving environment are unlikely to be practical so effective mitigation is doubtful.
High risk	indicates that you can expect significant nuisance dust to occur, and impacts are highly likely. There may be some interventions that can be applied to reduce the risk, but it is likely that significant re-engineering or redesign will be required.
Medium risk	indicates that you can expect some nuisance dust to occur and without careful and considered application of mitigation measures it is likely to cause impacts. The focus should be what can be done to break the source-pathway-receiving environment chain.
Moderate risk	although there may be some residual risk of nuisance dust, but it is possible it can be practically and effectively managed.
Low risk	indicates the risk of nuisance dust is likely to be minimal

The overall risk rating seems to be consistent (or reinforce) the fact that there have been no known external dust-related complaints for the existing quarrying, which is believed to not take place at the time of works in the newly extended Site area. That is, it is planned that any (residual) existing sand would have been quarried by the time the 'new' Site works would have commenced.

8 Discussion & Conclusions

8.1 Concentrations (NOx, CO, PM_{10}, $PM_{2.5}$)

The pollutants above were modelled under generally representative to worst-case/conservative conditions. The modelling identified that the adopted EPA criteria were not exceeded at the nominated residential locations for CO, NO_2 and PM_{10} compared against the criteria employed in this investigation.

Compliance at these sensitive receptor locations was also achieved even when respective background concentrations were included (i.e. for PM_{10}).

There were only excursions at the four sensitive receptors modelled in this investigation for one parameter only being $PM_{2.5}$ (including background air quality as needed to be considered) for only one of the two averaging periods modelled. Accordingly, a dust risk assessment was employed in this investigation using EPA methodology. Given this risk assessment and that no known external dust-related complaints have been known to have been received as a result of the Site's operations, it is unlikely that there will be any potential human health (or amenity) impact surrounding the site during the proposed operations, which would be operating in normal steady-state conditions almost all of the time.

Although not significant, some points worth noting based on the modelling results where adopted respective criteria were exceeded for on-site nominated coordinates for the following parameters are:

- PM_{10}
  - 1 year averaging: 0.02% (2 coordinates out of total 10,213 coordinates modelled); and
  - 1 day averaging: 0.46 % (47 coordinates out of total 10,213 coordinates modelled)
- NO_2
  - 1 year averaging: 0.06% (6 coordinates out of total 10,213 coordinates modelled); and
  - 1 hour averaging: 0.13 % (13 coordinates out of total 10,213 coordinates modelled).
- $PM_{2.5}$ – similar scenario to PM_{10} (above) but we have not focussed on $PM_{2.5}$ here as predicted concentrations exceeded 1 day averaging criteria at the residential receptors modelled.

The above concentrations would typically only be an issue if the worker (or visitor) on-site would be at the particular nominated coordinate modelled for the averaging period related to the pollutant modelled (e.g. 1 hour for NO_2 or 1 day for PM_{10}). Further, the meteorological conditions would also have to match to those that were modelled. Given this, it is unlikely that human health (or amenity) issues would result in the minor excursions above)

8.2 Deposition (TSP)

Total Suspended Particles were modelled under generally representative to worst-case/conservative conditions. The modelling identified that the adopted EPA (PEM) criterion in this assessment was not exceeded at the residential locations surrounding the Site. No equivalent criterion could be found in the new EPA legislation that came into effect from 1 July 2021. Despite this, the deposition results were at least two orders of magnitude below the adopted criterion outside the Site in this assessment. However, it was predicted that two (2) out of 10,213 values (0.02 percent of the coordinates), identified to be within the Site, exceeded 2,000 µg/m^2/month. Similar to the explanation for the gaseous concentrations in ***Section 8.1*** above, a person would have to be in the locations of these coordinates at the corresponding wind direction and averaging time for compliance not to be achieved

The dispersion modelling (both concentrations and deposition) undertaken in this report was based on a representative to worst-case operating scenario. There were no excursions at the four sensitive receptors modelled in this investigation apart from $PM_{2.5}$ for one averaging period only (i.e. 1 day not 1 year), which we subsequently risk-assessed (identifying a 'moderate' risk level[26]) and we understand that there have been no legitimate Site-related complaints from external sources. Given this, we suggest it is unlikely that there will be any ongoing potential human health (or amenity) impact surrounding the Site during the proposed operations, which would be operating in normal steady-state conditions almost all of the time.

8.3 Recommendation

No specific recommendations are warranted in this report assuming that site operations will be undertaken as considered in this report apart from Hanson following the control measures, as part of the Site's GED as outlined in the SEMP_Dust (prepared by Edge for this project).

[26] Dust impacts only likely to occur on rare occasions.

9 References

1. Air Quality Assessment – Lots 1 And 2 Dp732708 Old Telegraph Road, Maroota Proposed Sand Quarry, Job ID. 08915, Pacific Air Environment for PF Formation (04 September 2014).
2. Environment Reference Standard, Victoria Government Gazette, No. S 158 Tuesday 29 March 2022
3. Guidance Notes for Using the Regulatory Air Pollution Model AERMOD in Victoria, EPA Publication 1551, October 2013
4. Protocol For Environmental Management (PEM): Mining And Extractive Industries, EPA Victoria, 2007 – used as *State of Knowledge only*
5. US EPA (1995), Compilation of Air Pollutant Emission Factors, AP-42, Fourth Edition United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711
6. Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists), EPA Victoria, Publication 1961, February 2022 (EPA Publication 1961)
7. Guidance for assessing nuisance dust, EPA Victoria, June 2022, Publication 1943
8. Site Environmental Management Plan (SEMP)_Dust; Edge Group for Ricardo (for Hanson), 20220075-R-01-SEMP_Dust, 2022

Appendix A

AERMOD Meteorological Data Files Report

AERMOD ready Meteorological data files

Yannathan– VIC

This file was exclusively compiled for **EDGE Group** By pDs Consultancy.

pDs Consultancy
@1999–2022

INTRODUCTION

New generation regulatory model AERMOD requires hourly averaged meteorological data from a single site that is preferably within the model domain (‘on-site’ or site-specific data). However, data from the nearest ‘off-site’ meteorological station can be used when on-site data are not available, and the off-site data are representative of the area of concern (i.e. the meteorological parameters as well as surface characteristics characterise the transport and dispersion conditions of the location in question).

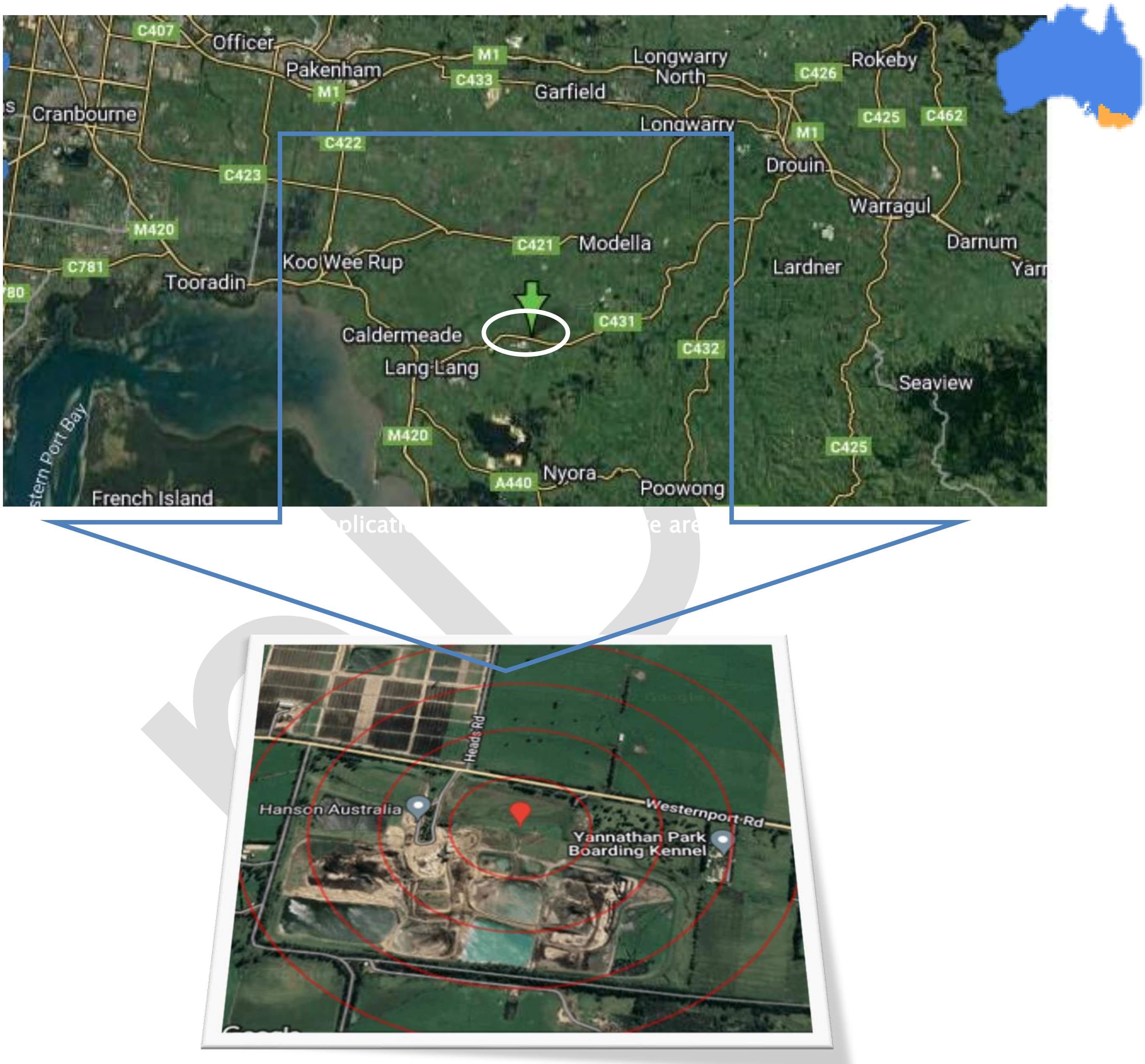
It is also preferable that:

- The compilation of the input meteorological data file is done in accordance with ‘best practice’, with procedures and algorithms recommended or set by environment regulators/US & VIC EPA.

pDs Consultancy has been engaged by **EDGE Group** to compile an ‘AERMOD-ready’ meteorological files for an application site at Westernport Road, Yannathan, Victoria. There are no weather stations in the radius of 10 KM. Therefore data was simulated for the location in question running TAPM (Air pollution Model by CSIRO) as per guidelines by EPA, Victoria.

This input meteorological data files have been compiled basically following the EPA, Victoria’s draft guidelines: “Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD) (Publication No.1550)”. The calculations for Stable Boundary layer was done following the latest formulations published by US, EPA.

LOCATION OF THE APPLICATION SITE–WESTERNPORT ROAD, YANNATHAN



Data Processing

Input Information

Data Used for the compilation

Meteorological Data

1. Mandatory Data (TAPM)
   i. 10m Wind Direction and Speed
   ii. Ambient Temperature (Screen Level)

2. Supplementary data (TAPM)

   I. Surface Pressure set to 1013 hPa
   II. Net Radiation simulated by TAPM
   III. Relative Humidity
   IV. Rainfall Rate

3. Upper air Data (TAPM)
   I. TAPM simulated convective mixing heights were used.

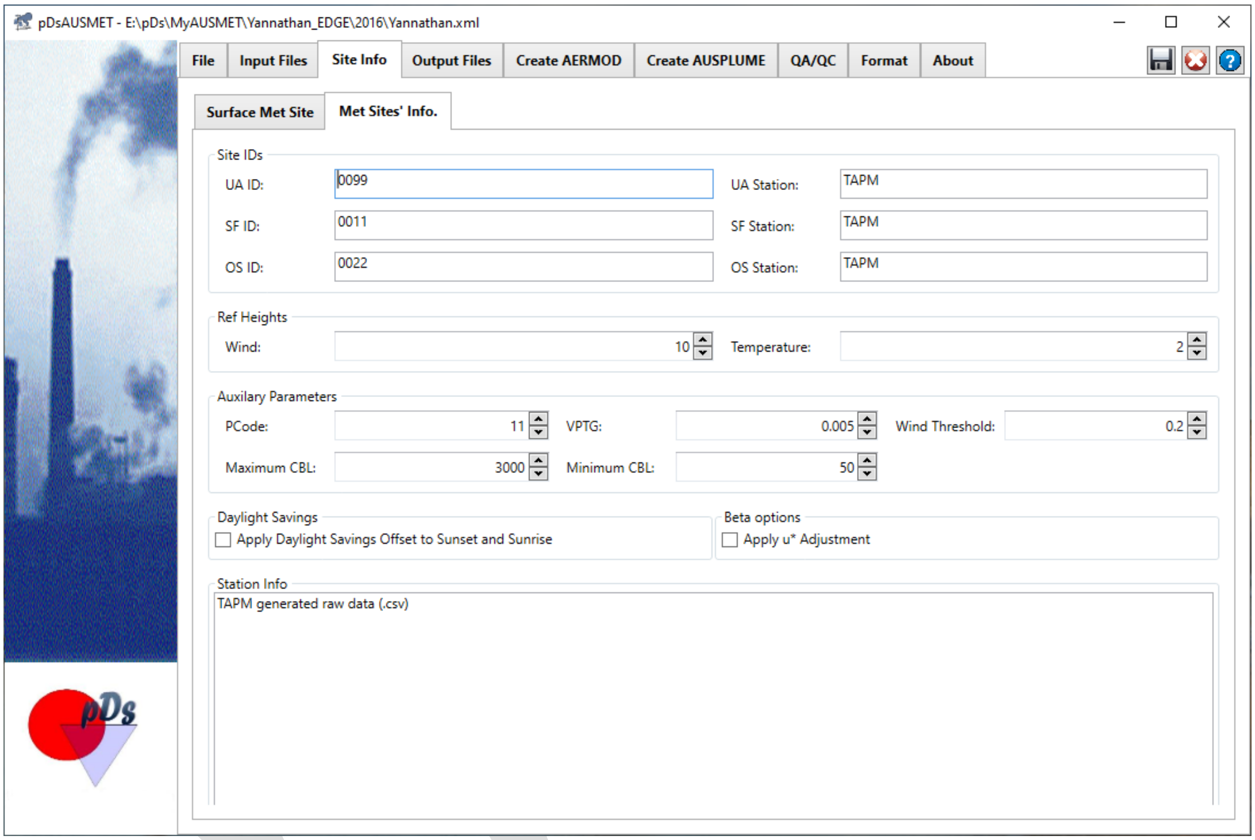
DATA SOURCE

- Data Source: **CSIRO**
- Period :1 Jan 2016 to 31 Dec 2020

QA/QC ON RAW DATA

I. Parameters QA/QCed based on extreme values

METSITE INFORMATION



DATA COVERAGE:

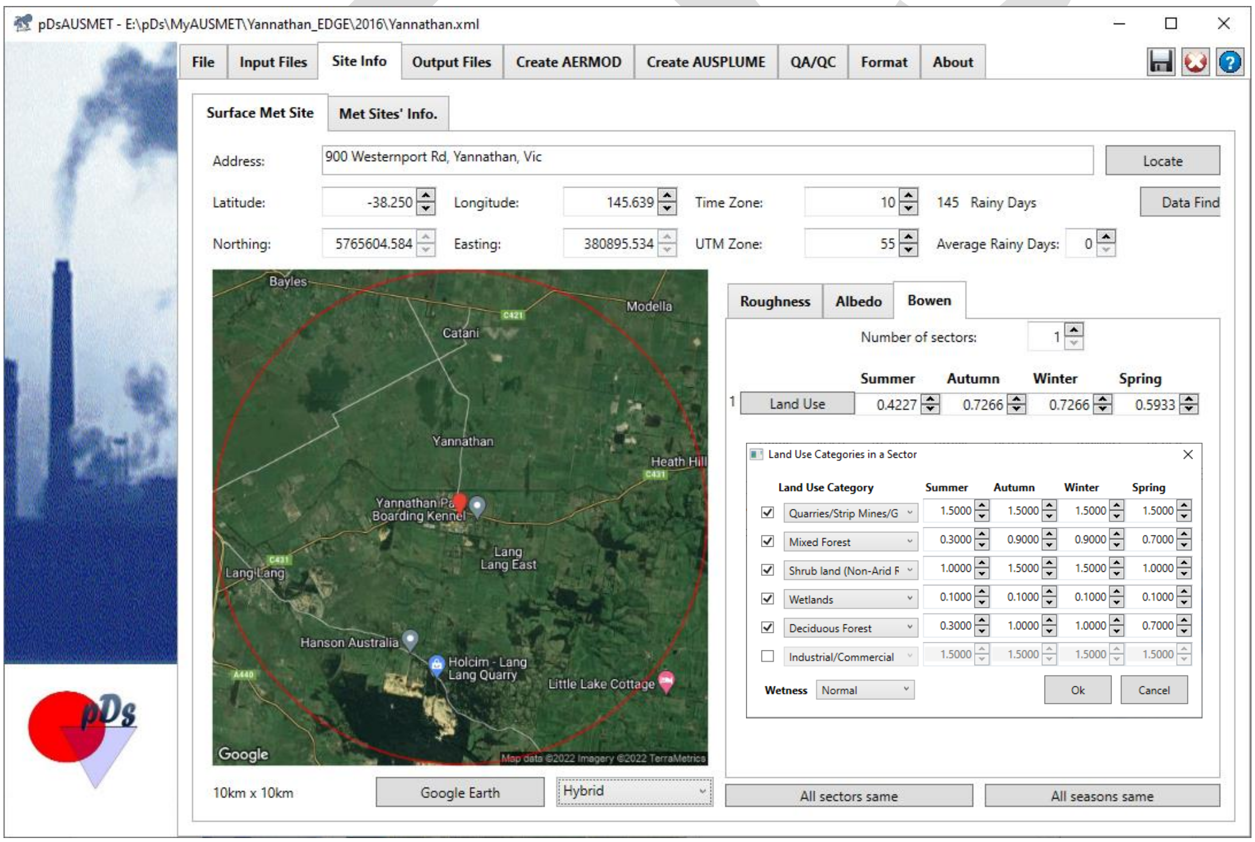
Season	Data Coverage %				
Year	2016	2017	2018	2019	2020
Summer	100	100	100	100	100
Autumn	100	100	100	100	100
Winter	100	100	100	100	100
Spring	100	100	100	100	100
Annual	100	100	100	100	100

Annual and Seasonal data coverage are meeting regulatory requirement (90% or better).

