Expert Witness Statement of Simon Welchman Fingerboards Minerals Sands Project

Department of Environment, Land, Water and Planning

Fingerboards Mineral Sands Project Inquiry and Advisory Committee

Prepared for:

White & Case on behalf of Kalbar Operations Pty Ltd

February 2021

Prepared by:

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Contents

Tables

Figures

1. INTRODUCTION

1. Name:

   a. Simon John Welchman

2. Address

   a. My business address is Ground Floor, 16 Marie Street, Milton, Queensland 4064.

3. Qualifications

   a. I hold the following qualifications:

      (i) I am a Director of Katestone Environmental Pty Ltd ("**Katestone**"), a consulting firm that works in the areas of air quality, odour, greenhouse gases, climate and weather forecasting.

      (ii) Bachelor of Environmental Engineering (Hons) from the University of Queensland.

   b. My curriculum vitae is attached as Annexure A.

4. I have sufficient expertise to make this statement because I am a qualified environmental engineer who has worked for 25 years in the field of air quality. Since 2004, I have been director of Katestone. During my time as director, I have conducted, managed, supervised and conducted quality assurance on more than one hundred air quality projects per year. I have also guided the development of Katestone's quality assurance process and project management system.

5. I have been instructed by White & Case on behalf of Kalbar Operations Pty Ltd to:

   a. Prepare an expert witness report for the Inquiry and Advisory Committee (IAC) hearing into the Fingerboards Project EES.

   b. Present evidence at the IAC hearing.

6. This written statement of evidence has been prepared in accordance with Planning Panel Victoria's Guide to Expert Evidence.

7. I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Inquiry and Advisory Committee.

Simon Welchman

2 February 2021

2. KATESTONE'S EES REPORT

8. Katestone Environmental Pty Ltd (Katestone) was commissioned to complete an Air Quality and Greenhouse Gas (GHG) Assessment of the Fingerboards Mineral Sands Project (the Project) that was included in the Project's Environment Effects Statement (EES). Katestone's report is included in the EES as Appendix A009 – Stage Two Air Quality and Greenhouse Gas Assessment (EES air quality assessment).

9. My role in the preparation of the EES air quality assessment for the Fingerboards Project included overseeing the conduct and completion of the work with Katestone's Project Manager, Tania Haigh. Specific tasks included:

    a. Oversee and technical advice on the development of the air quality assessment methodology

    b. Oversee and technical advice in relation to Katestone's review of ambient air quality monitoring

    c. Quality assurance of dispersion modelling results and advice to Katestone's Project Manager

    d. Review, advice and quality assurance in relation to EES air quality assessment report

    e. Review, advice and quality assurance in relation to Katestone's TRG and community presentation

    f. Review, advice and quality assurance in relation to Katestone's response to Peer Review.

10. I draw the IAC's attention to the following minor errors in the EES air quality assessment:

    a. Page 11, first line of page, "…equates to 3.6 g/m²/day…" should be "…equates to 3.6 g/m²/month…"

    b. Page 84, Section 4.1, the formula for calculating tonnes of carbon dioxide equivalent greenhouse gases from tonnes of carbon dioxide, methane and nitrous oxide using global warming potentials (GWP) is specified. The formula includes an incorrect GWP for methane of 21. The GWP for methane is 25. This typographical error does not affect the emission rates of greenhouse gases that are presented in the EES air quality assessment.

    c. Page 131, Section B2.2, "EF_{PM19}" should be "EF_{PM10}"

    d. Page 132, Section B2.4, "EF_{PM19}" should be "EF_{PM10}"

    e. Page 133, Section B2.8, section incorrectly states that the US EPA AP42 emission factor was adapted to include the effect of rainfall on wind erosion. This is not correct. The US EPA AP42 emission factor was used without adaption. No reduction in wind erosion erosion was applied for rainfall. A corrected version of Section B2.8 is shown below:

        i. The emission factors from wind erosion for the exposed areas of overburden and rehabilitated areas were calculated from the AP42 document, chapter 11.9 "Western Surface Coal Mining" (October 1998). ~~and adapted to include the effect of rainfall on wind erosion.~~

        ii. The TSP emission factor was estimated using the following equation:

        iii. $EF_{TSP} = 0.85 \cancel{\times \frac{(365-p)}{365}}$

        iv. ~~where:~~

        v. ~~*p:* number of days when rainfall is greater than 0.25 mm~~

11. The errors identified in paragraph 10 do not affect, in any way, the findings of the EES air quality assessment.

12. I have been assisted by the following persons to prepare this statement:

a. Natalie Shaw, Team Leader Approvals, review and quality assurance

b. Tania Haigh, Senior Consultant, emissions estimation, dispersion modelling, review and quality assurance

c. Manning Young, Consultant, emissions estimation, dispersion modelling, review and quality assurance.

13. I adopt the EES air quality assessment as the basis of this statement subject to the corrections noted above and the additional analysis presented in Sections 4 and 5 of this statement.

2.1 Air Quality

14. The EES air quality assessment was conducted to comply with the requirements of a Level 1 assessment as defined in the EPA Victoria's publication: Protocol for Environmental Management – Mining and Extractive Industries, EPA Victoria, 2007 (PEM). Accordingly, the assessment includes 12 months of ambient monitoring data and 12 months of meteorological data collected at the Project site.

15. The EES air quality assessment investigated the potential for the Project to affect air quality in its vicinity during construction, operations and decommissioning. To assess the operational stage, three years during the mine life were selected, namely: Year 5, Year 8 and Year 12. Emissions and potential impacts on air quality during decommissioning stages will be less than operations.

16. The operational years were selected for the reasons detailed in Section 3.3.2.2 of the EES air quality assessment. In particular:

    a. Year 5 was selected to provide for the potential worst-case air quality impacts from the Project because of it has the highest overburden extraction rate for the life of the Project.

    b. Year 8 and Year 12 were selected for consistency with the assessments of other disciplines and to investigate the potential impact of the Project as mining occurs in different locations within the Project area.

    c. Year 8, whilst having a relatively low overburden extraction rate, will involve mining in the southeastern portion of the mine.

    d. Year 12 has a relatively high overburden extraction rate and will include activity in the southwestern portion of mine, which is further south than in Year 5 and closer to receptors.

17. The EES air quality assessment used a dispersion modelling approach. The TAPM meteorological model has been used in conjunction with data collected by the on-site meteorological monitoring station to generate a 12-month meteorological dataset for use in dispersion modelling. Emissions of key pollutants were estimated using published emission factors and activity data provided by Kalbar. The regulatory-approved dispersion model, AERMOD, was used to predict ground-level concentrations of dust, key exhaust pollutants, respirable crystalline silica, and heavy metals.

18. The EES air quality assessment identified standard dust control measures and additional control measures that will be applied to minimise the emissions and potential impact of dust from the Project. Standard control measures are a combination of controls that are benchmarked as either best practice or maximum extent achievable (MEA), which will be routinely implemented to achieve a minimisation of dust emissions. Additional control measures are proactive and reactive strategies that utilise forecast weather conditions and real-time monitoring data to schedule and/or adjust management measures or mining activities.

19. The results show:

- Predicted ground-level concentrations of key exhaust pollutants due to the use of generators during construction are predicted to ***comply*** at all sensitive receptors. Predicted concentrations of key pollutants are, at most, 17% of the air quality design criteria.
- Predicted ground-level concentrations of particulates and respirable crystalline silica and dust deposition rates due to other construction activities are predicted to ***comply*** at all sensitive receptors.
- Ground-level concentrations of $PM_{2.5}$, respirable crystalline silica, heavy metals and dust deposition rates due to operations during Year 5, Year 8 or Year 12 operations with standard mitigation measures and ambient background concentrations are predicted to ***comply*** with air quality criteria for all relevant averaging periods at all sensitive receptors.
- Twentyfour-hour average ground-level concentrations of PM_{10} due to Year 5, Year 8 and Year 12 operations with standard and additional mitigation measures and ambient backgrounds are predicted to ***comply*** with the PEM objective at all sensitive receptors.
- Based on standard mitigation measures alone, 24-hour average concentrations of PM_{10} are predicted to be above the PEM objective on at most four days per year at any individual sensitive receptor. On these days, restricting a number of activities on-site to daytime only is sufficient additional mitigation to prevent the exceedances. For example, the following additional mitigation measures would suffice:
    - For Year 5, ceasing overburden transport in both pits, and product transport between 6pm and 7am on two days of the year with adverse meteorological conditions that may give rise to elevated dust levels.
    - For Year 8 and Year 12, ceasing overburden extraction in the eastern pit, overburden transport in both pits, and product transport between 6pm and 6am on selected days with adverse meteorological conditions that may give rise to elevated dust levels. These additional mitigation measures are predicted to be required on three days of the year for Year 8 operations, and 14 days of the year for Year 12 operations.