DETERMINATION OF SURFACE CHARACTERISTICS

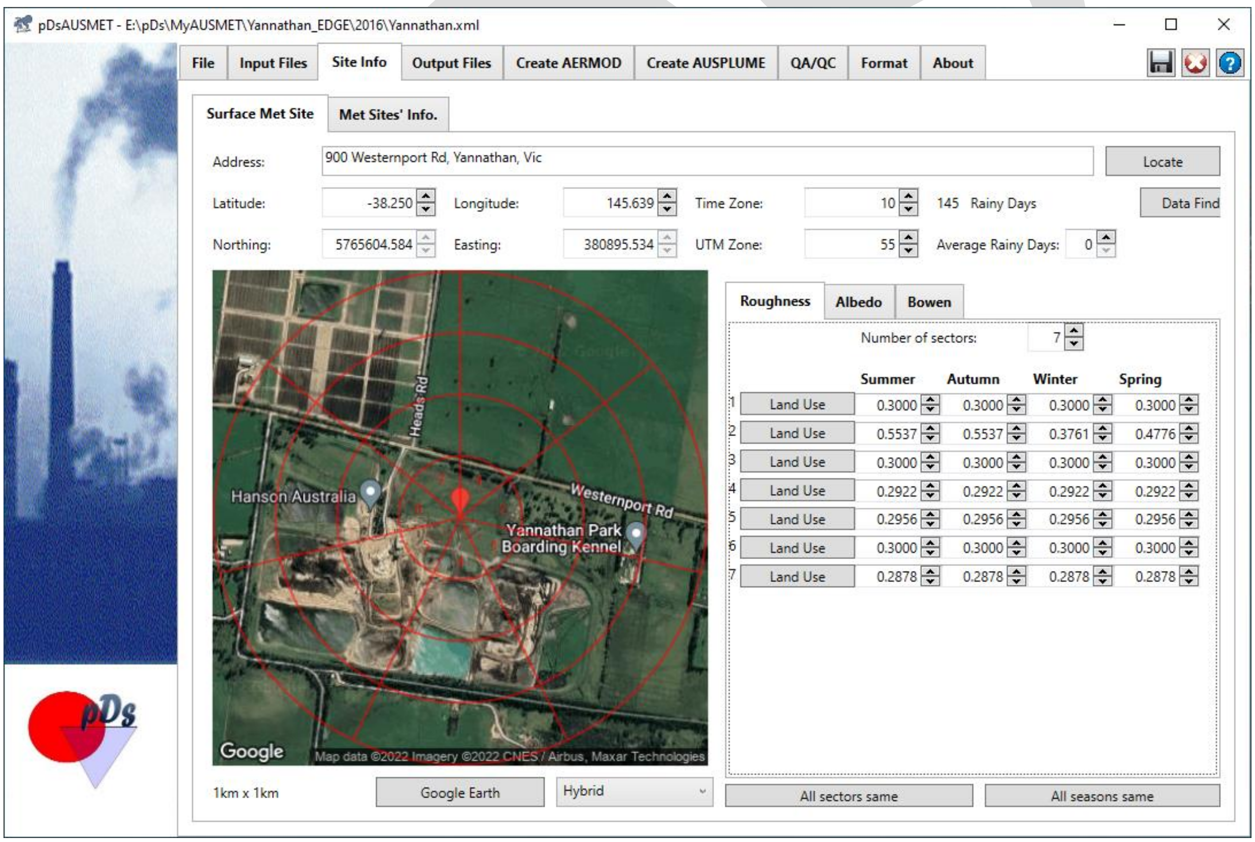
All available surface maps including google maps examined to determine correct land use categories within 10 Km by 10 KM area centring the application site.

Albedo and **Bowen ratio** were determined using land use categories shown



SURFACE ROUGHNESS

Sector dependent surface roughness was determined considering 7 sectors. The Roughness of each sector was assigned carefully examining land use distribution in 4 segments (250 m) of each sector.



The following parameters were determined/computed following EPA, VIC and US EPA guidelines.

Sensible Heat flux -Calculated based on cloud observations

I. Friction Velocity (U*)
II. Monin-Obukhov Length (L)
III. Height of the Stable Boundary Layer (SBL)
IV. Vertical Velocity Scale (W*)
V. Height of the Convective Boundary Layer (CBL)

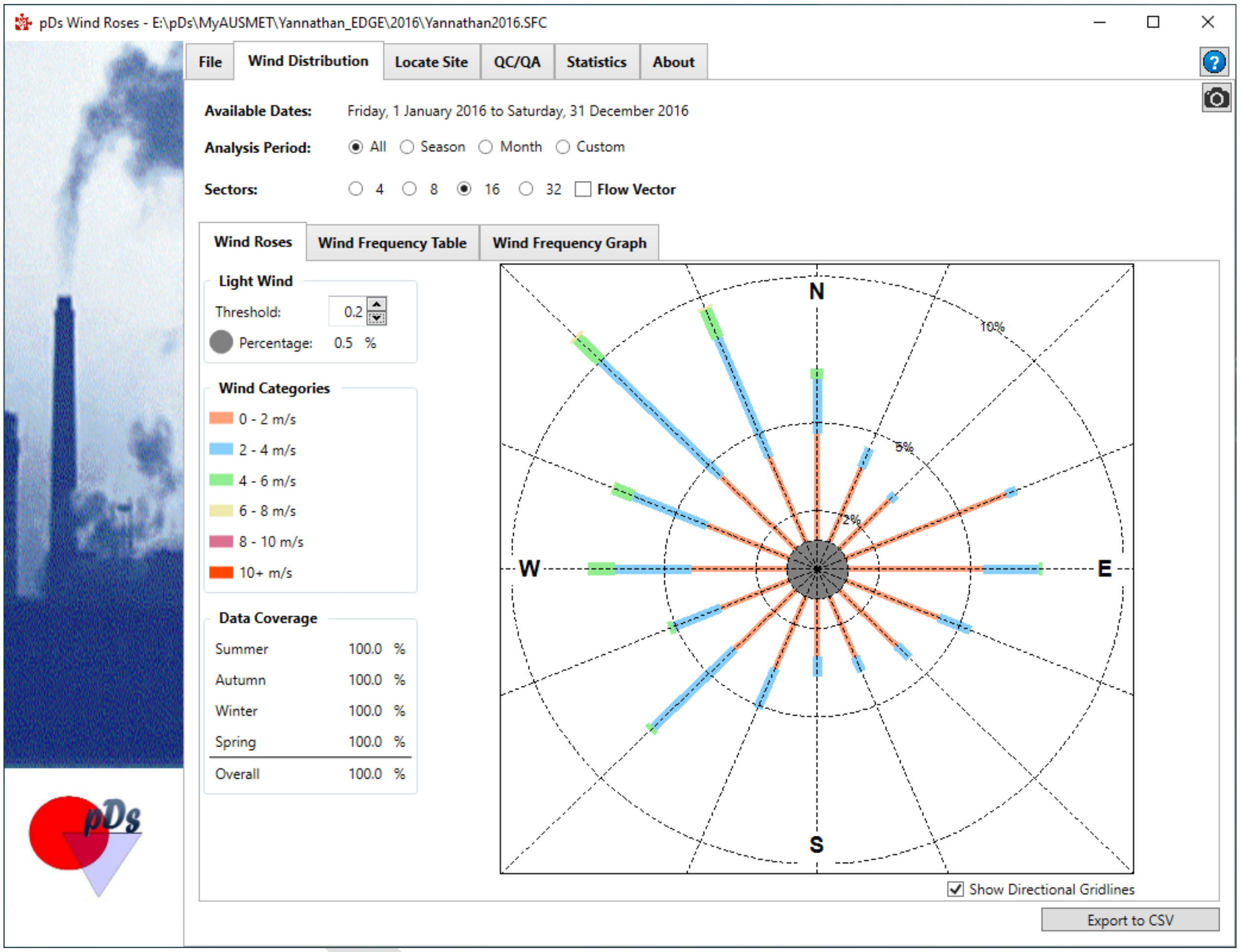
Mixing height (Convective)-CBL

DEFINITION:

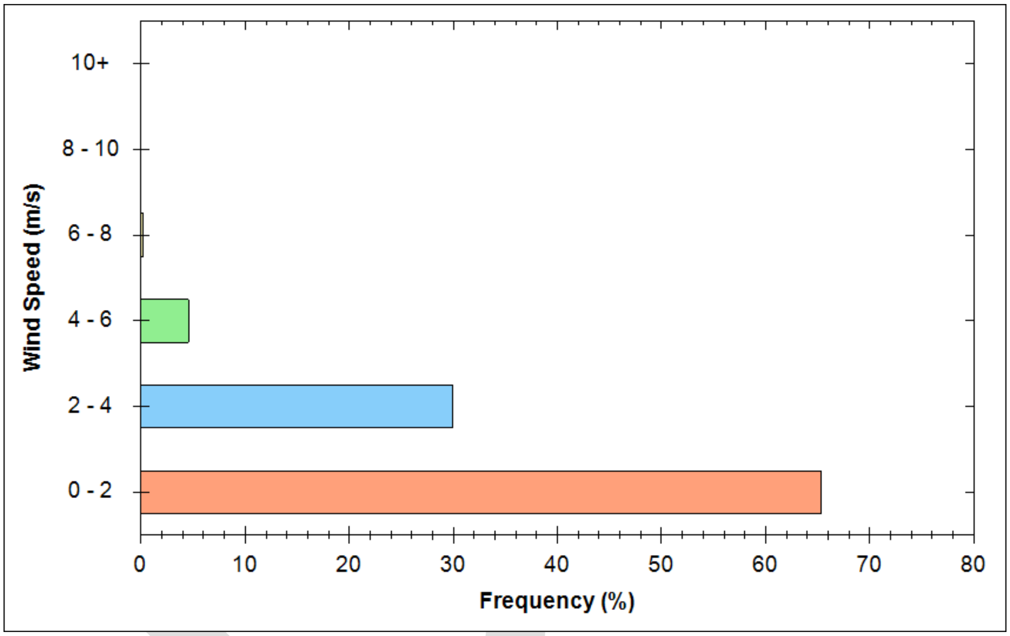
The convective mixing height, the depth of the surface mixed layer is the height of the atmosphere above the ground, which is well mixed due either to mechanical turbulence or convective turbulence. This height was simulated running TAPM.

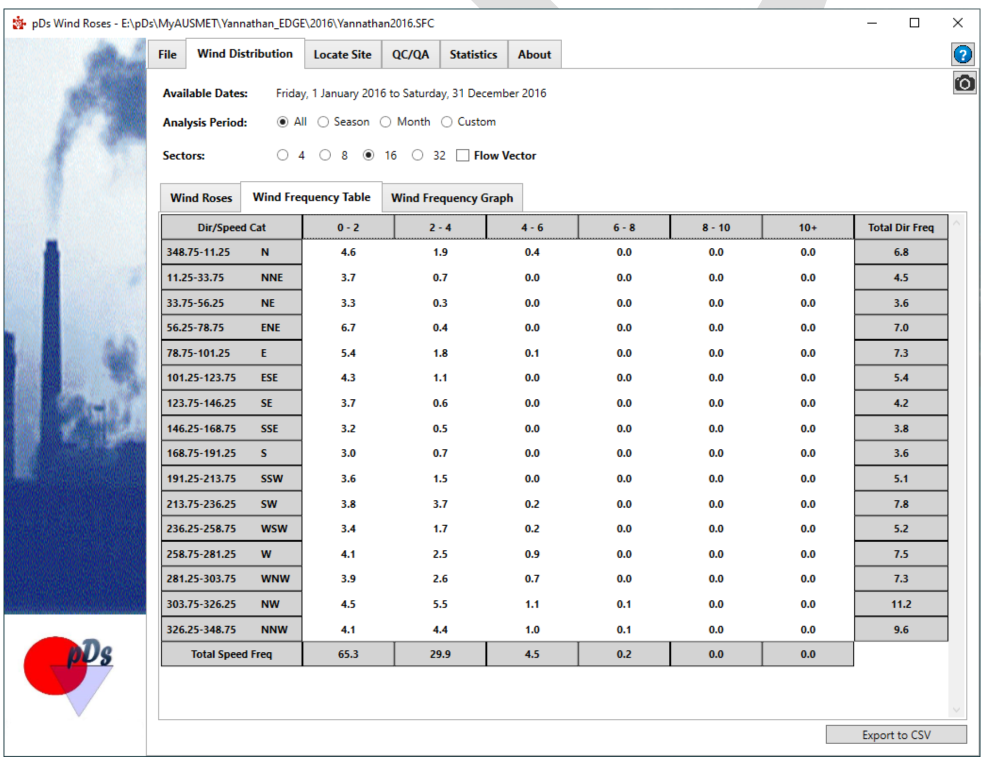
DATA ANALYSIS

ANNUAL WINDROSES FOR YANNATHAN-2016



FREQUENCY OF WIND SPEED

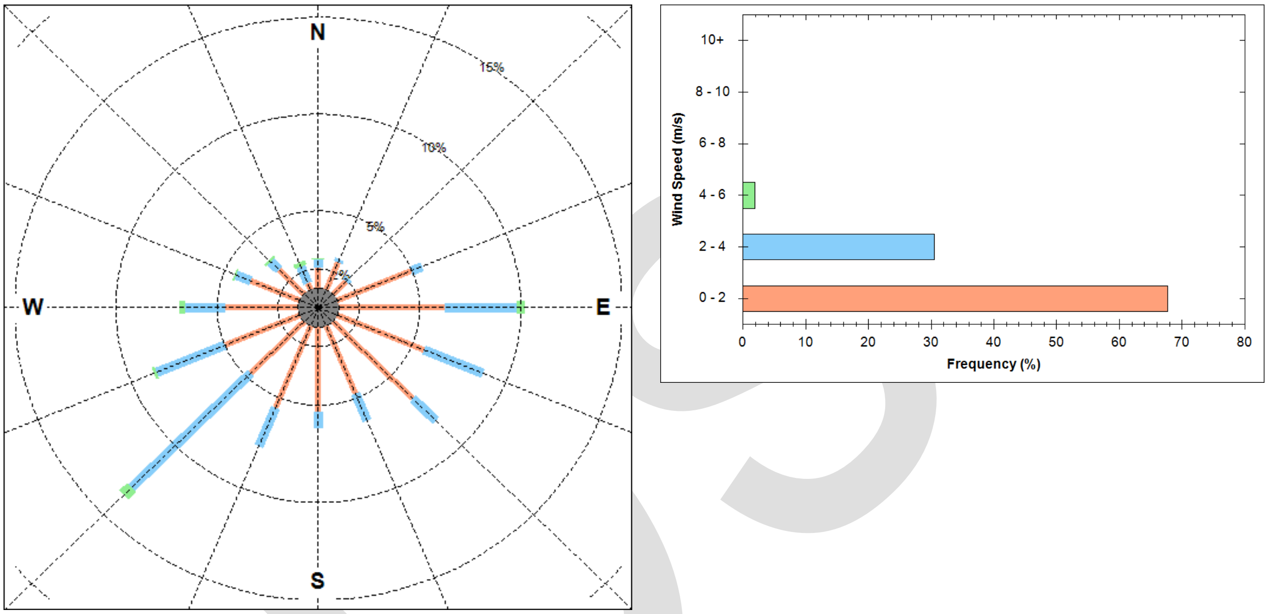




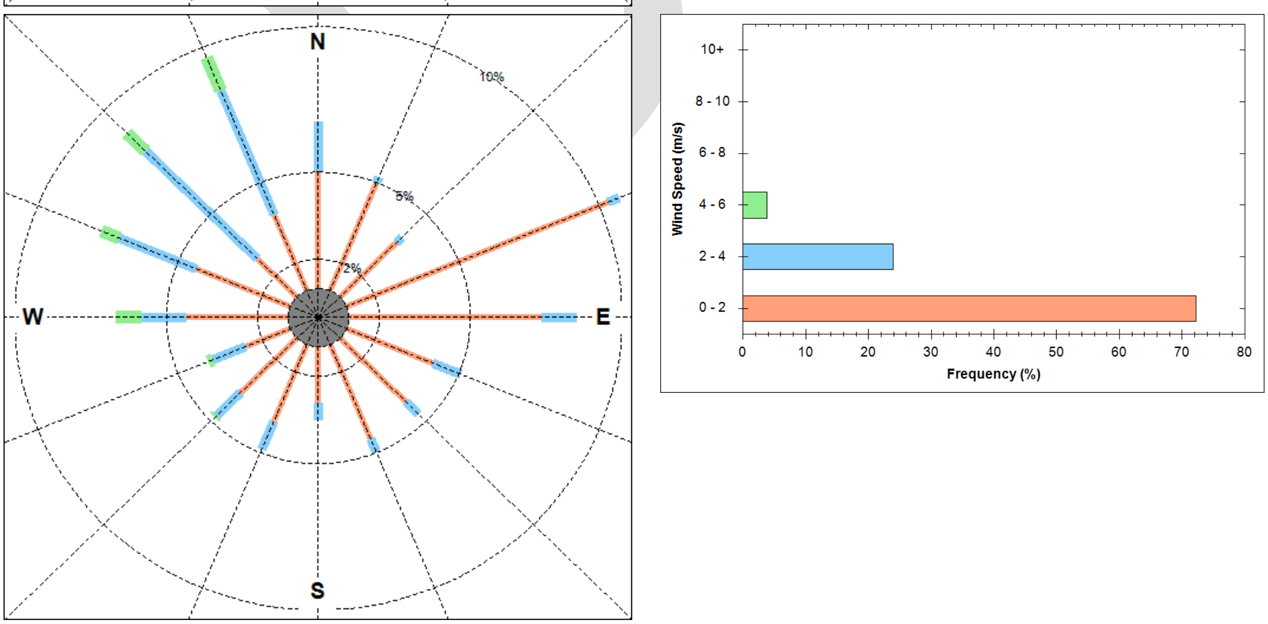
Dir/Speed Cat		0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10+	Total Dir Freq
348.75-11.25	N	4.6	1.9	0.4	0.0	0.0	0.0	6.8
11.25-33.75	NNE	3.7	0.7	0.0	0.0	0.0	0.0	4.5
33.75-56.25	NE	3.3	0.3	0.0	0.0	0.0	0.0	3.6
56.25-78.75	ENE	6.7	0.4	0.0	0.0	0.0	0.0	7.0
78.75-101.25	E	5.4	1.8	0.1	0.0	0.0	0.0	7.3
101.25-123.75	ESE	4.3	1.1	0.0	0.0	0.0	0.0	5.4
123.75-146.25	SE	3.7	0.6	0.0	0.0	0.0	0.0	4.2
146.25-168.75	SSE	3.2	0.5	0.0	0.0	0.0	0.0	3.8
168.75-191.25	S	3.0	0.7	0.0	0.0	0.0	0.0	3.6
191.25-213.75	SSW	3.6	1.5	0.0	0.0	0.0	0.0	5.1
213.75-236.25	SW	3.8	3.7	0.2	0.0	0.0	0.0	7.8
236.25-258.75	WSW	3.4	1.7	0.2	0.0	0.0	0.0	5.2
258.75-281.25	W	4.1	2.5	0.9	0.0	0.0	0.0	7.5
281.25-303.75	WNW	3.9	2.6	0.7	0.0	0.0	0.0	7.3
303.75-326.25	NW	4.5	5.5	1.1	0.1	0.0	0.0	11.2
326.25-348.75	NNW	4.1	4.4	1.0	0.1	0.0	0.0	9.6
Total Speed Freq		65.3	29.9	4.5	0.2	0.0	0.0	