20. An environmental management plan for the site will be developed that includes dust mitigation measures, ongoing monitoring program, and procedures for implementing additional mitigation measures in response to forecast conditions or real-time particulate monitoring.
21. Since submission of the EES, I have assessed the Project against the SEPP AAQ environmental quality objectives (See Section 52).

2.2 Greenhouse Gas (GHG) Assessment

22. Annual GHG emissions resulting from mining operations range from 57,530 tCO2-e (Year 9) to 80,148 tCO_2-e (Year 11). Annual emissions from the construction and decommissioning periods result in GHG emissions of 18,609 tCO2-e and 5,022 tCO_2-e. Based on these estimates, Kalbar would be required to commence NGER reporting for the Project in 2019/20 or the first year of operations. In line with a best practice approach, in the first year of operations Kalbar will commence monitoring of GHG emissions and regular review of emissions to identify opportunities for GHG mitigation.
23. The following figure shows a breakdown of GHG emissions by scope and source. The clear majority of Scope 1 GHG emissions are associated with diesel consumption of mining equipment and heavy machinery. Electricity usage is predominantly associated with processing operations.

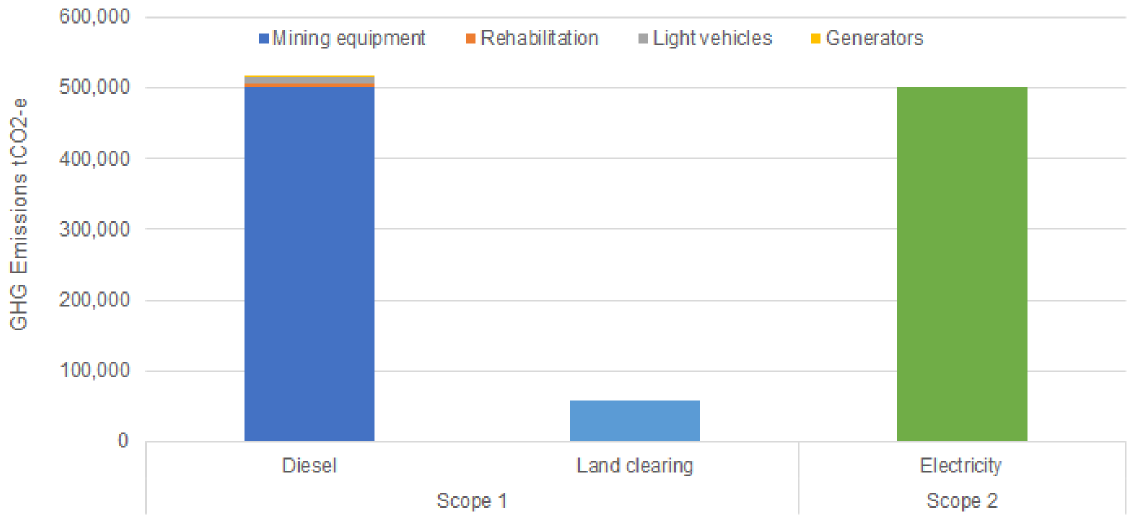

Figure 1 **Project GHG emissions by emission source and emission scope**

24. Best practice in terms of energy efficiency and associated GHG emissions will be achieved through a range of initiatives including:

- Ongoing monitoring and reporting GHG emissions and identifying opportunities to reduce GHG emissions
- Equipment selection, operations and maintenance
- Load optimisation, production scheduling and logistics planning including route optimisation
- Use of solar power to supplement electricity use where practical
- Minimisation of grid electricity consumption through power factor correction.