SEASONAL WINDROSES

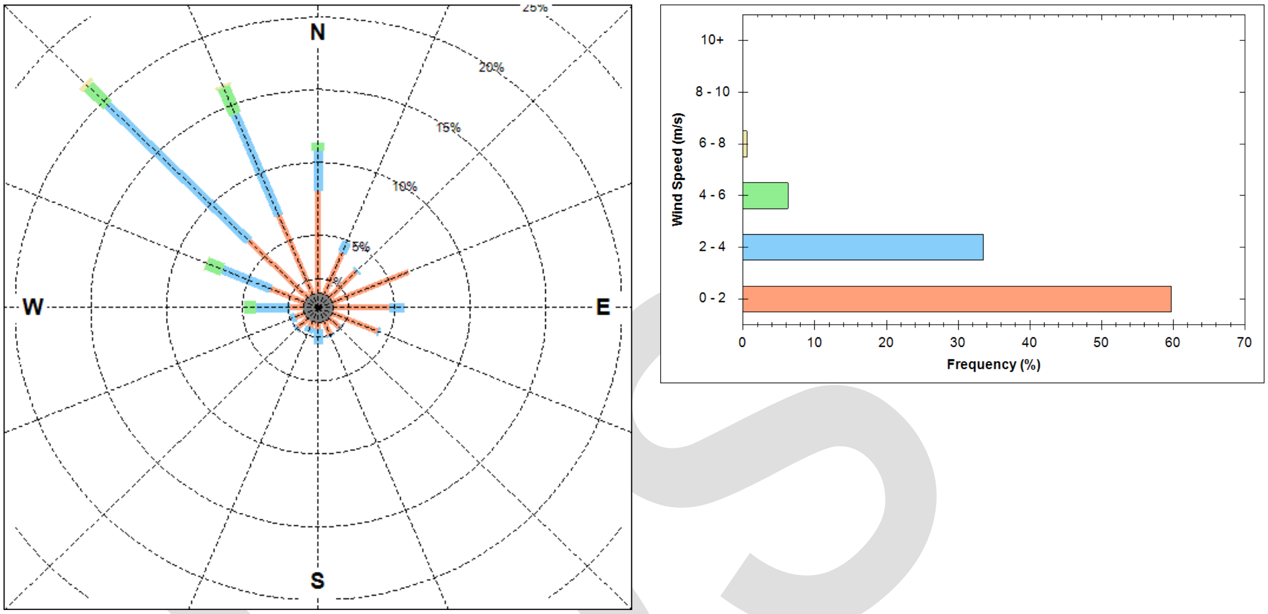
Summer



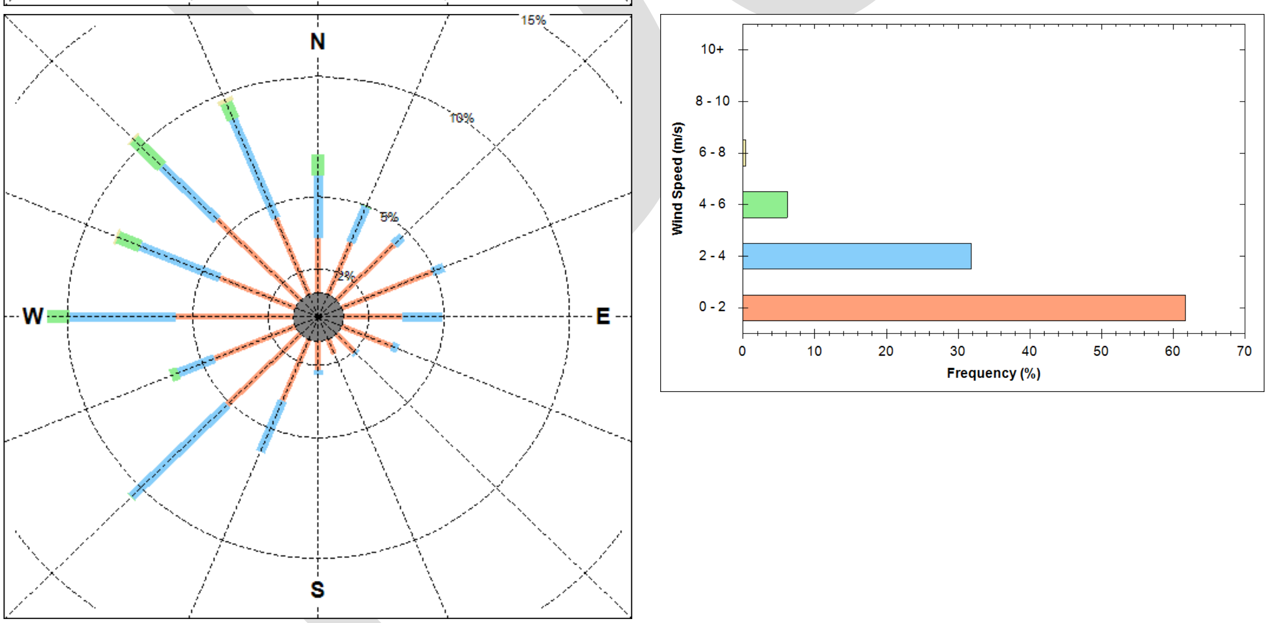
Autumn



Winter

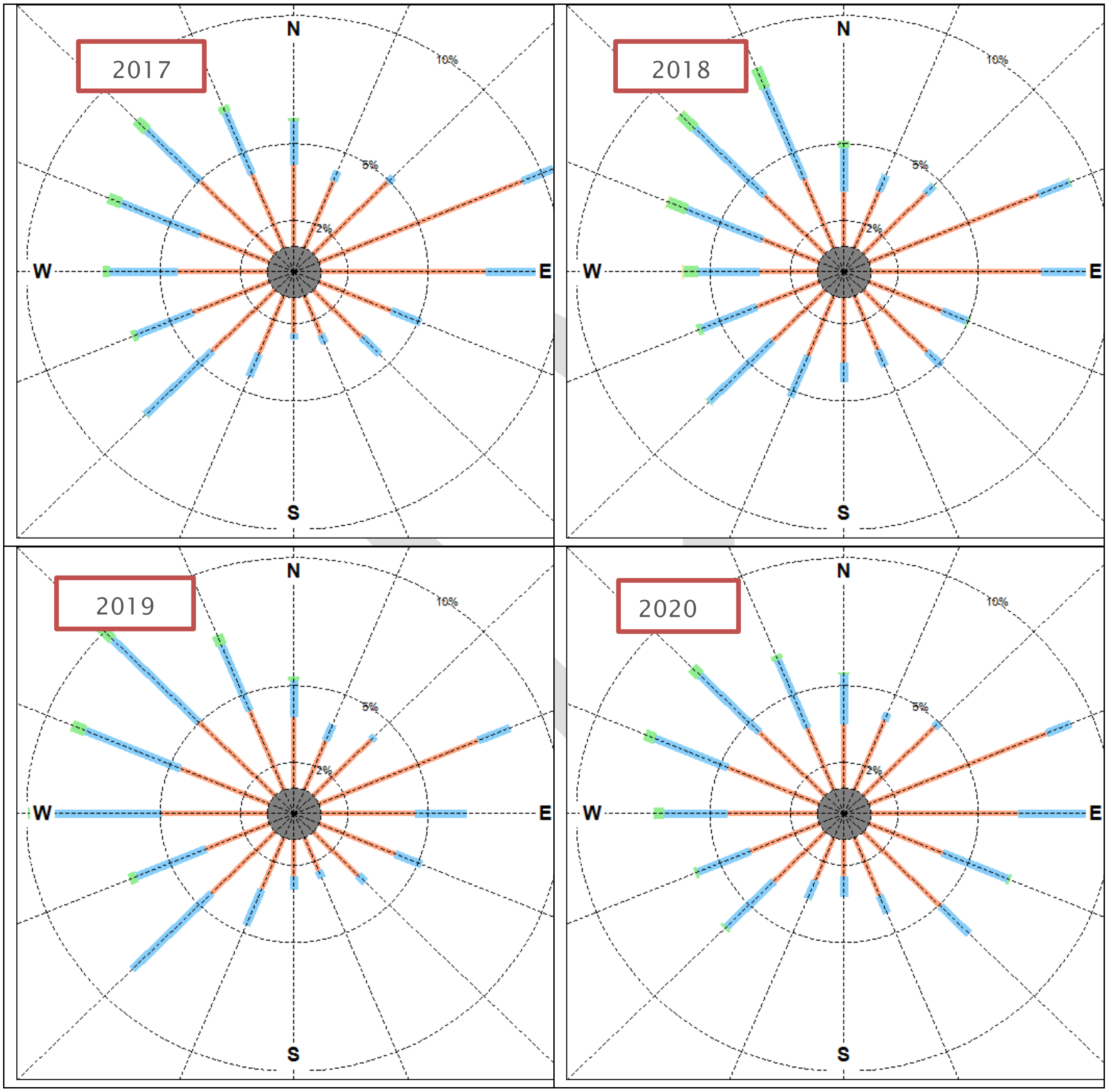


Spring



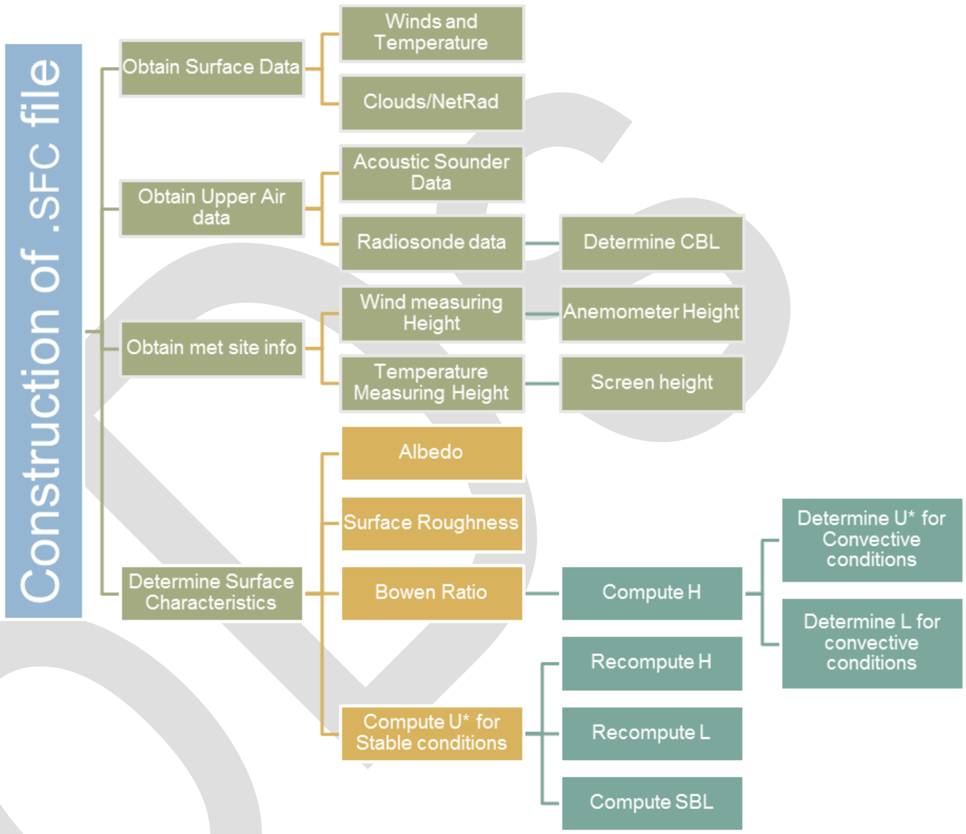
Seasonal variations are clearly depicted.

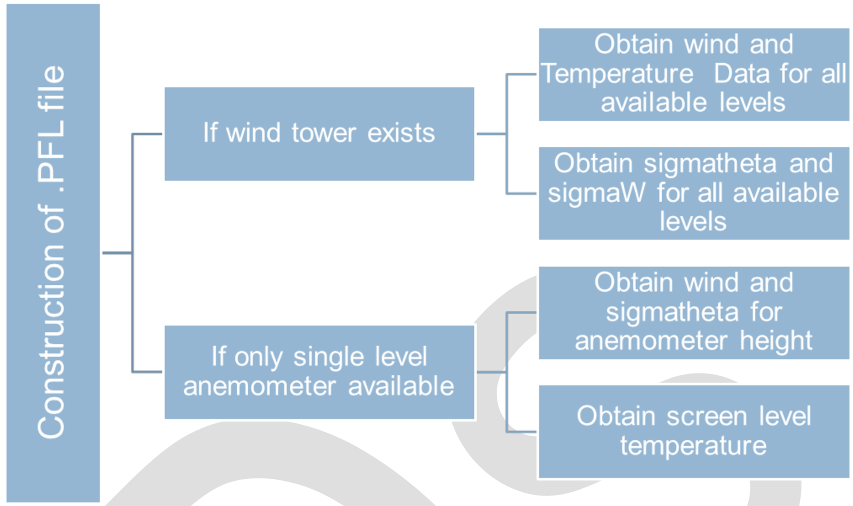
ANNUAL WINDROSES FOR THE REST OF THE YEARS



Appendix

FLOW CHARTS - CONSTRUCTION PROCEDURE




Construction of .PFL file
If wind tower exists
Obtain wind and Temperature Data for all available levels
Obtain sigmatheta and sigmaW for all available levels
If only single level anemometer available
Obtain wind and sigmatheta for anemometer height
Obtain screen level temperature

Bibliography

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Benkley, C.W,& Schulman L.L 1979 :Estimating Hourly Mixing Depths from Historical Meteorological Data :Jl of Applied Meteorology Vol 1 page 772-780

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USEPA 2012, User Guide for the AERMOD Meteorological Processor-AERMET; Addendum, United States Environmental Protection Agency, Washington DC, USA.

USEPA, 2000, Meteorological Monitoring Guidance for Regulatory Modelling Applications, EPA-450/R-99-005.United States Environmental Protection Agency, Washington DC, USA.

USEPA, Office of Air Quality Planning and Standards, AERSURFACE User's Guide, Research Triangle Park, North Carolina, EPA 454/B-08-001

USEPA, Office of Air Quality Planning and Standards, User's Guide for the AERMOD Meteorological Processor (AERMET) and Addendum, Research Triangle Park, North Carolina, EPA 454/B-03-002.

DISCLAIMER

Compilation of input meteorological data files for AERMOD was done under the supervision of qualified and experienced meteorologists. Although all due care has been taken, we cannot give any warranty, nor accept any liability (except that required by law) in relation to the information given, its completeness or its applicability to a particular problem. These data and other material are supplied on the condition that you agree to indemnify us and hold us harmless from and against all liability, losses, claims, proceedings, damages, costs and expenses, directly or indirectly relating to, or arising from the use of or reliance on the data and material which we have supplied.

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Site Environmental Management Plan (Dust)

Hanson Sand Quarry

Hanson Construction Materials

870-910 Westernport Road, Yannathan, Vic

April 2023

Edge Group Pty Ltd
423 City Road, South Melbourne 3205
P (03) 8625 9696
E info@edgegroup.net.au | **W** www.edgegroup.net.au

Client	**Hanson Construction Materials Pty Ltd**
Project	20220075
Document Title	Site Environmental Management Plan (Dust)
Document ID	20220075-R-01 SEMP_Dust_v4
Distribution	Electronic PDF

Role	Name/Title	Signature	Date
Written	Zaro Kasi Environmental Consultant		8 April 2023
Reviewed	Enzo De Fazio Director – Environment & Safety		8 April 2023
Approved	Enzo De Fazio Director – Environment & Safety		8 April 2023

Document Revision Table

Document ID	Changes	By	Date
20220075-R-01 SEMP_Dust_Draft	Draft	Edge Group Pty Ltd	9 May 2022
20220075-R-01 SEMP_Dust	Final	Edge Group Pty Ltd	03 July 2022
20220075-R-01 SEMP_Dust_v1	Final (internal only)	Edge Group Pty Ltd	18 July 2022
20220075-R-01 SEMP_Dust_v2	Final	Edge Group Pty Ltd	12 September 2022
20220075-R-01 SEMP_Dust_v3	Final	Edge Group Pty Ltd	30 September 2022
20220075-R-01 SEMP_Dust_v4	Final	Edge Group Pty Ltd	8 April 2023

423 City Road, South Melbourne Victoria 3205
T: 03 8625 9696
E: info@edgegroup.net.au
W: edgegroup.net.au
ABN: 17618314104

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1 Document Control

This Site Environmental Management Plan focussing on dust [SEMP (Dust)] is subject to a document control procedure, to ensure that all SEMP (Dust) holders have only up to date document versions.

The initial version of the document is designated as Version 0. As the SEMP is updated or supplemented as required, it must be designated as Versions 1, 2, 3, etc. Previous versions must be removed from used and stored – the latter up to seven years or in accordance with the recipient's document control management system (where applicable).

A record of the up-to-date version of document must be maintained using the format below. The Site owner or at minimum, the Site Supervisor/Manager, is responsible for ensuring that the SEMP (Dust) is kept up to date and must sign the record to confirm that replacement and new versions have been incorporated into the SEMP (Dust).

SEMP (Report) ID	Version	Date of Issue	Recipient	Signature
20220075-R-01 SEMP_Dust_Draft	0	9/05/2022		
20220075-R-01 SEMP_Dust	0	04/07/2022		
20220075-R-01 SEMP_Dust_v1	1	18/07/2022	Internal only	Internal only
20220075-R-01 SEMP_Dust_v2	2	12/09/2022		
20220075-R-01 SEMP_Dust_v3	3	30/09/2022		
20220075-R-01 SEMP_Dust_v4	4	8/04/2023		

2 Introduction

Edge Group Pty Ltd (Edge) has been engaged by Hanson Construction Materials Pty Ltd (Hanson) to develop a Site Environmental Management Plan focusing on the monitoring of dust [SEMP (Dust)] in relation to the proposed extension of the existing sand quarry at 870-910 Westernport Road, Yannathan, Victoria (the Site). The subject area (of the extension) is currently grassed and is an undeveloped (northern) section of the overall Site. The locations of the proposed extension quarry area and current dust deposition monitoring locations are shown in ***Appendix A***.

The Site already engages in boundary dust monitoring via the placement of four directional deposition dust gauges (DDDGs) set up at its boundaries.

2.1 Purpose

This management plan has been developed to assist Hanson with the monitoring of particles or dust as required in the Environmental Protection (EP) Act (2017) and its associated general environmental duty (GED) that came into effect 1 July 2021. The GED requires all Victorians to understand and minimise their risks of harm to human health and the environment from pollution and waste. The Environmental Reference Standard (ERS) under section 93 of the EP Act 2017 sets out the environmental values of ambient air, sound, land and water environments that are sought to be achieved or maintained in Victoria. The ERS is not a compliance standard. Its primary function is to provide an environmental assessment and reporting benchmark. The *Guideline for Assessing and Minimising Air Pollution*, *EPA Victoria Publication 1961, February 2022* provides a framework to assess and control risks associated with air pollution. Hereafter, this is referred to as the *EPA GAMAP.*

2.2 Objective

The objective of this plan is to design a program that can suitably monitor for dust generated by sand quarrying activities in accordance with the *EPA GAMAP* as required by Earth Resources Regulation (ERR), Victoria.

2.3 Responsible Party

Hanson is responsible for the implementation of this SEMP (Dust) including:

- Ensuring that monitoring is conducted at the frequency specified and associated reporting;

- Engagement of and responsibility for a suitably qualified environmental consultant to undertake monitoring and reporting as specified in this plan (where applicable); and
- Provision of reporting to stakeholders as needed.

2.4 Scope of Work

The scope of work undertaken by Edge is as follows:

- Site visit to assess the Site and surrounds;
- Identify likely areas of dust sources/generation;
- Recommend effective dust mitigation strategies for the proposed facility; and
- Prepare a dust monitoring program for the new quarry expansion area (and/or enhance the existing program).

2.5 Background

Edge understands the current landowner, Hanson, is proposing to extend its sand quarrying operation to the north of the Site. As part of that process, Hanson needs to prepare a particle or dust monitoring program or plan in accordance with the *EPA GAMAP* in order to capture the new quarry area.

2.6 Complaints received by Council and EPA

As part of the preparation of this SEMP, a Freedom of Information (FOI) was requested from the Cardinia Shire Council (Council) and EPA Victoria (EPA) of any dust related complaints received from surrounding properties within the last twelve months. At the time of writing, Council advised Edge that no dust related complaints had been received within this time frame (i.e. back to approximately mid-2021). Furthermore, EPA also did not receive any complaints within the same period.

ERR has noted a complaint was lodged in 2015. According to Site management, the complaint came from approximately a kilometre south of the Site on the other side of another quarry. After further investigation (by the Site and ERR), ERR decided the complaint was vexatious, however technically still recorded as a complaint.

3 Site Description

3.1 Site Description and Features

A summary of the site details is provided in ***Table 1***.

Table 1 – Summary of Site Details

Site Details	Description
Site Address	870-910 Westernport Rd, Yannathan, Victoria
Municipality	Shire of Cardinia
Planning Zoning	Green Wedge Zone (GWZ) Green Wedge Zone – Schedule 1 (GWZ1)
Planning Overlays	Significant Landscape Overlay Significant Landscape Overlay – Schedule 3 (SLO3)
Other Overlays	Aboriginal Cultural Heritage Designated Bushfire Prone Area
Abutting/nearest Land Uses	North and northwest: Agricultural (market garden) uses property with an office that has a room where the caretaker occasionally sleeps and therefore considered a residence. East: Yannathan Park – Boarding Kennels and Cattery which is an accommodation facility for cats and dogs (owner resides on site) South: Agricultural with some extractive industry West: Egg layer or broiler farm west of the quarry (includes a caretaker residence on site).

3.1.1 Proposed Future Site Use

Edge understands the Site will be used for an expansion of sand quarrying/extraction purposes.

Extraction will occur at least 250 metres away from the nearest sensitive receptor to the east of the Site (i.e. approximately 225 metres to the eastern Site boundary and then approximately 25 metres to the residential property, which is part of the Boarding Kennel and Cattery).

Once quarrying activities have ceased, the site will have one large dam with a central area of land, which will be revegetated.

3.2 Site Inspection

Edge attended Site (escorted by Hanson) on 28 March 2022 and observed the expansion Site area covered with grass. Dust emissions were observed below ground level (whilst extraction was taking place) and on haul roads closer to ground level. Dust was not observed to have escaped the Site to impact sensitive receptors. According to Hanson, there will be no additional haul roads or stockpiles associated with the quarry expansion. Hanson notes that existing haul roads may need to be diverted during extraction works.