25. The EES presents three options for the transport of HMC to its first delivery point:

- Option 1. Truck haulage of half of the HMC from site to Port Anthony combined with truck haulage of half of the HMC from site to Maryvale, then train freight of HMC from Maryvale rail siding to Port of Melbourne.
- Option 2. Truck haulage of HMC to Bairnsdale, then train freight of HMC from Bairnsdale rail siding to Port of Melbourne.
- Option 3. Truck haulage of HMC to Fernbank East rail siding, then train freight of HMC from Fernbank East rail siding to Port of Melbourne.

26. Estimated GHG emissions (Scope 3) for train freight of the HMC via Fernbank East rail siding (Option 3, the preferred transport option for the project) of 5,406 tCO2-e are lower than for the other transport options. GHG emissions associated with transport via truck to the Bairnsdale rail siding and rail to the Port of Melbourne (Option 2) are 6,708 tCO2-e. GHG emissions associated with the combined truck haulage to Port Anthony/train freight via the Maryvale rail siding (Option 1) is the highest of the options considered, 8,208 tCO2-e.

27. Train freight via Fernbank East rail siding is the preferred HMC transport option followed by train freight via Bairnsdale rail siding.

3. DUST ASSESSMENT PHILOSOPHY AND REGULATION

28. As a lot of EES submissions express concern about the effect of dust emissions. I have set out below a general overview of dust, dust impact assessment and the legislative context as it pertains to air quality management in Victoria.

3.1 Dust metrics

3.1.1 Overview

29. The key group of air pollutants that is generated by mining activities is particulate matter, which is commonly referred to as dust.

30. Particulate matter is a term used to define solid or liquid particles that may be suspended in the atmosphere. Particulate matter is a generic term that is commonly used interchangeably with other terms such as smoke, soot, haze and dust. The potential effect of particulate matter on the environment, human health and amenity depends on the size of the particles, the concentration of particulate matter in the atmosphere and rate of deposition. Concentration is the mass of particulate matter that is suspended per unit volume of air. Suspended particulate matter in ambient air is usually measured in micrograms per cubic metre ($\mu g/m^3$). Deposition is the mass of particulate matter that settles per unit surface area. Deposited particulate matter is usually measured in grams per square metre (g/m^2).

31. Particulate matter with an aerodynamic diameter greater than 10 micrometres (µm) tend to be associated with amenity impacts, while particulate matter less than 10 µm are associated with health impacts. For this reason, particulate matter is sub-divided into a number of metrics based on particle size. These metrics are total suspended particulates (TSP), PM_{10}, $PM_{2.5}$ and dust deposition rate.

32. TSP refers to the total of all particles suspended in the air. When TSP is measured using the standard method (a high-volume air sampler), the maximum particle size has been found to be approximately 30 µm. TSP was first used as a human health metric, but research found a poor correlation between the concentration of TSP and health effects (US EPA, 2010). TSP is now used as a metric of the potential for particulate matter to affect amenity.

33. PM_{10} is a subset of TSP and refers to particles suspended in the air with an aerodynamic diameter less than 10 µm (US EPA, 2010).

34. Coarse particulate matter is a subset of TSP and PM_{10} and refers to particles suspended in the air with an aerodynamic diameter between 2.5 and 10 µm (US EPA, 2010).

35. $PM_{2.5}$ is a subset of TSP and PM_{10} and refers to particles suspended in the air with an aerodynamic diameter less than 2.5 µm. $PM_{2.5}$ is also called fine particulate matter (US EPA, 2010).

36. Dust deposition rate is the mass of particulate matter that collects on an area over a one-month period. Dust deposition rate is used as a metric of the potential for particulate matter to affect amenity.

37. The atmospheric lifetime of particles depends on the size of the particle, with coarse particulate matter tending to deposit quickly and in relatively close proximity to its point of emissions, whilst fine particulate matter may remain suspended in the atmosphere for many days and travel many hundreds of kilometres. The atmospheric lifetimes of particles and potential travel distances based on the particle size are summarised in Table 1 (US EPA, 1996).