4 Wind Roses

The dust movement pathway relevant to amenity is air-deposition. This pathway is dependent on weather conditions – i.e. windy conditions and elevated temperatures (heat) can produce more dust. Due to weather conditions, which influence dust dispersion; annual records were reviewed as taken by the Bureau of Meteorology (BOM) at the Nilma North (Warragul) weather station at 9 am and 3 pm intervals, shown in ***Figures 1*** and ***2***, below. In correspondence with EPA, the Nilma North (Warragul) weather station was selected as it was the known closest active station to the Site (as also confirmed by EPA via email correspondence with Edge in June 2022). The Nilma North weather station data showed that the maximum recorded wind speeds at greater than 40 kilometres per hour at a frequency of at least 28% (of the time) from the east and 24% (of the time) from the west at 9am and more than 40 kilometres per hour up to approximately 35% (of the time) from the west at 3pm. In summary, it appears that the predominant wind direction between both recorded times is from the west. The sources of these data are shown in wind roses provided below:

Rose of Wind direction versus Wind speed in km/h (13 Jan 2014 to 28 Jun 2022)
Custom times selected, refer to attached note for details
NILMA NORTH (WARRAGUL)
Site No: 085313 • Opened Jan 2014 • Still Open • Latitude: -38.1321° • Longitude: 145.9865° • Elevation 134.1m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.

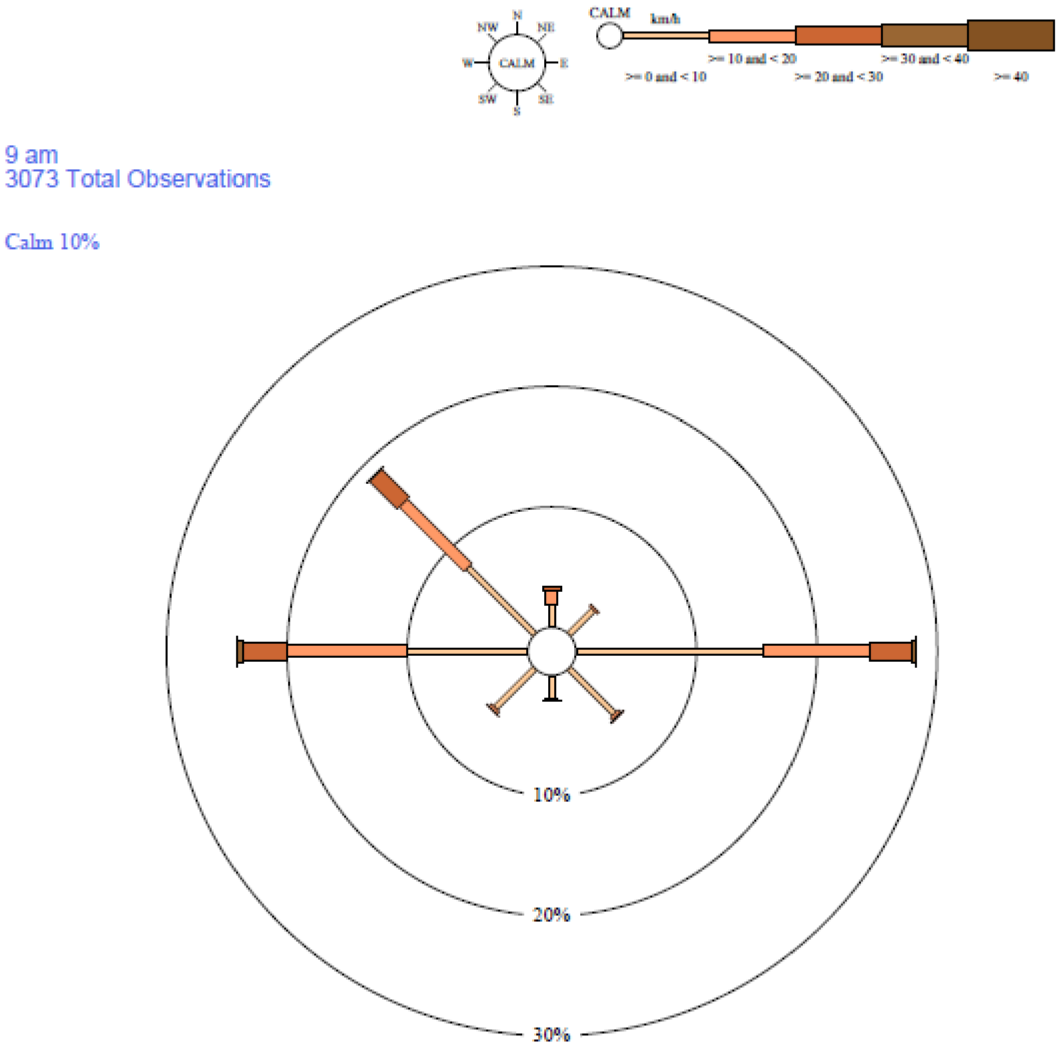

Figure 1 – Wind Rose showing 9am annual average wind speed and directions

Rose of Wind direction versus Wind speed in km/h (13 Jan 2014 to 28 Jun 2022)
Custom times selected, refer to attached note for details

NILMA NORTH (WARRAGUL)
Site No: 085313 • Opened Jan 2014 • Still Open • Latitude: -38.1321° • Longitude: 145.9865° • Elevation 134.1m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.

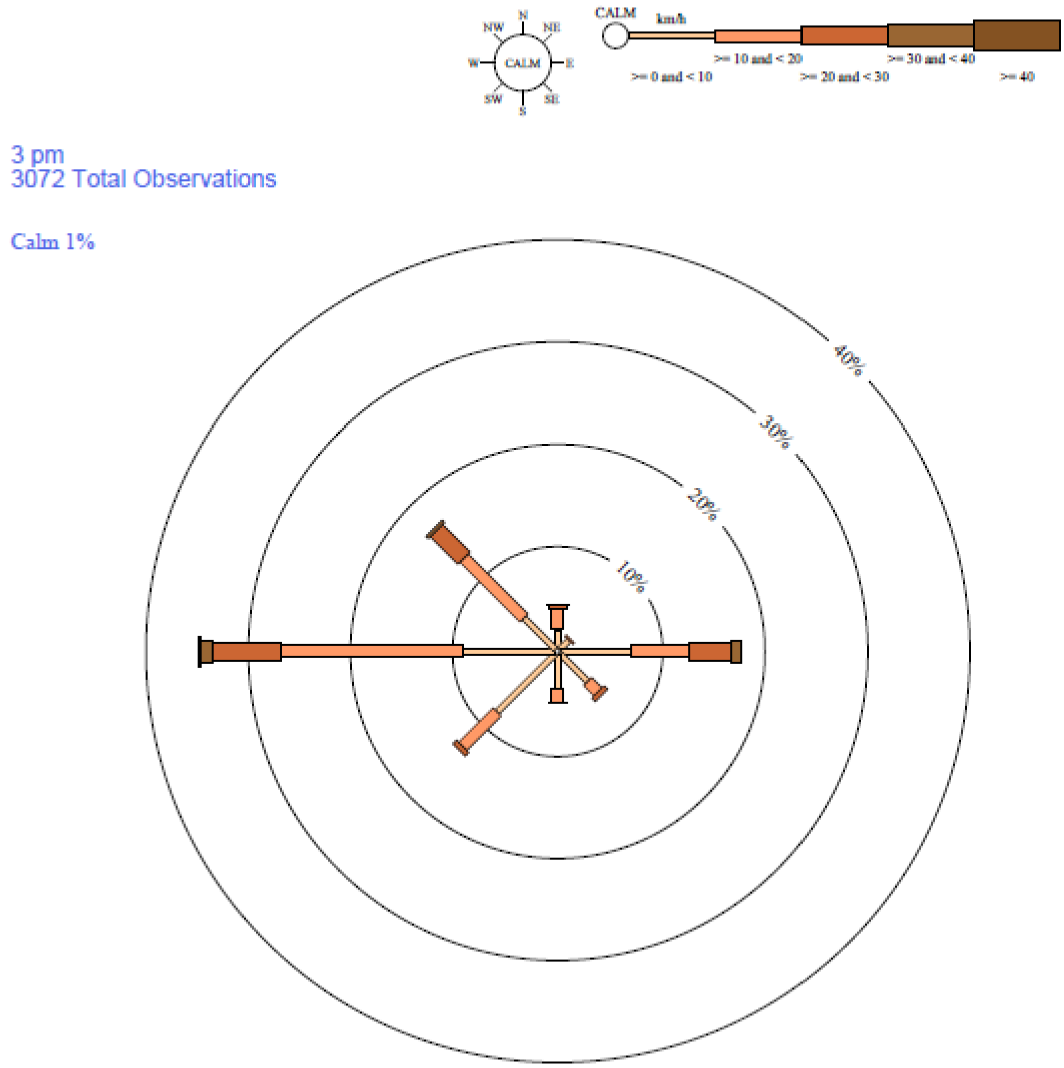

Figure 2 – Wind Rose showing 3pm annual average wind speed and directions

5 Roles and Responsibilities

Table 2: Roles and Responsibilities

Role	Responsibilities
Managers	• Monitor overall environmental performance; • Assure compliance with applicable legal and other requirements to which the organisation subscribes; and • Promote continual improvement.
Project Managers	• Management of all operations, workers and subcontractors (typically focussing on projects); • Ensure compliance with all environmental requirements outlined in the SEMP; • Ensuring that all relevant environmental protection equipment is provided and maintained; and • Review environmental reports and inspections and initiate actions to rectify as appropriate.
Site HSEQ Advisor	• Undertake site inspections; • Carry out monitoring activities; • Implement this SEMP; • Provide on-site advice in relation to the management of environmental issues; • Assist in developing training programs regarding environmental requirements and deliver where required, including delivery of the environmental components of any toolbox talks; • Conduct environmental incident investigations; and • Prepare environmental monitoring reports as required for the Site.
Workers (including Sub-Contractors)	• Comply with the relevant requirements of the SEMP, or other environmental management guidance as instructed by a member of Site management; • Participate in any Project/Site induction program(s) as required; • Report any environmental incidents to the Site Manager immediately or as soon as practicable if reasonable steps can be adopted to control the incident; • Undertake remedial action as required to ensure environmental controls are maintained in good working order; and • Stop activities where there is an actual or immediate risk of harm to the environment or human health and advise the Project Manager or Site Manager.

6 Dust Emission Control

The following list existing controls and strategies (or actions) currently in place and those to be implemented against (any) adverse dust emissions and emergency processes to be put in place in the event that they need to be implemented.

6.1 Existing Dust Suppression Controls

- There are mature trees on-site to the north-western, northern and north-eastern boundaries of the extraction area. Such vegetation assists in preventing any adverse dust emissions escaping the site. These trees are expected to continually grow (with the exception of felling a small number of trees on the northern boundary) thus minimising the chance of off-site nuisance dust emissions from the proposed quarry emissions:
- Haul roads are regularly sprayed with water to reduce airborne dust in the current extraction area;
- Dust resulting from all operations including extraction, loading, transportation, and stockpiling are controlled by the use of water sprays, dust extraction or dust proof enclosures;
- Trucks that are transporting product (i.e. sales) are fitted with canopies/tarps;
- Trucks use the on-site wheel washer when exiting the quarry;
- Continuously observe Site conditions and off-site migration of dust;
- Spray and extraction systems are maintained in an operable condition;
- Water spraying of stockpile slightly west of the processing plant to keep it such that no continual visible dust emissions occur.
- Mounds of (soil) stockpiles from two to three metres high were built on the east of the Site, which are covered in grass, to protect the off-site sensitive (kennel and cattery) receptor being impacted by noise;

- Based on Hanson (Yannathan) data, the material being extracted (i.e. sand) is typically greater that 50 µm in particle size, thus not of the typical size to be wind-blown;[1] and
- Provision of field personnel with information (e.g. through tool boxes) and training on the measures used to prevent dust generation and emissions at the site.

6.2 Strategies or Controls for Dust Suppression (planned or if required)

Hanson has changed its extraction method to dredging for the deeper (sand) layers - this is believed to reduce dust by removing the need for haul trucks to the processing plant (located approximately in the centre of the Site). The following controls will be in place for the processing plant:

- Material received is largely moist due to the shallow water table;
- Loaders to hopper through various screens to remove the oversize material and then the sand is placed through a wet scrubber (attrition cell); and
- Material is wet after the attrition cell.

In terms of other dust suppression strategies, Hanson shall select a combination of the following controls when required (i.e. if continuous dust plumes are generated or a significant number of complaints are received by Hanson):

- Avoid stripping topsoil during periods of high winds (>20 m/s);
- Watering with dust suppressant additive when topsoil or sand source is exposed and causing adverse emissions outside the Site;
- Implement corrective actions to eliminate the causal factors (see also ***Section 8, Table 7***);
- The new diverted haul roads to the proposed extraction area shall be sprayed regularly with water to reduce airborne dust, with a water cart on standby;

[1] https://www.der.wa.gov.au/images/documents/your-environment/air/publications/Guideline_for_managing_impacts_of_dust.pdf. **Appendix 2**.

- Ensure the entry/exit road on-Site and the adjacent (off-site) Westernport Road are not covered in sediment. Especially for Westernport Road, any sediment will be removed as soon as possible with a street sweeper/cleaner;[2]

- Rumble grid at the Site exit point if needed;

- Avoid dry sand quarrying works during windy days i.e. >20 m/s (but would have to be confirmed on-site during such activities in terms of what would be the trigger for adverse windspeeds); and

- Although not an example of a dust suppression control to prevent an off-site dust nuisance, it is expected that the operators of mobile plant (i.e. front end loaders, excavator and articulated dump trucks) will be protected from any dust inside air-conditioned sealed cabins. *The operators are also expected to clean their cabins by an appropriate industrial-type vacuum cleaner;*

- Installation and monitoring of an additional closed-circuit television (CCTV) camera along each of the sensitive receptor boundaries, which could be integrated into existing CCTV network and enable monitoring potential dust emissions;

- Vehicle speed restrictions to reduce airborne dust on haul roads;

- Application of magnesium chloride-based sealant to haul roads in late spring in preparation for summer. This provides a harder wearing and longer-lasting crust to the roadways through the dryer months (it is soluble and will disperse during the rainy season);

- Use of dust suppressants (environmentally friendly) on any stockpiles to minimise the production of dust (the main one being slightly off-centre of the Site to the west of the processing plant);

- Water to be sprayed on work faces when the risks of dust are elevated;

- Long term storages of any fill and overburden materials in stockpiles to be stabilised (i.e. covered);

[2] *To date (30 September 2022), Site management advised Edge that no issues have resulted from quarry material having spilt on Westernport Road or any resulting dust emissions.*

- Availability on-site of at least 2,000 litres of water per hectare of disturbed land for dust control; and
- Physically mark out the boundaries of the work area to identify permitted / prohibited areas of soil disturbance, vegetation clearing, etc.

6.3 Emergency Actions

In case of an emergency (especially related to human health), contact emergency services on 000 and notify Site Manager. The Hanson 24 hour emergency contact phone number is also 1800 882 478. Should the emergency involve dust, consult the appropriate Safety Data Sheet *(**Appendix C**)* and enact the following:

- If in eyes, hold eyelids apart and flush continuously with running water for at least 15 minutes; and
- If inhaled remove self from dusty area.

7 Dust Monitoring Plan

7.1 Overview

For the purposes of this plan, the following aspects drives the design of data collection:

- Dust deposition rates at the boundaries of the extraction site generated from on-site sources, with particular attention to boundaries adjacent to (any) sensitive receptors.

Collected data may be split into the following assessment requirements:

- Deposited dust – for assessment against amenity-based (dust nuisance) criteria;
- Weather (e.g. wind speed and direction) – to assist with identifying possible particle sources; and
- Sampling methodology must be undertaken in accordance with *AS/NZS 3580.10.1:2016 Methods for sampling and analysis of ambient air Guide to siting air monitoring equipment* – please refer to ***Appendix D***.

Required dust monitoring types are shown in ***Table 3.***

Table 3 – General Monitoring Types

Monitoring Type	Details
Visual observations	• Regular (e.g. daily) inspections of haul roads and entry / exit points are required • Responding to any potential dust issues/complaints from nearby residents
Gravimetric sampling	• Ambient (deposition) sampling of total suspended particles (TSP)
Real time sampling	• Real-time (concentration) sampling of particular matter such as PM_{10} and $PM_{2.5}$

7.2 Assessment Criteria

Applicable assessment criteria for the site are the EPA ERS shown in ***Table 4***.

Table 4 – Assessment Criteria Summary

Pollutant	Air Quality Criterion	Allowable Exceedances	Source	Monitoring
PM_{10}	165 µg/m^3 (10-min average)	0	Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists). EPA Publication 1961 February 2022.	Continuous monitoring equipment being explored by Hanson
	150 µg/m^3 (15-min average)	0		
	120 µg/m^3 (30-min average)	0		
	80 µg/m^3 (1-hour average)	0		
	50 µg/m^3 (1-day average)	0	Environment Reference Standard (ERS), No. S245 Wednesday 26 May 2021	
	20 µg/m^3 (1-year average)	0		
$PM_{2.5}$	25 µg/m^3 (1-day average)	0		
	8 µg/m^3 (1-year average)	0		

7.3 Weather Monitoring

Weather is a component of a dust monitoring program. Site-specific knowledge of wind speed and direction can be essential in validating dust monitoring locations (which are shown in ***Appendix A***). The Nilma North (Warragul) Weather Observation Station (as managed by the *Australian Government, Bureau of Meteorology*) is located approximately 32 kilometres east north-east of the subject site at its closest boundary. Given that the GAMAP does not specify the requirement of a weather station, weather observations for the site (particularly wind data where needed) will rely on this data source, unless otherwise notified.

In the event that a weather station needed to be set up on-site, it would need to be positioned in accordance with *AS/NZS 3580.14:2014 Methods for sampling and analysis of ambient air Part 14: Meteorological monitoring for ambient air quality monitoring applications* as is practicable. Reporting and logging would also need to be consistent with this standard. Please refer to ***Appendix E*** on this standard for some key considerations/ details when deploying a weather station.

7.4 Frequency and Duration of Dust Monitoring

Table 4 of the *EPA ERS* specifies that the following be monitored for rural locations with residences in close proximity (which is the case of the subject site due to distances to nearest sensitive receptors):

- PM_{10}, $PM_{2.5}$ and nuisance dust (dust deposition)[3]; and
- 12 months of 24-hour representative data to be available.

For operational practices:

- Real-time continuous monitoring of PM_{10} and $PM_{2.5}$ at nearest sensitive locations linked to a reactive management strategy.[4]

A dust monitoring plan is provided in ***Table 5***. The following frequency and duration of sampling is proposed to meet this plan's objectives:

- To proactively demonstrate compliance with the *EPA GAMAP*:
  - Nuisance dust (dust deposition) on twelve (monthly) consecutive occasions in the first year (minimum 30-day sample period) and after one year, this requirement should be assessed (i.e. based on the results being compared against the deposition criterion) – *this is already occurring on-site*:
  - Monitoring locations are designed (along with wind data) to differentiate between Hanson and other neighbours that could be potentially generating dust emissions, and which could impact sensitive receptors in the local area (e.g. ploughing on the market garden site immediately north of Westernport Road, across the road from the subject Site). One directional dust deposition

[3] The hazard information provided in the Hanson "Aggregates, Road Base, Sand and fill" Safety Data Sheet (2020) applies to the dusts within silica sand and particularly inhalable dust particles with a diameter less than 75 microns. This does not appear to mean that all particulate matter are less than 75 microns at the Site. Based on Particle Size Distribution (Technical Services Clarinda) NATA laboratory results (April and June 2022) for Yannathan, respirable crystalline silica is not required to be monitored based on at least 98% of the sampled material being equal or greater than 75 microns. This is also consistent with the "Product Grading" (in *Table 1*) data in the *Yannathan Sand Quarry, Assessment of Potential Dust Impacts, May 2013* (GHD for Hanson Construction Materials) where zero (0) to three (3) percent of particles passed through a pan size of 0.075 millimetres (75 microns). Given the above, it is presumed that sand will not be at a particle size of 4 microns, which was the size (or lower) that was reported to be responsible for silicosis according to the occupational hygiene department in WorkSafe Victoria as per the Silicosis Summit on 27 February 2020 (that Edge personnel attended).

[4] Most sensitive receptors are considered off-site immediate to the site boundary.

gauge is currently placed on the subject Site to assist with this dust source investigation/identification process:

- Hanson proposes to install a real-time dust monitor (for PM_{10}. $PM_{2.5}$ and Total PM) to be located at each of the two common boundaries between the two closest eastern and western residences and the subject Site; and
- Hanson proposes to install a real-time dust monitor (for PM_{10}. $PM_{2.5}$ and Total PM) to be located at the northern Site boundary. This could act as a comparative measurement source between quarrying operations not occurring in the northern portion of the site compared to when the proposed quarry extension was to occur.

Table 5 – Dust Monitoring Plan (Existing and Proposed)

Location	Main Receptors Targeted	Parameter	Frequency	Duration	Comments
Existing: Northern Boundary (Westernport Road)	Visitors and market garden across Westernport Road (no resident in this area – i.e. office located to the northwest of Site across the road)	Dust Deposition [4g/m^2/month]*	12 x times/year (i.e. monthly)	30 days minimum	Refer to *Table 6* for results
Existing: Southern Boundary (Burts Road)	Any off-site sensitive receptors to the south	Dust Deposition [4g/m^2/month]*	12 x times/year (i.e. monthly)	30 days minimum	
Existing: Western Boundary (West Milners Road)	Residential receptor to the west (part of an industrial facility)	Dust Deposition [4g/m^2/month]*	12 x times/year (i.e. monthly)	30 days minimum	
Existing: Eastern Boundary (Pine Trees)	Cattery and Kennel resident	Dust Deposition [4g/m^2/month]*	12 x times/year (i.e. monthly)	30 days minimum	
Proposed: Northern Boundary	To detect any change between existing Site and proposed extension in quarrying operations to the north. Any ploughing emission to the north across from the Site could also potentially be detected.	PM_{10} [50 µg/m^3] & $PM_{2.5}$ [25 µg/m^3]; 24 hr average; PM_{10} [20 µg/m^3] & $PM_{2.5}$ [8 µg/m^3]; 1 year average Environmental Reference Standards, ERS; No. S 245 Wednesday 26 May 2021 PM_{10} monitoring is frequently used as an indicator of nuisance dust, with trigger	Continuous for 12 months	365 days minimum	Various options being explored by Hanson for real-time equipment.** Weather Monitoring in place.

Location	Main Receptors Targeted	Parameter	Frequency	Duration	Comments
Proposed: Western Boundary (West Milners Road)	Residential receptor to the west (part of an industrial facility)	levels set at 80 µg/m^3 (1-hour average), 120 µg/m^3 (30-minute average), 150 µg/m^3 (15-minute average) or 165 µg/m^3 (10-minute average). *Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists). EPA Publication 1961 February 2022.*	Continuous for 12 months	365 days minimum	Various options being explored by Hanson for real-time equipment.** Weather Monitoring in place.
Proposed: Eastern Boundary (Pine Trees)	Cattery and Kennel resident		Continuous for 12 months	365 days minimum	Various options being explored by Hanson for real-time equipment.** Weather Monitoring in place.

Notes:

** Historically, threshold figures of 4 g/m2 /month (no more than 2 g/m2 /month above background), as a monthly average, taken at the boundary of an industrial premises (such as the subject Site), have been and are currently used. These figures can be continued to be used as a 'rule of thumb' level for requiring further investigation and addressing dust issues, but not as a level up to which industry is allowed to pollute up to. According to the EPA, this monitoring only partially contributes to meeting the GED, because the focus and emphasis needs to be on reviewing operation controls and management practices to prevent and minimise dust nuisance as far as reasonably practicable.*

*** Although to be used for background measurement purposes for the EPA, this proposed monitoring (that is currently being explored by Yannathan) can be linked to a reactive management strategy that would allow changes to the operations on the Site to be made if particle concentrations are reaching adopted criteria over a short timeframe (e.g. 1 hour) that may impact on the achievability of the 24-hour health-based values.*

Table 6 – Dust Monitoring (Existing) Results

Location	Results
Northern Boundary (Westernport Road)	Directional dust deposition gauge The (top) bottle of this gauge recorded the most samples (i.e. 92 out of 170 samples or 54% of samples from 2007-2022), compared to the sample containers in the NESW directions, that exceeded 4 $g/m^2/mth$. In two instances (Sample 324987 24/01/2012 and Sample 328024 21/02/2012), all five samples exceeded 4 $g/m^2/mth$. The most common reason given (for only the main gauge) for criterion excursions is "due to high winds." The average for the (main) bottle recorded between 2007 and 2022 is 8.9 $g/m^2/mth$. The averages for the NESW samples recorded between 2007 and 2022 are between 1.8 and 2.5 $g/m^2/mth$.
Southern Boundary (Burts Road)	Directional dust deposition gauge The (top) bottle of this gauge recorded 72 out of 169 samples (or 43%) from 2007-2022 to have exceeded 4 $g/m^2/mth$. In ten instances (between 2007 and 2022), all five samples exceeded 4 $g/m^2/mth$. The most common (i.e. 20 out of 40) reason given (for any of the sample containers) for criterion excursions was due to northerly winds. The average for the main gauge recorded between 2007 and 2022 is 5.4 $g/m^2/mth$. The averages for the NESW samples recorded between 2007 and 2022 are between 2.4 and 8.0 $g/m^2/mth$ (only the northern sample had exceeded the criterion).
Western Boundary (West Milners Road)	Directional dust deposition gauge The (top) bottle of this gauge recorded the most samples (i.e. 119 out of 159 samples or 75% of samples from 2007-2022), compared to the sample containers in the NESW directions, that exceeded 4 $g/m^2/mth$. In eleven instances (between 2007-2022) did all five samples exceed 4 $g/m^2/mth$. The most common reason (i.e. 36 out of 38) given for criterion excursions is "due to high winds." The average for the (main) bottle recorded between 2007 and 2022 is 7.0 $g/m^2/mth$. The averages for the NESW samples recorded between 2007 and 2022 are between 2.6 and 3.8 $g/m^2/mth$.
Eastern Boundary (Pine Trees)	Directional dust deposition gauge The (top) bottle of this gauge recorded 88 out of 145 samples (or 61%) from 2007-2022 to have exceeded 4 $g/m^2/mth$.

Location	Results
	In five instances (between 2007 and 2022), all five samples exceeded 4 $g/m^2/mth$. The most common (i.e. 38 out of 48) reason given (for any of the sample containers) for criterion excursions was due to high winds with a mixture of wind directions given mainly from the southern and western directions. The average for the (main) bottle recorded between 2007 and 2022 is 9.8 $g/m^2/mth$. The averages for the NESW samples recorded between 2007 and 2022 are between 2.3 and 14.7 $g/m^2/mth$ (only the western sample had exceeded the criterion).

8 Triggers and Contingencies

Table 7 identifies triggers and contingency actions relating to the dust monitoring program.

Table 7 – Triggers and Contingencies

Trigger	Contingency/Action
Dust complaint made to Hanson, Council or EPA	All complaints (or concerns) made to Hanson shall be investigated for verification and validated within 24 hours of the initial complaint being made and recorded in Hanson's incident/complaint register (or as appropriate). The following must be recorded for all verification investigations for follow-up on a complaint: • Time, date and location of incident; • General description of incident and person making the report (if not anonymous); • Weather conditions at the time of the incident (including wind direction); • What did the dust look like to the interested party including colour if possible?; • Record the intensity of the dust (strong or weak emissions)?; • Where was the dust thought to be coming from (i.e. what direction?); • How long the dust emission lasted for that day?; • How often has the dust emission occurred if it has happened before?; • The impact that the dust has had on the interested party; • Time and date of follow-up investigation; • Weather conditions at the time of the follow-up investigation (face to face follow-up is preferred here); • Name of person undertaking the investigation; • If determined to be an on-site source, assess need to alter on-site activities or further mitigate dust (e.g. implement water truck use, dust binder, etc); • Summary of investigation findings; • Specification of whether further action is required (e.g. continue existing monitoring in area, if any; or change and/or implement new monitoring); • Where applicable, let the interested party know of the findings and any actions to be put in place [(Hanson may also need to follow up with them with results/outcomes of changes processes/procedures (e.g. monitoring, work practices, etc)]; • Completion and closing out of any required actions in the action register;

Trigger	Contingency/Action
Dust levels reported above adopted criteria	• Undertake further monitoring at the affected location over the following week, including weather conditions at the time of the follow-up investigation; • If results remain elevated, review weather conditions and daily inspection reports to identify the likely source; • Enter incident into a (site) reporting register, log, etc with detail of the determined source of the dust; • If determined to be an on-site source, assess need to alter on-site activities or further mitigate dust (e.g. implement water truck use, dust binder, etc); • Undertake additional monitoring following alteration of activities, including weather conditions at the time of the follow-up investigation; and • Closure for rectification of issue/s.

In the event of an incident or an emergency, the following 24 hour emergency contact number shall be called:

24 hour Emergency Contact: 1800 882 478

9 Monitoring Data Management and Reporting

9.1 Monitoring Data

An electronic database of all recorded monitoring data will continue to be maintained by Hanson (as it has been up to now for the results from the dust deposition gauge monitoring currently employed on-site). Hanson shall continue to add new data to the database after each collection event and include the complete set of data for all historical and recent events.

In addition to analytical monitoring, daily dust inspection records, any dust release events and weather station data should also be stored electronically.

Hanson should maintain such a database with the potential that it could be audited at any time by regulatory authorities such as ERR, EPA, WorkSafe, etc.

10 Conclusions

Depending on the phase of works and meteorological conditions, Edge has developed controls and mitigation strategies to manage the risk to human and ecological health. The controls and mitigation strategies include:

10.1 Controls and Mitigation Strategies

- Prior to all work continuing, all personnel must read and understand this plan;
- Ensure this plan and appropriate SDS are accessible by all site workers and visitors (the latter where applicable if not escorted);
- Have controls at the ready (if needed) such as water hoses and/or water carts;
- Monitor wind and weather forecasts (Bureau of Meteorology), if Hanson does not have access to an on-site weather monitor;
- Cease work activities temporarily or re-organise quarrying activities based on any adverse weather conditions (e.g. relocate active works away from sensitive locations or cease works for a short period of time, such as a 'few' hours, until more favourable meteorological conditions are experienced); and
- Check all boundaries when monitoring dust conditions.

11 SEMP (Dust) Review

It is the responsibility of the Site Manager/Supervisor to review the SEMP (dust) periodically and ensure that it is:

- Up-to-date with potential dust sources and their controls; and
- Current with any organisational changes, such as changes to site management.

Amendments to the SEMP (dust) must be carried out in accordance with the document control procedure discussed in ***Section 1*****.**

The Site Manager/Supervisor or its nominated consultants may periodically audit the SEMP (dust) in relation to the site operations that are being undertaken. Such a review may result in a requirement for the SEMP (dust) to be updated.

12 Disclaimer

This plan was prepared in accordance with industry accepted environmental sustainability consulting practice concerned with the operation on sites similar to the subject site. The service provided is conducted in a manner consistent with that of the same care and skill ordinarily exercised by members of the same profession currently practicing under the same conditions.

No other warranty, expressed or implied, is made as to the professional advice indicated in this plan. Note that it may not contain sufficient information for the purposes of other parties or for other uses. It should be recognised that this plan is not intended to be a definitive investigation of the environmental management at the subject property. The assessment did not include a review of compliance with any Building requirements, any applicable environmental legislation other than the dust-related criteria included within.

The information contained in this plan is accurate to the best of the consultant's knowledge based on the data (plans, etc) given during the preparation of the document in May 2022. Environmental criteria can change in a limited time, which may be important if the plan is used after a protracted delay, without reviews in place, etc.

The initiatives/measures of this plan are based upon phone conversations with the proponent, perusal of external data from regulatory agencies and industry bodies – which was conducted by Edge personnel. While normal assessments of data reliability have been made, Edge assumes no responsibility or liability for errors in any data obtained from the regulatory agencies, statements from sources outside of Edge, or developments resulting from situations outside the scope of this project.

Opinions and recommendations presented herein apply to the existing and reasonably foreseeable site conditions at the time of this plan preparation. They cannot apply to site changes of which Edge is unaware and has not had the opportunity to review. Changes in applicable standards may also occur because of legislation or the broadening of knowledge in the subject industry/sector. Accordingly, the initiatives/measures put forward in this plan may be invalidated, wholly or in part, by changes beyond our control.

This plan does not, and not purports to give legal advice on the actual construction/set-up or operation of the development or matters relating to it. Qualified legal practitioners can only give this advice.

13 References

1. A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities. *Department of Environment and Conservation,* March 2011.
2. Bureau of Meteorology – Nilma North (Warragul) Wind Roses, Prepared and purchased, 28 June 2022
3. Civil Construction, building and demolition guide, *EPA Victoria Publication 1834*, November 2020
4. Environment Protection Act 2017 – EPA Victoria
5. Environmental Reference Standard 2021 – EPA Victoria
6. Managing truck and other vehicle movements Guidance sheet*, EPA Victoria Publication 1896*, September 2020
7. The Guideline for Assessing and Minimising Air Pollution, *EPA Victoria Publication 1961*, *February 2022*
8. Victoria planning report, viewed June 2022

Appendix A

Proposed Extraction Area and Existing Dust Monitoring Locations

Figure 1: Proposed extraction area (red polygon is the boundary of the subject Site)

Figure 2: Existing Dust Gauge Locations *(Source: Assessment of Potential Dust Impacts, GHD for Hanson Construction Materials, May 2013)*

Figure 3: Dust Gauge (Burt Road)

Figure 4: Dust Gauge (Western Port Road)

Figure 5: Dust Gauge (West Milners Road)

Figure 6: Dust Gauge (Pine Trees)

Appendix B

Existing Site Dust Deposition Gauges Naming Protocol

Table 1: Sample descriptions for dust deposition samples

Site Location	DDG Samples	DDDG Samples
Northern Boundary	Western Port	North (1)
		East (1)
		South (1)
		West (1)
Southern Boundary	Burts Road	North (2)
		East (2)
		South (2)
		West (2)
Western Boundary	West Milners Road	North (3)
		East (3)
		South (3)
		West (3)
Eastern Boundary	Pine Trees	North (4)
		East (4)
		South (4)
		West (4)

Appendix C

Safety Data Sheet

Hanson
HEIDELBERGCEMENTGroup

Quarry Products

Safety Data Sheet

SECTION 1: IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Company Details:	Hanson Construction Materials Pty Ltd ABN 90 009 679 734
Address	Level 10, 35 Clarence street Sydney 2000
Tel/Fax	Tel: +61 2 9323 4000 Fax: +61 2 9323 4500
Emergency Contact No	1800 882 478

Product:	AGGREGATES, ROAD BASE, SAND AND FILL
Other Names/Synonyms	Gravel, Fill, Road Base, Blue metal, Ridge gravel, Quartz sands, Scoria
Use	Quarry products are used in building construction and other civil Engineering activities such as road building.
Other Information	NA

SECTION 2: HAZARDS IDENTIFICATION

HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA
NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE, IMDG OR IATA

Classification of the substance or mixture
GHS classifications Specific Target Organ Systemic Toxicity (Repeated Exposure): Category 2

Label elements
Signal word WARNING Pictograms

Hazard Statement(s)
H373 May cause damage to organs (lungs) through prolonged or repeated exposure (inhalation).
Prevention Statement(s)
P260 Do not breathe dust.
P272 – Contaminated work clothing should not be allowed out of the workplace.
Response Statement(s)
P314 Get medical advice/attention if you feel unwell.
P363 – Wash contaminated clothing before reuse.
Storage Statement(s)
Disposal Statement(s)
P501 Dispose of contents/container in accordance with relevant regulations.

Other Hazards

The hazard information provided in this Safety Data Sheet applies to the dusts within Silica Sand and particularly inhalable dust particles with a diameter less than 75 microns.

Silica Sand are supplied from naturally occurring materials excavated and processed at sand pits, gravel pits and hard rock quarries. Depending upon the source materials, the quarry product may contain varying amounts of quartz (crystalline silica).

SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS

All significant constituents are listed below:

Major Ingredients

Name	CAS	Proportion
SAND (INCLUDING CRYSTALLINE SILICA)	14808-60-7	0-100 %
Crushed Stone, Gravel	Not required	0-100 %

Note: These are naturally occurring materials excavated and processed at sand pits, gravel pits and hard rock quarries. Depending on the source materials/deposit the Crystalline Silica (quartz) content of any particular quarry product can range from 0 to 100%

Other ingredients may be added:

- Some quarry products such as road base, stabilized and pre-coated aggregates are made by blending materials from one or more quarries/sources in order to meet the required physical properties or customer specification. Aggregates used for road works are often mixed or coated with the below prior to delivery

Portland cement	65997-15-1	0 - 4 %
Blast Furnace Slag or Fly Ash		0 - 4 %
Pozzolans		0 - 4 %
Precoat (Diesel and bitumen)		0 - 1 %
Lime		0 - 4 %

- Some materials sold as quarry products are made by recycling by products from building demolition, and wash out waste from concrete operations
- Depending on the source materials the Crystalline Silica (quartz) of any particular quarry product can range from 0 to 100%

SECTION 4: FIRST AID MEASURES

Swallowed	Rinse mouth and lips with water. Do not induce vomiting. If symptoms persist, seek medical attention
Eye	Flush thoroughly with flowing water, while holding eyelids open, for 15 minutes to remove all traces. If symptoms such as irritation or redness persist, seek medical attention
Skin	Remove heavily contaminated clothing. Wash off skin thoroughly with water. Use a mild soap if available. Shower if necessary. Seek medical attention for persistent redness, irritation or burning of the skin
Inhaled	Remove the source of contamination or move the victim to fresh air. Ensure airways are clear and have a qualified person give oxygen through a face mask if breathing is difficult. If irritation persists seek medical attention
First Aid Facilities	Eye wash and normal washroom facilities

Advice to Doctor: Treat symptomatically or consult a Poisons Information Centre

SECTION 5: FIRE FIGHTING MEASURES

Flammability:	Not flammable or combustible
Hazards from combustion products:	None
Suitable extinguishing media:	Not applicable
Special protective precautions ands equipment for fire fighters:	None
Hazchem code:	None allocated

SECTION 6: ACCIDENTAL RELEASE MEASURES

Spills:

- Dust is best cleaned up by vacuum device to avoid making dust airborne. Wetting down before sweeping up dust may be a useful control measure
- Recommendations on Exposure Controls / Personal Protection (see Section 8 below) should be followed during spill clean-up if conditions are dusty

SECTION 7: HANDLING AND STORAGE

Storage Precautions	No special storage requirements
Transport	Not classified as a Dangerous Goods, according to the Australian Code for the Transport of Dangerous Goods by Road and Rail (6th Edition)
Proper Shipping Name	None Allocated

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

The following applies to dust from this product:

Exposure Limits:
Workplace Exposure Standards for Airborne Contaminants, Safe Work Australia.

- Exposure to dust should be kept as low as practicable, and below the following NES.
- Crystalline silica (quartz): 0.05 mg/m^3 TWA (time –weighted average- 8 Hour) as respirable dust
- Total dust (of any type, or particle size): 10 mg/m^3 TWA

All occupational exposures to atmospheric contaminants should be kept to as low as reasonably practicable and in all cases to below the Workplace Exposure Standard (WES).
TWA (Time Weighted Average): the time-weighted average airborne concentration over an eight-hour working day, for a five-day working week over an entire working life. According to current knowledge this concentration should neither impair the health of, nor cause undue discomfort to, nearly all workers.