Table 1 Atmospheric lifetime and potential travel distance of particles of various size categories

Particle size	Description	Atmospheric lifetime	Travel distance
TSP	Total of all particles suspended in the atmosphere	Minutes to hours	Typically deposits within the proximate area downwind of the point of emissions
PM_{10}	A subset of TSP, including all particles smaller than 10 µm in diameter.	Days	Up to 100 kilometres or more
$PM_{2.5}$	A subset of the PM_{10} and TSP categories, including all particles smaller than 2.5 µm in diameter.	Days to weeks	Hundreds to thousands of kilometres

38. Figure 1 shows the sizes of particulate matter as $PM_{2.5}$ and PM_{10} relative to the average width of a human hair, which is 70 µm (U.S. EPA).

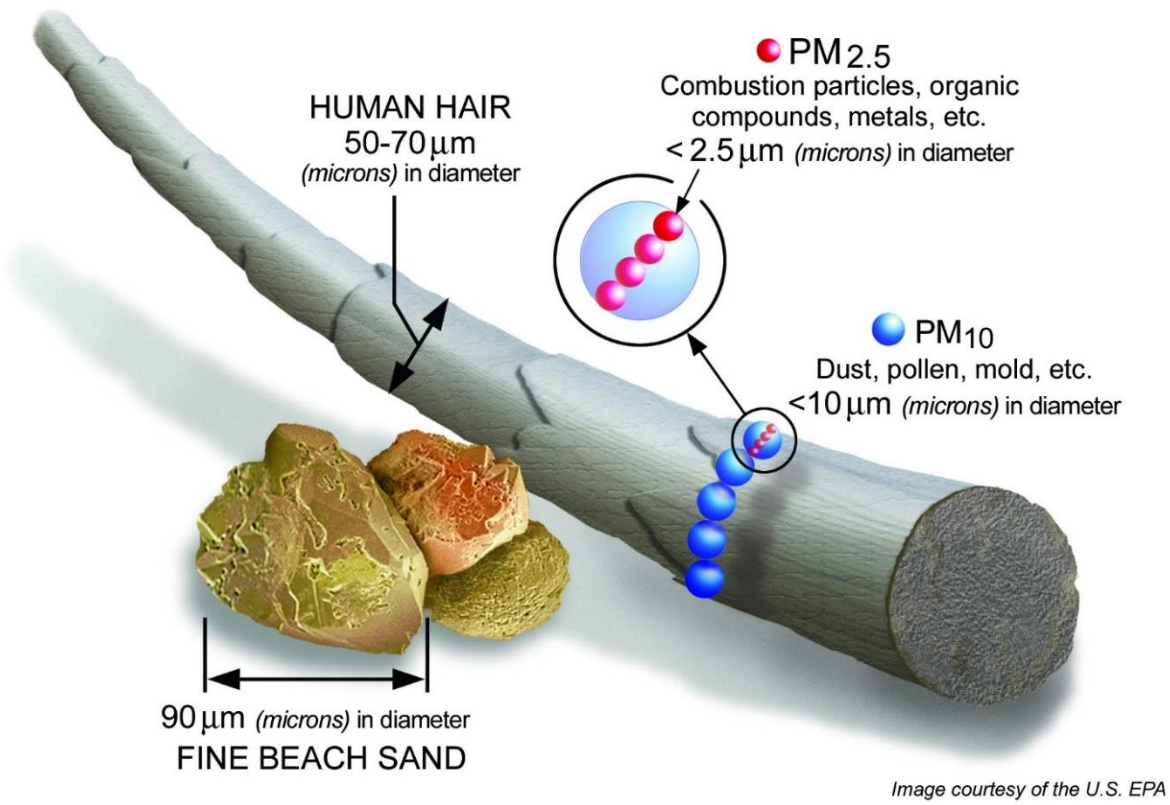

Figure 2 Sizes of particulate matter smaller than $PM_{2.5}$ and PM_{10} relative to the average width of a human hair (http://www.epa.gov/)

3.1.2 Amenity impacts of particulate matter

39. Amenity impacts can occur when levels of particulate matter become elevated (NSW Health, 2017). The following impacts on amenity are commonly noted:

    - Short-term reduction in visibility. For example, at a local scale particulate matter may pass across a road and temporarily affect a driver's ability to see oncoming traffic. At a regional scale, a visible plume of particulate matter may adversely affect the aesthetics of the environment such as scenic views;
    - Build-up of particulate matter on surfaces within homes resulting in the occupant needing to clean more frequently;
    - Soiling of washing; and
    - Build-up of particulate matter on the roofs of houses and, during rainfall, the flushing of the particulate matter into rainwater tanks potentially affecting quality of drinking water or tank capacity.