Engineering Controls:

- All work should be carried out in such a way as to minimise dust generation, and exposure to dust.
- Mechanical ventilation: Dust extraction and collection may be used, if necessary, to control airborne dust levels
- Work areas should be cleaned regularly

Personal Protection:

Skin:	Ensure a high level of personal hygiene is maintained when using this product. That is; always wash hands before eating, drinking, smoking or using the toilet Remove all contaminated clothing. Wash gently and thoroughly with tepid water and non-abrasive soap. If irritation develops and persists seek medical attention
Eyes	Safety glasses with side shields or safety goggles (AS/NZ 1336) or a face shield should be worn
Respiratory:	Where engineering and handling controls are not enough to minimise exposure to total dust and to respirable crystalline silica, personal respiratory protection may be required. The type of respiratory protection required depends primarily on the concentration of the respirable crystalline silica dust in the air, and the frequency and length of exposure time. Amount of exertion required during the work, and personal comfort are other considerations in choice of respirator. A suitable P1 or P2 particulate respirator chosen and used in accordance with AS/NZS 1715 and AS/NZS 1716 may be sufficient for many situations, but where high levels of dust are encountered, more efficient cartridge-type or powered respirators or supplied-air helmets or suits may be necessary. Use only respirators that bear the Australian Standards mark and are fitted and maintained correctly. For dust levels approaching or exceeding the NES (see above) a more effective particulate respirator providing a greater protection factor should be worn. Procedures for effective use of respirators should be applied and supervised. Do not contaminate the home environment with dusty work clothes and shoes. Do not shake out work clothes before laundering

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance	May range from fine white grains (sand) to large dark rock (aggregate/road base).
Odour	None
Ph	3.0 –10.0
Vapour Pressure	Not determined
Vapour Density	Not determined
Boiling Point/range	Not determined
Freezing/melting point	Not determined
Solubility	Not soluble.
Specific gravity	2.2- 2.7 (water=1)
Flash Point	Not applicable
Upper and lower flammability Limits	Not applicable
Ignition Temp	Not applicable
Particle Size	A *proportion* of the dust may be respirable (below 10 microns) and if it becomes airborne constitutes an exposure if inhaled.

SECTION 10: STABILITY AND REACTIVITY

Chemical Stability:	Chemically Stable
Condition to avoid:	Dust generation.
Incompatible materials:	None
Hazardous Decomposition: Products	None
Hazardous Reactions:	None

Crystalline silica is stable, compatible with other materials, does not polymerise, and will not decompose into hazardous by-products**.**

SECTION 11: TOXICOLOGICAL INFORMATION

Health Effects

Acute (short term)-

Swallowed	Unlikely under normal industrial use. Mildly abrasive to mouth and throat if swallowed
Eye	Dust is irritating to the eyes. Exposure to dust may aggravate pre-existing eye conditions
Skin	Dust may be mildly irritating and drying to the skin due to its physical characteristics
Inhaled	Dust is mildly irritating to the nose, throat and respiratory tract and may cause coughing and sneezing. Pre-existing upper respiratory and lung diseases including asthma and bronchitis may be aggravated

Chronic (long term) -

Eyes	Dust may cause irritation and inflammation of the eyes and aggravate pre-existing eye conditions
Skin	Repeated heavy contact with the dust may cause drying of the skin and can result in skin rash (dermatitis) typically affecting the hands. Over time this may become chronic and can also become infected

Inhaled	Repeated exposure to the dust may result in increased nasal and respiratory secretions and coughing. Inflammation of lining tissue of the respiratory system may follow repeated exposure to high levels of dust with increased risk of bronchitis and pneumonia. Long term occupational over-exposure or prolonged breathing-in (or inhalation) of crystalline silica dust at levels above the NES carries the risk of causing serious and irreversible lung disease, including bronchitis, and silicosis (scarring of the lung), including acute and/or accelerated silicosis. It may also increase the risk of other irreversible and serious disorders including scleroderma (a disease affecting the skin, joints, blood vessels and internal organs) and other auto-immune disorders. Inhalation of dust, including crystalline silica dust, is considered by medical authorities to increase the risk of lung disease due to tobacco smoking The product contains a proportion of respirable free crystalline silica in the quartz component. Crystalline silica (inhaled in the form of quartz or cristobalite from occupational sources) has been classified by The International Agency for Research on Cancer (IARC) as carcinogenic to humans (Group 1). Safe work Australia - workplace exposure standards for airborne contaminants classifies RCS as Category 1A (Carc. 1A) -Known to have carcinogenic potential for humans.
Other Information	Inhalation of airborne particles from other sources in the work environment, including those from cigarette smoke, may increase the risk of respiratory diseases. It is recommended that all storage and work areas should be smoke-free zones and that other airborne contaminants should be kept to a minimum

SECTION 12: ECOLOGICAL INFORMATION

Aggregates, Road Base, Sand and Fill

Ecotoxicity	Quarry Products pose no ecology risk. They are non-toxic to aquatic and terrestrial organisms and are not biodegradable
Persistence and Degradability	Product is persistent and is non-degradable
Mobility	Low mobility would be expected in a landfill situation
Dust	Crystalline silica is non-toxic to aquatic and terrestrial organisms; is not biodegradable; is insoluble and is expected to have low mobility in landfill

SECTION 13: DISPOSAL CONSIDERATIONS

- Crystalline silica itself in all common forms can be treated as a common waste for disposal or dumped into a landfill site in accordance with local authority guidelines.
- Measures should be taken to prevent dust generation during disposal and exposure and personal precautions should be observed (see above).
- Wear sufficient respiratory protection. Dampen spilled material with water to avoid airborne dust, then transfer material to a suitable container for reuse.
- May be disposed in local landfill.

SECTION 14: TRANSPORT INFORMATION

UN Number None Allocated

UN proper Shipping name	None Allocated
Class and subsidiary risk	None Allocated
Packing Group	None Allocated
Hazchem Code	None Allocated
Special precautions for user	See Above
DG class	None Allocated

SECTION 15: REGULATORY INFORMATION

- Crystalline silica is classified as non-Dangerous Goods according to the Australian Code for the Transport of Dangerous Goods by Road and Rail
- Crystalline silica in the form of respirable dust is classified as Hazardous according to the Safe work Australia (formerly ASCC/NOHSC) Approved Criteria For Classifying Hazardous Substances [NOHSC:1008] 3rd Edition
- Exposures by inhalation to high levels of dust may be regulated under the Hazardous Substances Regulations (State and Territory) as they are applicable to Respirable Crystalline Silica, requiring exposure assessment, and control of inhalation exposure below the NES
- Persons who have potential for exposure above the NES may be required by Regulations to have periodic health surveillance including Chest X-ray (see relevant State Government Regulations and SWA (ASCC/NOHSC documentation)

SECTION 16: OTHER INFORMATION

Emergency Contact No (All hours)
1800 882 478

Emergency Contact No (Office Hours)
Contact For further information contact the Risk Manager at your nearest Hanson office;

New South Wales & ACT
Level 18, 2-12 Macquarie St
Parramatta, NSW, 2150
Ph: (02) 9354 2600
Fax: (02) 9354 2699

Tasmania
114 Gormandston Road
Moonah, TAS, 7009
Ph: (03) 6272 6796
Fax: (03) 6272 1714

South Australia
55 Galway Avenue
Marleston, SA, 5033
Ph: (08) 8292 5950
Fax: (08) 8292 5995

Northern Territory
Winnellie Road Level 1
Winnellie, NT, 5789
Ph: (08) 8984 4266
Fax: (08) 8984 3717

Victoria
601 Doncaster rd
Doncaster, VIC, 3108
Ph: (03) 9274 3700
Fax: (03) 9274 3794

Queensland
10 The Boulevard
Brisbane Airport 4008
Toowong, Qld, 4066
Ph: (07) 3246 5500
Fax: (07) 3246 5533

Western Australia
level 1 35 Great Eastern Highway
Rivervale, WA, 6103
Ph: (08) 9311 8811
Fax: (08) 9470 2793

Authorised by: Paul Johnston
Date of issue information 1/7/2020 (*Replace version dated 1-7-15*)

Notice: We believe the information contained in this Safety Data Sheet is accurate and is given in good faith, but no warranty expressed or implied is made. The suggested procedures are based on experience as of the date of publication. They are not necessarily all-inclusive nor fully adequate in every circumstance. Users are advised to make their own independent determination of suitability and completeness of information at their own risk, in relation to the particular purposes and specific circumstances.
Since the information contained in this document may be applied under conditions beyond our control, no responsibility can be accepted by us for any loss or damage cause by any person acting or refraining from action as a result of any information contained in this Safety Data Sheet. Where the information provided herein disclosed a potential hazard or hazardous ingredient, adequate warning should be provided to employees and users and appropriate precautions taken

END OF SDS

Appendix D

AS/NZS 3580.10.1:2016

Australian/New Zealand Standard™

Methods for sampling and analysis of ambient air

Method 10.1: Determination of particulate matter—Deposited matter—Gravimetric method

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EV-007, Methods for Examination of Air, to supersede AS/NZS 3580.10.1:2003.

The objective of this Standard is to provide regulatory and testing bodies with a Standard method for determining deposited matter that rapidly settles from the air. The objective of this revision is to add Appendix A which sets out a procedure for determining the mass deposition rate of metals present in the deposited matter.

The term 'normative' has been used in this Standard to define the application of the appendix to which it applies. A 'normative' appendix is an integral part of a Standard.

FOREWORD

Particulate matter sampled by this method is predominantly dust particles which, because of their size, rapidly settle from the air. This dust can be a nuisance by soiling property in the vicinity of its point of emission. Some common sources of such particles are minerals processing, bulk materials handling, surface mining operations, industrial processes, unsealed roads, incineration and natural causes such as wind-blown dust.

This method is used primarily to establish long-term trends and to investigate localized dustfall.

This procedure has been widely used in Australia for over 40 years and, during this time, extensive data has been collected. Data collected using this method is not directly comparable with data obtained by other deposit gauge methods.

Depending on the situation, the metal content of the deposited matter can be of interest. Metals occur naturally in soil and rocks and can be released into the air as particulate matter through weathering, mining activities and wind-blown dust. Anthropogenic sources of particulate metals include minerals processing, incineration and combustion of fuels containing metals. Some metals, upon inhalation or ingestion, can lead to a range of health effects such as cancer, neurotoxicity and reproductive toxicity.

STANDARDS Australia
STANDARDS NEW ZEALAND

METHOD

1 SCOPE

This Standard sets out a method for the sampling of particulate matter that is deposited from the atmosphere, and procedures for the gravimetric determination of the mass deposition rate of insoluble solids, ash, combustible matter, soluble solids and total solids from ambient air.

The method provides an estimate of the mean surface concentration of deposited matter settling from the air over a sampling period, typically one month. Particulate matter deposition rates of 0.1 g/m^2 month and above may be determined using a monthly sampling period.

The sample obtained by the sampling procedure specified may be subjected to physical or chemical analysis. A method to determine deposition rates for metals present in deposited matter is provided in Appendix A of this Standard.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1152	Specification for test sieves	
2162	Verification and use of volumetric apparatus	
2162.1	Part 1:	General—Volumetric glassware
2164	Laboratory glassware—One-mark volumetric flasks	
2166	Laboratory glassware—One-mark pipettes	

AS/NZS

3580	Methods for sampling and analysis of ambient air	
3580.1.1	Part 1.1	Guide to siting air monitoring equipment
3580.9.15	Method 9.15	Determination of suspended particulate matter—Particulate metals high or low volume sampler gravimetric collection—Inductively coupled plasma (ICP) spectrometric method

3 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

3.1 Ash

The mass of that portion of the insoluble matter remaining after combustion.

3.2 Combustible matter

The mass of that portion of the insoluble matter lost during combustion.

3.3 Constant mass

Within ±1 mg of the previous mass.

3.4 Deposited matter

Particles which are collected in a deposit gauge (see Clause 6.1) and which pass through a 1 mm mesh sieve complying with AS 1152.

3.5 Insoluble matter

The mass of the insoluble portion of the deposited matter.

3.6 Soluble matter

The mass of the soluble portion of the deposited matter.

3.7 Total solids

The mass of the particulate matter deposited in a deposit gauge.

3.8 U_{95}

A measurement of uncertainty at a confidence interval of 95% according to ISO GUM.

4 PRINCIPLE

Over a given sampling period, particles that settle from the ambient air are collected in a vessel and retained together with any rainwater. The sample is passed through a sieve to remove any extraneous matter (e.g. leaves, insects) and the sieved sample containing the deposited matter is transferred to a filtration apparatus. The insoluble and soluble materials are separated by filtration and the mass of the dried insoluble solids is gravimetrically determined.

The ash and combustible matter content are determined by loss on ignition of the insoluble solids. Soluble solids are determined from the filtrate. The total solids are obtained by the addition of the insoluble solids and the soluble solids. The mass deposition rate of deposited matter is then calculated from the mass of solids obtained, the funnel cross-sectional area and the exposure period.

5 REAGENTS

5.1 General requirements

Only reagents of recognized analytical grade and distilled water or water of an equivalent purity shall be used.

5.2 Copper sulfate solution

Dissolve 7.8 g of copper sulfate pentahydrate ($CuSO_4.5H_2O$) in water and dilute to 1 L in a volumetric flask.

6 APPARATUS

6.1 Deposit gauge

A deposit gauge (see Figure 1) consists of a 150 ±10 mm diameter glass funnel (nominal angle of cone sides 60°) and a glass collection bottle. The internal diameter of the funnel stem shall be sufficient to permit passage of particulate matter during washing. The funnel is supported firmly in the neck of a wide-mouth, glass bottle of a suitable size, preferably of a minimum volume of 4 L, by means of a rubber or plastic stopper with a groove or outlet pipe to allow water overflow under excessive rainfall conditions. The funnel diameter shall be known to the nearest millimetre when used in the calculation of results.

NOTES:

1 The size of the bottle should be selected after consideration of the expected rainfall over the sampling period.

2 The funnel diameter is determined by taking the mean of two measurements (at right angles to each other) of the internal diameter of the funnel.

3 Stoppers should preferably be constructed from a non-reactive, non-friable substance and should be replaced when ageing is evident.

4 Plastic funnels or bottles should not be used.

6.2 Lid

A tight-fitting lid for sealing the deposit gauge collection bottle shall be used during transport. It shall be made of an impermeable material that does not react with the expected constituents of the collected deposited matter.

6.3 Stand

The stand supports the deposit gauge such that the horizontal plane of the funnel is 2.0 ±0.2 m above ground level. The stand shall be sufficiently sturdy to prevent any noticeable sway and ensure the funnel aperture plane is maintained in a horizontal position. A typical stand is illustrated in Figure 2. The stand generally incorporates a container or beaker to protect the bottle contents from sunlight which has the potential to accelerate algal growth. This container or beaker should be provided with a drainage hole at the base to prevent rainwater build-up.

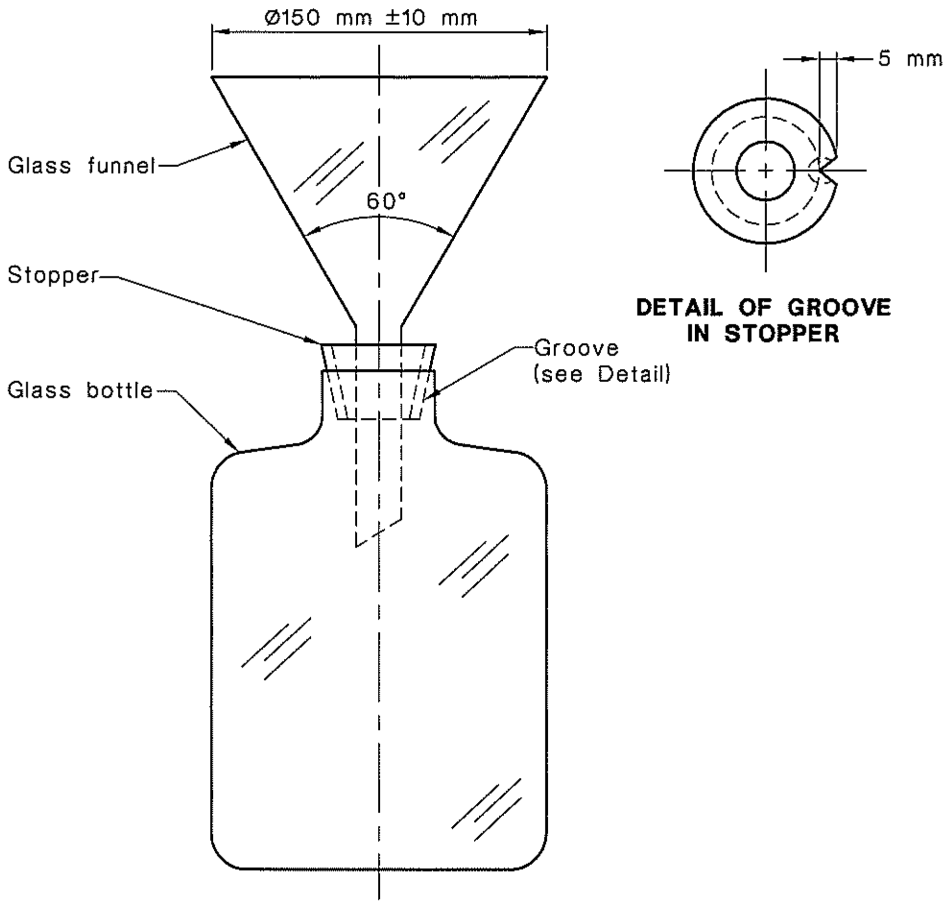

FIGURE 1 TYPICAL STANDARD DEPOSIT GAUGE

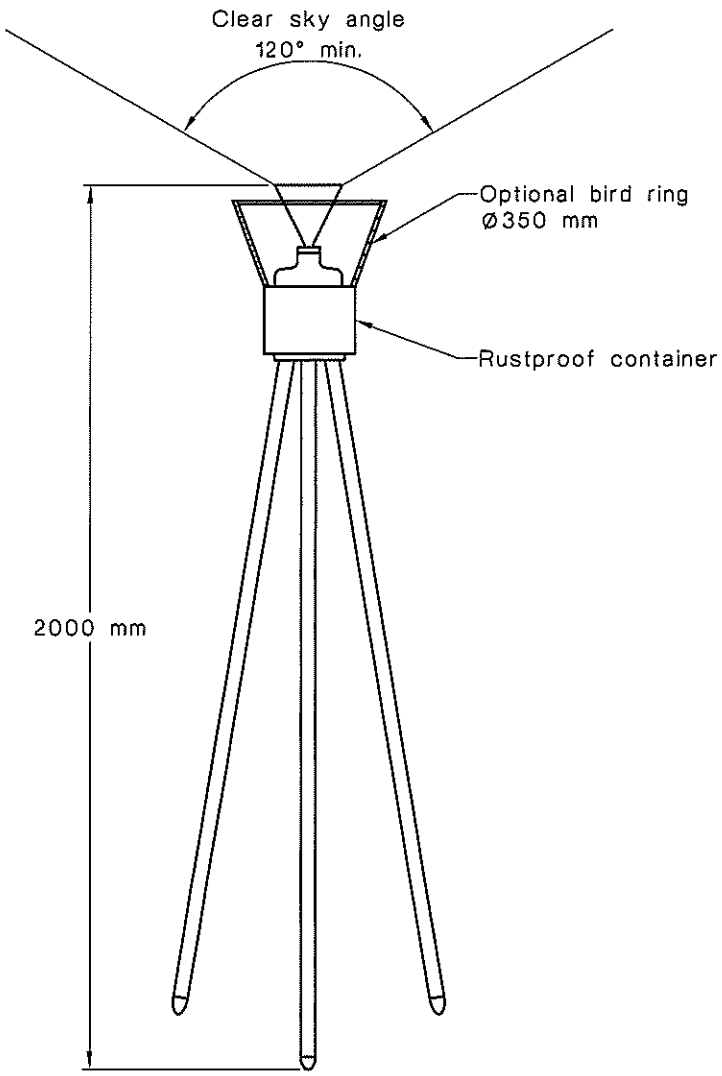

FIGURE 2 TYPICAL STAND WITH DEPOSIT GAUGE

6.4 Bird ring (optional)

The bird ring (see Figure 2) shall be of inert and corrosion-resistant metal wire (having a diameter of 4 mm to 6 mm) and of suitable design to prevent birds perching on the funnel.

6.5 Glassware

Grade A volumetric glassware shall be used throughout. Volumetric flasks shall comply with AS 2164, and pipettes shall comply with AS 2166. Use of volumetric glassware shall comply with AS 2162.1.

All beakers, flasks, evaporating dishes and crucibles (including filters) shall be uniquely numbered to ensure traceability of each sample as it proceeds through the analysis process.

6.6 Filtration apparatus

Silica crucibles with porous filter bases (porosity 3) or Gooch crucibles of porcelain, silica or alundum with filter pads of equivalent retention are acceptable for separation of the insoluble fraction from the soluble fraction. Alternatively, Buchner funnels with an appropriate filter pad of glass, quartz or ashless filter paper and membrane filters may be used.

NOTE: Consideration should be given to the hygroscopic nature of the filter.

The choice of filter apparatus is based on the difficulty of filtering the deposited material and any further analysis of collected material required.

6.7 Test sieve

The test sieve shall have a 1 mm aperture and comply with AS 1152.

6.8 Filter cutter

If required, a means of cutting filter pads without contamination shall be used. Suitable cutters include ceramic knives or scissors.

7 SAMPLING

7.1 Location

The sampling site should be selected in accordance with the guidelines given in AS/NZS 3580.1.1.

7.2 Positioning of the gauge

The height of the funnel aperture above the surface of the immediate surrounding area shall be 2 ±0.2 m. It is important that the funnel aperture plane is horizontal.

7.3 Period of exposure

For routine monitoring programs, the period of exposure is typically 30 ±2 days.

7.4 Procedure

7.4.1 *Preparation of deposit gauge*

Washing agents that do not attack the inside surface of the deposit gauge and lid shall be used to clean the deposit gauge bottle. After cleaning, the deposit gauge bottle shall be rinsed with water in order to remove any remaining extraneous matter and residual washing agent. Pipette 10.0 mL of copper sulfate solution (see Clause 5.2) into the deposit gauge bottle so as to prevent algal growth in the deposit gauge. Tightly seal the bottle. The gauge and prepared assembly should be packed for transport to the sampling site.

7.4.2 *Gauge exchange*

Deposit gauges should be changed on the first day of each month or as near as possible to the first day of each month. Where a gauge has overflowed soluble matter cannot be determined. The volume of liquid in the gauge should be recorded as it gives an indication of the rainfall for the exposure period.

At the end of the exposure period, the gauge exchange procedure shall be as follows:

(a) Wash any deposited matter adhering to the inside of the funnel into the deposit gauge bottle using a minimum volume of distilled water from a wash bottle.

    NOTE: A brush or rubber policeman may be used to dislodge any foreign/particulate matter adhering to the internal surface of the funnel.

(b) Remove the funnel and attached stopper and seal the bottle with a lid. Identify the bottle with a label detailing the site location, period of exposure and funnel diameter to the nearest millimetre. Return the bottle to the laboratory for analysis.

(c) Insert the clean funnel with attached stopper into a fresh bottle containing algicide and leave exposed for the next sampling period.

(d) Ensure that the funnel is firmly held in the neck of the bottle and that the funnel aperture plane is horizontal.

7.4.3 *Storage*

During storage, deposit gauges shall be tightly sealed and kept in a cool, dark environment to prevent the growth of algae, fungi and other micro-organisms. Analysis of the deposited matter should be performed at the earliest opportunity and completed within 30 days of collection.

8 PROCEDURE FOR SAMPLE ANALYSIS

8.1 Determination of total solids

8.1.1 *General*

Total solids shall be determined by either of the procedures in this Clause (8.1).

8.1.2 *Procedure 1*

The procedure shall be as follows:

(a) Pass the contents of the deposit gauge bottle into a beaker or flask through a 1 mm test sieve (see Clause 6.7), ensuring that all particulate matter is washed out.

(b) Transfer the remaining particles adhering to the internal surface of the deposit gauge into the beaker or flask, with the aid of a rubber policeman, and small quantities of water. Evaporate the contents of the vessel on a hotplate to a volume of approximately 30 mL and then transfer the contents to an evaporating dish which has been dried at 105°C for 1 h, cooled in a desiccator and weighed (m_1).

NOTES:

1 It may be necessary to carry out the evaporation in several stages if the total volume of rainwater and washings are large.

2 For rapidity, provided that no material is lost, vacuum distillation, a vacuum oven or a sand bath may be used as alternatives to the hotplate.

(c) Evaporate the contents of the evaporating dish on a steam bath or hotplate to near dryness and transfer to a drying oven. Dry at 105 ±5°C for 1 h, cool in a desiccator and weigh. Repeat the drying, cooling and weighing process until the dish and its contents are at a constant mass and record the mass (m_2).

(d) Place the evaporating dish on a hotplate, add approximately 50 mL of water and heat gently for 30 min to redissolve soluble solids, then proceed to Clause 8.2.2(d) or Clause 8.2.3(d), as applicable for the determination of insoluble solids.

8.1.3 *Procedure 2*

Determine the insoluble solids according to Clause 8.2 and soluble solids according to Clause 8.4. The sum of these two fractions comprises the total solids.

8.2 Determination of insoluble solids

8.2.1 *General*

If the deposit gauge bottle contains a large volume of water (rainfall plus washings from Clause 7.4.2(a)), filter the contents of the bottle through the filtration apparatus (see Clause 6.6) until approximately 400 mL remains, taking care not to disturb the deposit.

Determine insoluble solids by either of the procedures in this Clause (8.2).

If soluble solids are to be determined then ashless filters shall be used.

NOTES:

1 The filter details, i.e. type, porosity and grade, should be recorded.

2 This filtrate is required for the determination of soluble solids (as described in Clause 8.4.3(b)) and should be retained if determination of soluble solids is required.

8.2.2 *Using Gooch crucibles with filter pads or silica crucibles with porous bases*

The procedure shall be as follows:

(a) Assemble the Gooch crucible apparatus.

(b) Pass the contents of the deposit gauge bottle into a beaker or flask through a 1 mm test sieve. Use a rubber policeman to ensure that all particulate matter in the gauge is transferred.

(c) Place the beaker or flask containing the sample on a steam bath or hotplate and evaporate to approximately 30 mL (see Clause 8.1.2(b), Note 2).

(d) Heat a crucible to 850°C in a furnace and maintain for 30 min, allow to cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass and record the mass (m_3).

(e) Pass the sample through the prepared crucible (Step (d)).

NOTE: The filtrate from this procedure should be added to the filtrate collected at Clause 8.2.1 if soluble solids are to be determined using the procedure in Clause 8.4.

(f) Dry the filter crucible in a drying oven for a minimum of 1 h at 105 ±5°C, cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass and record the mass (m_4).

8.2.3 *Using Buchner funnel and filter pad*

The procedure shall be as follows:

(a) Assemble the Buchner funnel and filter, apply a vacuum and pass 500 mL of distilled water through the filter. Discard the filtrate.

(b) Dry the filter in an oven held at 105 ±5°C for 1 h, cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass and record the mass (m_3).

NOTE: The procedure described in Steps (a) and (b) is not required for membrane filters.

(c) Pass the contents of the deposit gauge bottle into a beaker or conical flask through a 1 mm test sieve. Use a rubber policeman to ensure that all particulate matter in the gauge is transferred.

(d) Filter the sample through the Buchner funnel and previously prepared filter.

NOTE: The filtrate from this procedure should be added to the filtrate collected at Clause 8.2.1 if soluble solids are to be determined using the procedure in Clause 8.4.3.

(e) Remove the filter and dry in an oven held at 105 ±5°C for a minimum of 4 h. Cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass and record the mass (m_4).

8.3 Determination of ash and combustible matter

8.3.1 *General*

Determine combustible matter by calculation according to Clause 9.1(d). Determine ash by either of the procedures in this Clause (8.3):

8.3.2 *Using Gooch crucibles with filter pads or silica crucibles with porous bases*

The procedure shall be as follows:

(a) Heat the crucible from Clause 8.2.2 Step (f) to 850°C for 30 min to ignite the sample.

(b) Allow the crucible to cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass. Record the mass (m_5).

8.3.3 *Using Buchner funnel and filter pad*

The procedure shall be as follows:

(a) Heat a crucible to 850°C for 30 min.

(b) Allow the crucible to cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass. Record the mass (m_3).

(c) Fold and place the dried filter paper, or portion of filter paper if metals analysis is also being undertaken, containing the insoluble solids (see Clause 8.2.3(e)) into the crucible.

(d) Heat the crucible at 850°C for 30 min to ignite the sample. Allow to cool in a desiccator and weigh. Repeat the heating, cooling and weighing process to constant mass (m_5).

NOTE: The temperature of the furnace should be raised gradually to 850°C to minimize loss of sample. The crucible may be placed in a furnace at 200°C and the temperature increased gradually to 500°C over a 30 min period and then increased to 850°C over a further 30 min period. The total ashing time will therefore be 90 min.

8.4 Determination of soluble solids

8.4.1 *General*

Soluble solids are calculated from the difference between the total solids and the insoluble solids or by evaporation of the filtrate from the insoluble solids determination.

Determine by either method in this Clause (8.4).

8.4.2 *Using direct calculation*

Soluble solids are calculated from the difference between the total solids and the insoluble solids (see Clause 9.1(e)(i)).

8.4.3 *Using filtrate collected during the insoluble solids procedure*

The soluble solids are determined from the filtrate of the insoluble solids determination (see Clause 8.2). The procedure shall be as follows:

(a) Transfer the filtrate from Clause 8.2 to a large beaker and evaporate on a hot plate to approximately 30 mL.

(b) Transfer the filtrate to a pre-weighed evaporating dish (m_6) that has been dried at 105 ±5°C for 1 h.

(c) Evaporate the contents of the evaporating dish on a steam bath or hotplate to near dryness and transfer to a drying oven. Dry at 105 ±5°C for 1 h, cool in a desiccator and weigh. Repeat the drying cooling and weighing process until the dish and its contents are at a constant mass and record the mass (m_7).

NOTE: For large volumes of filtrate (greater than 1 L) it is permissible to determine the soluble solids from an aliquot of the total filtrate. Record the total volume of filtrate then take a known volume and proceed as in Step (a). The aliquot volume should be sufficient to obtain a measurable mass.

9 CALCULATION AND EXPRESSION OF RESULTS

9.1 Calculation

The results shall be calculated as follows:

(a) *Mass deposition rate of total solids*

Total solids are calculated by either of the following methods:

(i) If total solids are determined according to Clause 8.1.2—

$$S_t = \frac{[(m_2 - m_1) - 0.055] \times 10^6 \times 4 \times F}{\pi \times D^2 \times t} \qquad \text{. . . 9.1(1)}$$

where

S_t = mass deposition rate of total solids, in grams per square metre per month

m_2 = mass of the evaporating dish and the total solids in the sample, in grams

m_1 = mass of the evaporating dish, in grams

F = factor to express results to a 30-day month

= 30

D = diameter of the funnel, in millimetres

t = sampling period, in days

NOTE: The subtraction of 0.055 g in Equation 9.1(1) is a correction for the mass of algicide added to the gauge in Clause 7.4.1.

(ii) If total solids are determined according to Clause 8.1.3—

Total solids (g/m^2.month) = $S_i + S_s$ . . . 9.1(2)

where

S_i = mass deposition rate of insoluble solids, in grams per square metre per month, determined according to Clause 8.2

S_s = mass deposition rate of soluble solids, in grams per square metre per month, determined according to Clause 8.4

(b) *Mass deposition rate of insoluble solids*

$$S_i = \frac{(m_4 - m_3) \times 10^6 \times 4 \times F}{\pi \times D^2 \times t} \qquad \text{. . . 9.1(3)}$$

where

S_i = mass deposition rate of insoluble solids, in grams per square metre per month

m_4 = mass of the filter, or crucible if used, and the insoluble solids in the sample, in grams

m_3 = mass of the pre-dried filter, or crucible if used, in grams

F, D and t are as previously defined in Item (a)(i).

(c) *Mass deposition rate of ash*

$$S_a = \frac{(m_5 - m_3) \times 10^6 \times 4 \times F}{\pi \times D^2 \times t} \times \frac{m_4}{(m_4 - m_8)} \qquad \text{. . . 9.1(4)}$$

where

S_a = mass deposition rate of ash, in grams per square metre per month

m_5 = mass of the crucible and the ash in the sample, in grams

m_3 = mass of the crucible, in grams

m_4 = mass of the filter, and the insoluble solids in the sample, as determined in Clause 8.2.3(e), in grams

m_8 = mass of the portion of the filter, and the insoluble solids in the portion, used for insoluble metals analysis, as determined in Clause A2.2(b), in grams

F, D and t are as previously defined in Item (a)(i).

Where the entire filter is ashed, Equation 9.1(4) can be simplified by reducing the $\frac{m_4}{(m_4 - m_8)}$ term to one.

(d) *Mass deposition rate of combustible matter*

Combustible matter (g/m^2.month) = $S_i - S_a$ . . . 9.1(5)

where

S_i = mass deposition rate of insoluble solids in grams per square metre per month, determined according to Clause 8.2

S_a = mass deposition rate of ash, in grams per square metre per month, determined according to Clause 8.3

(e) *Mass deposition rate of soluble solids*

Soluble solids shall be calculated by either of the following methods:

(i) If soluble solids are determined according to Clause 8.4.2—

Soluble solids (g/m^2.month) = $S_t - S_i$ . . . 9.1(6)

where

S_t = mass deposition rate of total solids, in grams per square metre per month, determined according to Clause 8.1.2

S_i = mass deposition rate of insoluble solids, in grams per square metre per month, determined according to Clause 8.2

(ii) If soluble solids are determined according to Clause 8.4.3—

$$S_s = \frac{\left[(m_7 - m_6) - 0.055\right] \times 10^6 \times 4 \times F}{\pi \times D^2 \times t} \times \frac{V_{tot}}{V_{part}} \quad \text{. . . 9.1(7)}$$

where

S_s = mass deposition rate of soluble solids, in grams per square metre per month

m_7 = mass of the evaporating dish and soluble solids, in grams

m_6 = mass of the evaporating dish, in grams

V_{tot} = total volume of filtrate, in mL

V_{part} = volume of filtrate used for soluble solids determination, in mL

F, D and t are as previously defined in Item (a)(i).

NOTE: The subtraction of 0.055 g in Equation 9.1(7) is a correction for the mass of algicide added to the gauge in Clause 7.4.1. This assumes the loss of four of the five water molecules.

Where the total filtrate volume is evaporated to dryness, Equation 9.1(7) can be simplified by reducing the $\frac{V_{tot}}{V_{part}}$ term to one.

9.2 Expression of results

Results may be reported in either grams per square metre per month or milligrams per square metre per day. To convert g/m^2.month to mg/m^2.day, multiply by 33.3.

10 MEASUREMENT UNCERTAINTY

The measurement uncertainty shall be determined based on individual laboratory sampling and weighing procedures.

11 TEST REPORT

The test report shall contain the following information:

(a) Reference to this Standard, i.e. AS/NZS 3580.10.1.

(b) Reporting organization.

(c) Deposition rate of solids from air in grams per square metre per month or milligrams per square metre per day.

(d) Location of the deposit gauge: all relevant details, for example, including a coordinate reference to within 100 m, height above ground level, classification of area (e.g. industrial, residential, agricultural or urban).

(e) Any non-conformance with AS/NZS 3580.1.1 or this Standard.

(f) The dates and times of sampling.

(g) Any other relevant data, for example, meteorological conditions, proximity of bushfires, farm ploughing activities, traffic on unsealed roads.

(h) The uncertainty associated with the measurement along with the confidence interval and coverage factor according to ISO GUM.

NOTE: The reporting of data depends somewhat on future use. Additional relevant information which could be reported includes the following:

(a) Mean values (quarterly or annually).

(b) Maximum values (monthly or annually).

APPENDIX A

DETERMINATION OF DEPOSITION RATES OF METALS PRESENT IN DEPOSITED MATTER

(Normative)

A1 SCOPE

This Appendix sets out a procedure for determining the metals content of deposited matter collected in accordance with this Standard using inductively coupled plasma-atomic emission spectroscopy (ICP-AES) or inductively coupled plasma mass spectrometry (ICP-MS).

This method is applicable to the determination of hydrochloric/nitric acid-soluble metals present in the deposited matter. This method is suitable for the determination of the following metals:

(a) Aluminium.

(b) Arsenic.

(c) Antimony.

(d) Barium.

(e) Beryllium.

(f) Cadmium.

(g) Chromium.

(h) Cobalt.

(i) Iron.

(j) Lead.

(k) Magnesium.

(l) Manganese.

(m) Molybdenum.

(n) Nickel.

(o) Selenium.

(p) Thallium.

(q) Tin.

(r) Titanium.

(s) Vanadium.

(t) Zinc.

NOTE: Other elements may be determined by this method if adequate performance is demonstrated.

This method is not suitable for the determination of deposited copper unless a metal-free algicide is used in place of the copper sulfate solution specified in Clause 7.4.1.

The procedure described in this Appendix for extracting metals from the insoluble solids will dissolve metals that are environmentally available.

Typically, metal deposition rates of 0.02 mg per square metre per month and above may be determined for samples collected over a 30-day period, with subsequent analysis by ICP-MS. The minimum reporting limit will vary for different metals.

A2 PROCEDURE FOR METALS DEPOSITION ANALYSIS

A2.1 General

If metals deposition analysis is required, the Buchner funnel and filter pad procedure (see Clause 8.2.3) with ashless filter paper shall be used for the determination of insoluble solids and evaporation of the insoluble solids filtrate (see Clause 8.4.3) shall be used for the determination of soluble solids.

Filters with low and consistent metal content shall be used.

The procedure described in AS/NZS 3580.9.15 for extraction of metals from high and low volume air sampler filters shall be used to extract metals from the insoluble solids collected on the filter paper. Analysis of the metals extraction solution shall be carried out by ICP-AES or ICP-MS as described in AS/NZS 3580.9.15.

Determination of soluble metals shall be performed by redissolving the dry solids from the soluble solids determination in 2% nitric acid solution (i.e. the working diluent solution described in Clause 6.5.3 of AS/NZS 3580.9.15), followed by analysis by ICP-AES or ICP-MS (as described in AS/NZS 3580.9.15).

A2.2 Determination of insoluble metals

After the completion of the insoluble solids determination (see Clause 8.2.3), the procedure for determining insoluble metals shall be as follows:

(a) Cut the dried filter paper into two approximately equal pieces using a filter cutter (see Clause 6.8). To avoid contamination and damage, handle the filter with non-metallic and non-serrated forceps.

(b) Weigh the portion of the filter paper being used for insoluble metals analysis. Record the mass (m_8).

(c) Transfer the filter paper portion to a beaker, or digestion vessel compatible with a dry block heater.

(d) Follow the procedure described in Clause 9.1.3 of AS/NZS 3580.9.15 to extract any metals present on the filter paper in to the solution.

(e) Determine the mass of metals present on the filter paper by ICP analysis of the extracted solution using the procedure described in Clause 9.3 of AS/NZS 3580.9.15.

(f) Prepare and analyse, as described in Clause 9.2.2 of AS/NZS 3580.9.15, a minimum of one laboratory blank filter solution from each batch of filter papers analysed.

NOTES:

1 As an alternative to weighing the filter paper portion as described in Step (b) above, the proportion of the total filter paper used for insoluble metals analysis can also be calculated based on the area of the filter paper portion relative to the area of the original filter paper.

2 The remaining filter paper portion can be used for the determination of ash and combustible matter (see Clause 8.3.3). If determination of ash and combustible matter is not required, the entire filter can be used for metals determination.

A2.3 Determination of soluble metals

The procedure for determining soluble metals shall be as follows:

(a) Following completion of the soluble solids determination (see Clause 8.4.3), place the evaporating dish on a hotplate, add approximately 50 mL of 2% nitric acid solution (prepared as described in Clause 6.5.3 of AS/NZS 3580.9.15) and heat gently to redissolve the soluble solids.

(b) Remove the evaporating dish from the hotplate and allow to cool to room temperature.

(c) Decant the solution into a 100 mL volumetric flask.

(d) Rinse the evaporating dish with approximately 10 mL of 2% nitric acid solution and add to the volumetric flask. Make up to the mark with 2% nitric acid solution and mix thoroughly.

(e) Determine the mass of soluble metals by ICP analysis of the solution using the procedure described in Clause 9.3 of AS/NZS 3580.9.15.

A3 CALCULATION AND EXPRESSION OF RESULTS

A3.1 Calculation

A3.1.1 *General*

Metals results determined using ICP-AES instruments are commonly reported in mass units of micrograms (μg). Metals results determined using ICP-MS instruments are typically reported in units of nanograms (ng) and shall be converted to mass units of μg for the purpose of the following calculations.

A3.1.2 *Calculation of the mass of metals in the insoluble solids fraction*

The mass of metal x present on the filter shall be calculated from Equation A3.1.2:

$$m_{xf} = c_x \times v_x \times d_f \times \frac{m_4}{m_8} \qquad \text{. . . A3.1.2}$$

where

m_{xf} = mass of metal x present on the filter, in μg

c_x = concentration of metal x in the test sample solution, in μg/mL

v_x = volume of test solution, in mL

d_f = dilution factor ($d_f = 1$ when there is no dilution of the sample solution)

m_4 = mass of the filter, and the insoluble solids in the sample, as determined in Clause 8.2.3(e), in grams

m_8 = mass of the portion of the filter, and the insoluble solids in the portion, used for insoluble metals analysis, in grams

The mass of metal x present on each laboratory blank filter (m_{xl}) shall be calculated in the same way.

A3.1.3 *Calculation of the average mass of metals on the laboratory blank filter*

The mass of metal x present on the laboratory blank filter shall be calculated as the mean value of all laboratory blank filter analyses conducted for the particular batch of sample filters:

$$\overline{m_{xl}} = \frac{\sum_{j=1}^{n} m_{xl,j}}{n} \qquad \text{. . . A3.1.3}$$

where

$\overline{m_{xl}}$ = average mass of metal x present in a laboratory blank filter, in μg

$m_{xl,j}$ = mass of metal x present in laboratory blank filter j, in μg

n = number of laboratory blank filters analysed

A3.1.4 *Calculation of the mass of metals in the soluble solids fraction*

The mass of soluble metal x present shall be calculated from Equation A3.1.4:

$$m_{xs} = c_x \times v_x \times d_f \times \frac{V_{tot}}{V_{part}} \qquad \text{. . . A3.1.4}$$

where

m_{xs} = mass of metal x present in solution, in μg

c_x = concentration of metal x in the test sample solution, in μg/mL

v_x = volume of test solution, in mL

d_f = dilution factor (d_f = 1 when there is no dilution of the sample solution)

V_{tot} = total volume of filtrate, in mL

V_{part} = volume of filtrate used in soluble metals determination, in mL

Where the total filtrate volume has been used in the soluble metals mass determination, Equation A3.1.4 can be simplified by reducing the $\frac{V_{tot}}{V_{part}}$ term to one.

A3.1.5 *Calculation of the total deposition rate of metals from ambient air*

The total deposition rate of metal x from ambient air shall be calculated from Equation A3.1.5:

$$S_{mx} = \frac{\left[\left(m_{xf} - \overline{m_{xl}}\right) + m_{xs}\right] \times 10^3 \times 4 \times F}{\pi \times D^2 \times t} \qquad \text{. . . A3.1.5}$$

where

S_{mx} = total mass deposition rate of metal x, in milligrams per square metre per month

m_{xf} = mass of metal x present on the filter, in μg

$\overline{m_{xl}}$ = average mass of metal x present on laboratory blank filters, in μg

m_{xs} = mass of metal x present in solution, in μg

F, D and t are as previously defined in Clause 9.1(a)(i).

A3.2 Expression of results

Results are typically reported in either milligrams per square metre per month or micrograms per square metre per day. To convert from mg/m^2 month to μg/m^2.day, multiply by 33.3.

A4 MEASUREMENT UNCERTAINTY

The measurement uncertainty shall be determined based on individual laboratory sampling, weighing and analysis procedures.

A5 TEST REPORT

The test report shall contain the following information:

(a) Reference to this Standard, i.e. AS/NZS 3580.10.1.

(b) Reporting organization.

(c) Deposition rate of each metal from air in milligrams per square metre per month or micrograms per square metre per day. If the measured concentration is less than the method detection limit, the result shall be reported as 'less than the method detection limit'.

(d) The method detection limit for each metal.

(e) The dates, times (expressed as local or standard time) and period of sampling.

(f) Sampling location—all relevant details, including a coordinate reference to within 100 m, height above ground level and classification of area (peak station, neighbourhood station or background station; refer to AS/NZS 3580.1.1).

(g) Any non-conformance with this Standard.

(h) Any non-conformance with AS/NZS 3580.1.1.

(i) The uncertainty associated with the measurement along with the confidence interval and coverage factor.

(j) Laboratory blank filter results.

(k) Any recovery rates outside of the acceptable range.

(l) Any other relevant data.

NOTES

NOTES

This Australian/New Zealand Standard was prepared by Joint Technical Committee EV-007, Methods for Examination of Air. It was approved on behalf of the Council of Standards Australia on 8 September 2016 and by the New Zealand Standards Approval Board on 6 September 2016 and published on 13 October 2016.

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Originated as AS 2724.1—1984.
Previous edition AS 3580.10.1—1991.
Jointly revised and redesignated as AS/NZS 3580.10.1:2003.
Reconfirmed in 2014.
Second edition 2016.

This Standard was issued in draft form for comment as DR AS/NZS 3580.10.1:2016.

Jointly published by Standards Australia Limited, GPO Box 476, Sydney, NSW 2011 and Standards New Zealand, PO Box 1473, Wellington 6011

ISBN 978 1 76035 582 1 Printed in Australia

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Appendix E

AS/NZS 3580.14:2014

(Key considerations/details)

AS/NZS 3580.14: 2014 sets out methods for the collection of meteorological data for use in ambient air quality monitoring and modelling applications. Requirements and guidance are provided for the in-situ monitoring of primary meteorological variables being: wind speed, wind direction, temperature, humidity, atmospheric pressure, precipitation and solar radiation.

This Standard specifies the following:

- Stable location
- A requirement for the siting of wind sensors at a height of 10 metres above ground level is preferable; however the Installation of wind sensors at a height of at least 2 metres above surrounding ground level is acceptable taking into account other siting factors below.
- Temperature and relative humidity:
  - Mounted over a plot of open level ground at least 9 metres in diameter free of obstructions, and freely exposed to sunshine and wind
  - To be clear of obstructions, this means a distance of at least four times the obstruction height
  - Located at least 30 metres from large, paved areas and not close to hollows or ridges or other changes in terrain (so far as is reasonably practicable)
  - Area should ideally be unwatered short grass, or natural earth (not concrete)
  - Should not be located close to artificial or natural sources of moisture
  - Measurements at 2 metres or higher above ground
- Solar radiation and black globe temperature:
  - An upward-looking solar radiation sensor should be free from any obstructions above the sensor
  - No shadows should be cast on the sensor
  - Should be located away from light-coloured walls or other objects likely to reflect sunlight.

It is sometimes not practical to meet these standards at a particular location. In these instances, the station should ideally be located:

- On a flat cleared area (e.g. a grassy surface)

- Clear from obstructions such as buildings and trees (a rule of thumb would be to locate the weather station ten times the height of the obstruction away).

The station should not be:

- In a gully or other depression
- On a geological formation such as a rock outcrop
- On or near steep slopes, cliffs, or ridges
- On a veranda or under an awning.

If there is a solar panel, this should face north

The data from a weather monitoring station should also be reported and logged in accordance with *AS3580.14-2014.*

The report will include:

- Reference to the Australian standard (*AS3580.14: 2014*).
- Reporting organisation (e.g., Hanson).
- A recorded value for each parameter:
    - The type of instrument used to obtain the recorded value, including starting thresholds for wind direction and wind speed sensors.
    - The calibrated measurement range in the corresponding reporting units.
    - The measurement height above ground level (in meters).
- Date, time and period of sampling.
- Sampling location, including:
    - Coordinate reference.
    - Height above ground level (mAHD).
    - Classification of area with a description of the sampling location.
- Any non-conformance with the standard.
- Uncertainty associated with the measurement along with the confidence interval and coverage factor.
- Any other relevant data, for example:
    - Mean values (e.g. hourly, daily, monthly or annual).
    - Minimum/Maximum values (e.g. hourly, daily, monthly or annual).
    - Time/day, month or year certain values exceeded.

Appendix F

Weather Parameters & Units

Table 1: Reporting Weather Parameters & Units

Parameter Units	Units
Wind Speed	Meters/second (m/s)
Wind Direction	Degrees from true North (°)
Ambient Temperature	Degrees Celsius (°C)
Relative Humidity	Percent (%)
Barometric Pressure	Hectopascals (hPa)
Precipitation	Millimetres (mm)

Appendix G

Dust Deposition Exceedance Graphs

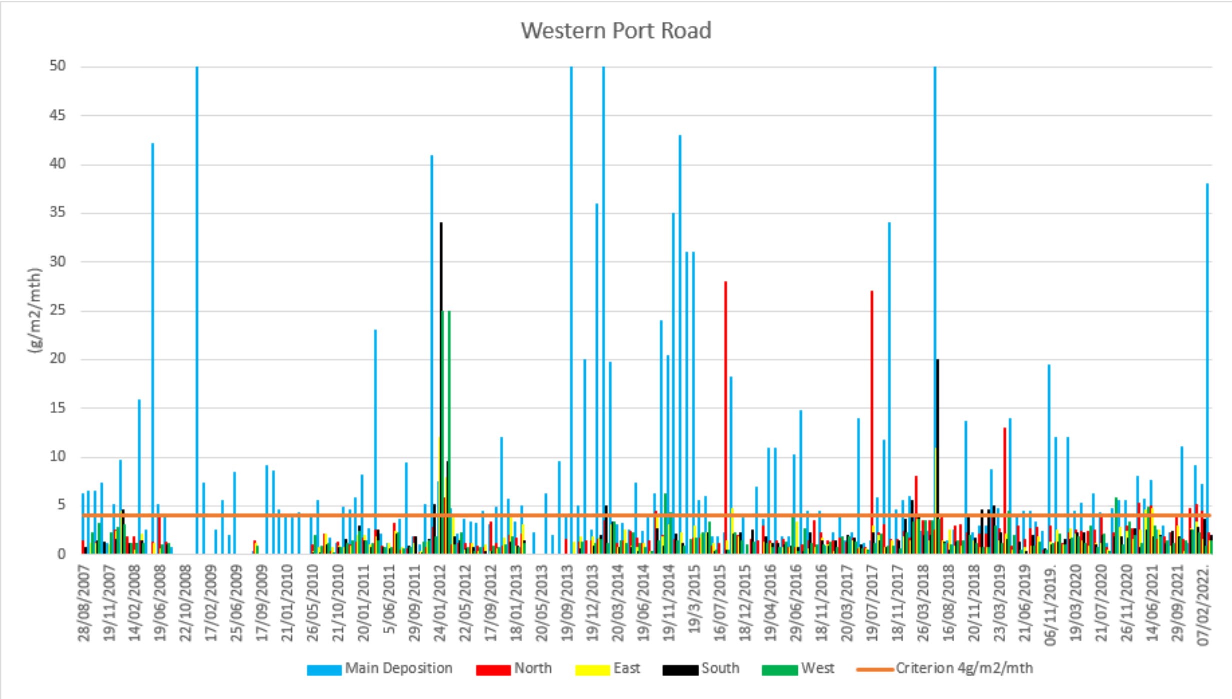

Figure 1: Dust deposition data (over $4g/m^2/mth$) between 2007-2022 from Western Port Road dust gauge

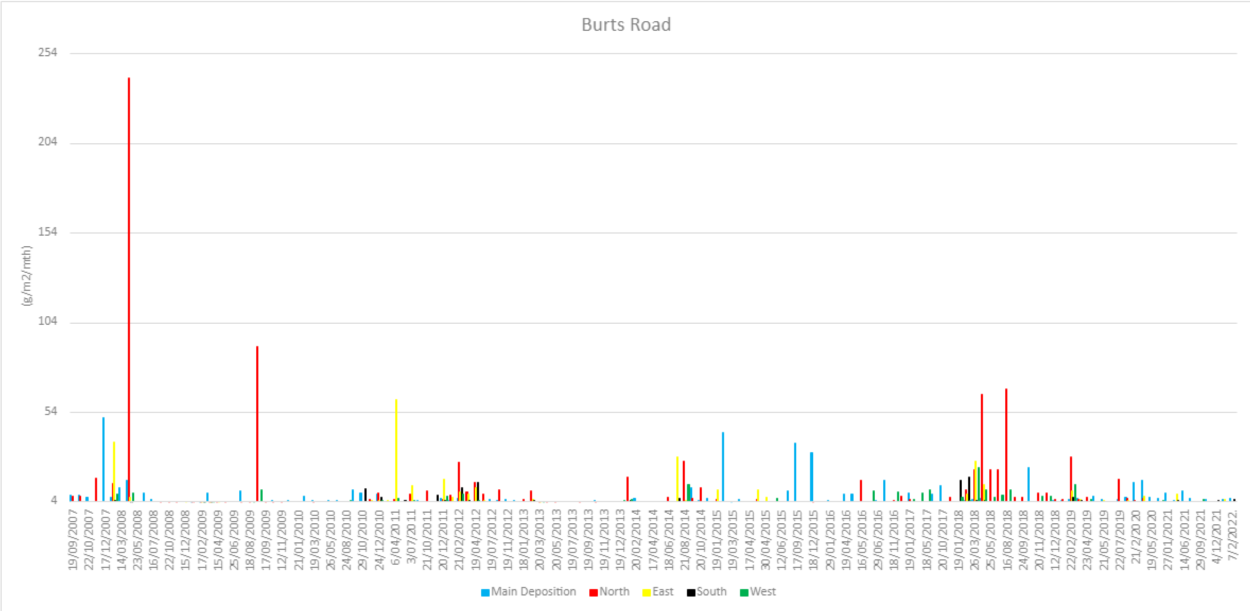

Figure 2: Dust deposition data (over 4g/m^2/mth) between 2007-2022 from Burts Road dust gauge

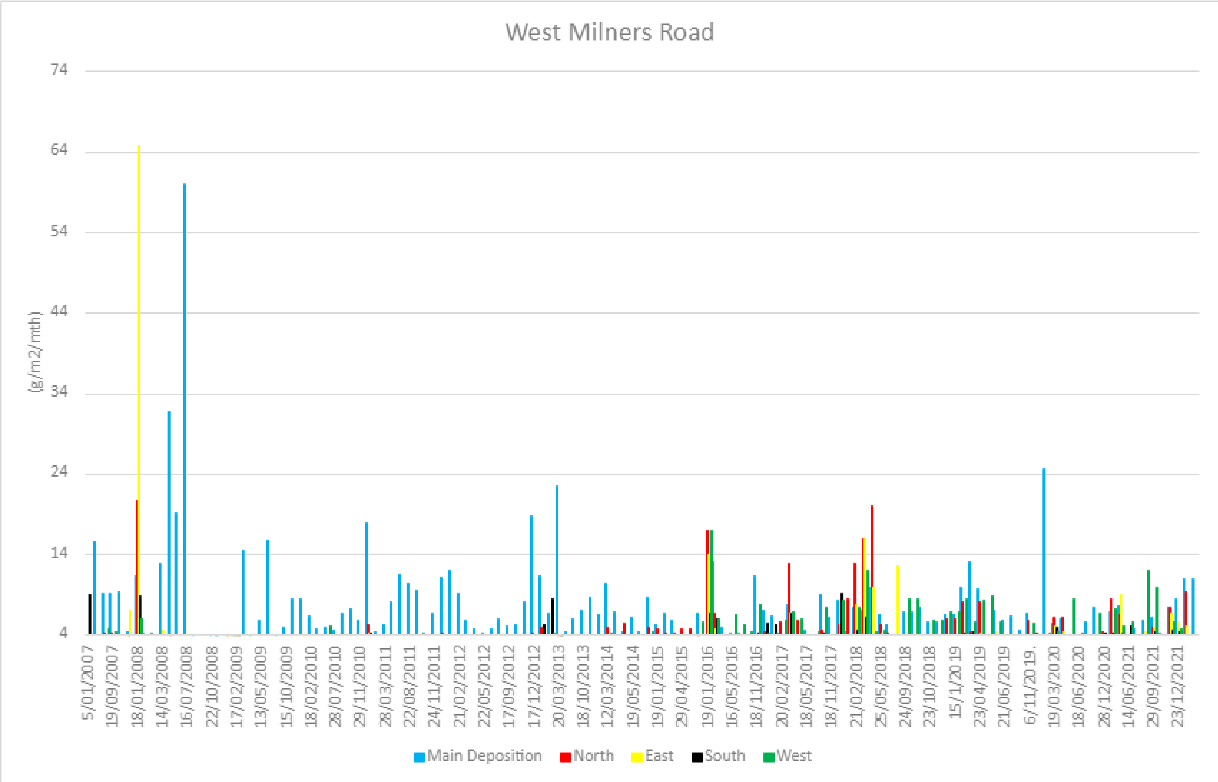

Figure 3: Dust deposition data (over $4g/m^2/mth$) between 2007-2022 from West Milners Road dust gauge

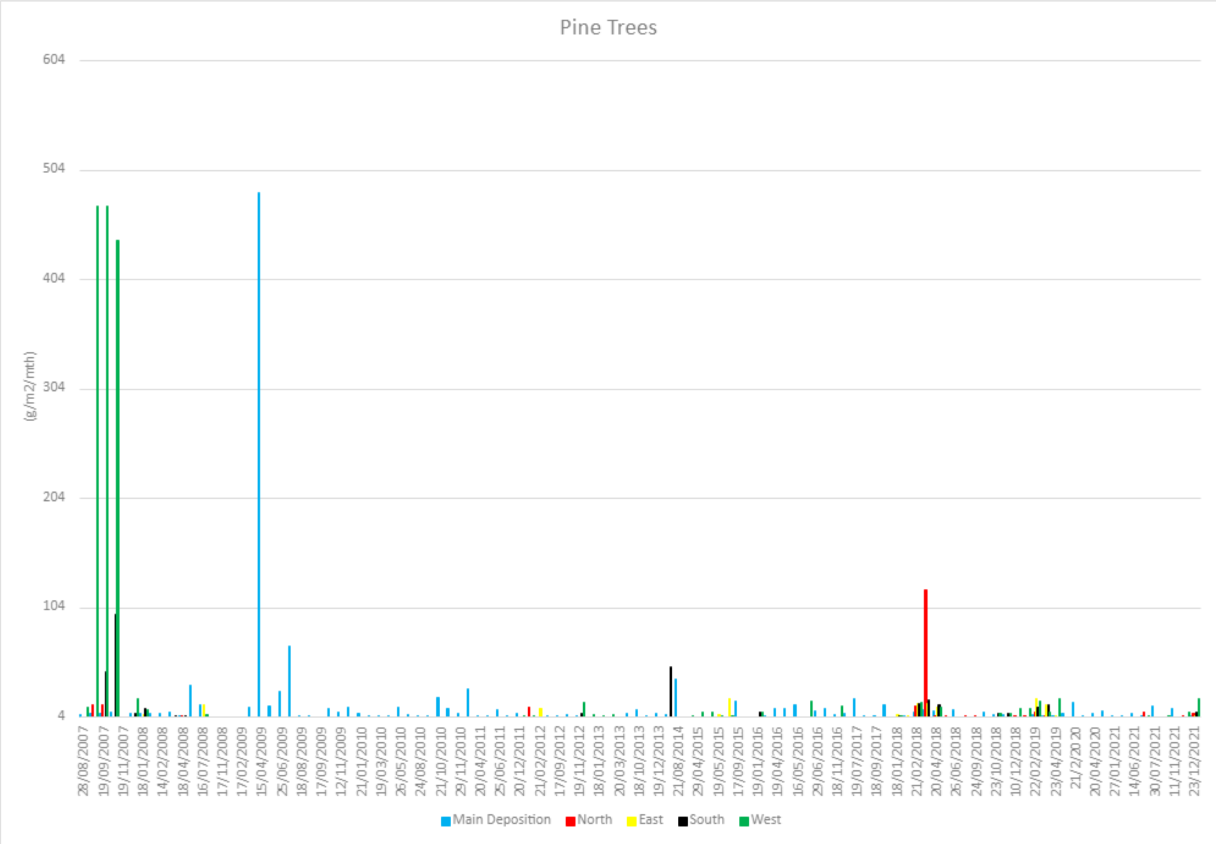

Figure 4: Dust deposition data (over 4g/m^2/mth) between 2007-2022 from Pine Trees dust gauge