3.1.3 Health effects of particulate matter

40. The human body's respiratory system has a number of defence mechanisms to protect against the harmful effects of particulate matter (NSW Health, 2017). Coarse particulate matter may be trapped in the mucus on the walls of the airways and can be removed by cilia, small hair-like structures that line the surface of the airways. The particulate matter is expelled from the body by coughing or is swallowed. Under normal conditions a human respiratory tract in good health is able to deal with inhaled particulates without undue stress or long-term effects.

41. However, there is a demonstrated statistical association between health effects and the concentration of fine particulate matter. Recent studies Ono (2005), Cowherd and Donaldson (2005) and US EPA (2006) indicate that in susceptible sub-populations, fine particulate matter from combustion related sources are markedly more detrimental to health than coarse particulate fractions ($PM_{10-2.5}$). There is data associating PM_{10} from a combustion origin with health effects, but this fraction also contains $PM_{2.5}$ (Drew, 2009) and, hence, the specific cause cannot be delineated.

42. Exposure to elevated levels of particulate matter can cause a variety of health effects (NSW Health, 2017). Both long (over years) and short term (hours or days) elevated levels of exposure to particles have been linked to health problems.

43. There is clearly a fundamental distinction between particulate matter originating from the combustion of fuel and secondary chemical reactions, and mechanically generated crustal particulate matter. Where the former is generated, for example, by motor vehicles, power stations, and industrial activities, it consists predominantly of fine particulate matter ($PM_{2.5}$). While the latter originates from construction, mining, earthworks, unpaved roads, agricultural activities and erosion and consists predominantly of coarse particulate matter (PM_{10} and TSP).

44. Particulate matter is the major air pollutant that is emitted from mining and processing activities. The majority of particulate matter emitted from mining consists of large particles generated from activities such as mechanical disturbance of soil and overburden by bulldozers, excavators and vehicles on dirt roads. Particulate matter is also generated from wind erosion of stockpiles and bare ground. The emission rate estimates for the Project indicate that the majority of the dust emissions (approximately 89%) are larger than 2.5 micrometres. Air quality assessments of mining projects have shown that it is possible, with contemporary design and dust control measures, to avoid exceedance of the air quality objectives.

3.2 Legislative framework for air quality

3.2.1 Relevant documents for regulatory assessment

45. The following legislation is relevant to the Project:

- *Environment Protection Act 1970* (EP Act)
- *Environment Protection Act 2017* (the 2017 Act)
- *Environment Protection Amendment Act 2018* (the 2018 Act)
- *Environment Effects Act 1978*
- *Mineral Resources (Sustainable Development) Act 1990*
- National Environment Protection Measure for Ambient Air Quality, 1998.
- Protocol for Environmental Management, State Environment Protection Policy (Ambient Air Quality) Mining and Extractive Industries, 2007
- The Victorian State Environment Protection Policy (Ambient Air Quality) (SEPP AAQ)
- The Victorian State Environment Protection Policy (Air Quality Management) (SEPP AQM)
- Proposed Final Environment Reference Standard, 14 December 2020.

3.2.2 Environment Protection Acts

46. The EP Act authorises the EPA Victoria to issue works approvals and licences for scheduled premises and to establish State Environment Protection Policies. The 2017 Act came into effect during the preparation of the EES air quality assessment. Both Acts make it a criminal offence to unlawfully pollute the air environment. The 2018 Act provides for a general environmental duty to eliminate risks of harm to human health and the environment so far as reasonably practicable, or if it is not reasonably practical to do so, to reduce those risks as far as reasonably practicable.

47. The 2018 Act is intended to come into effect in July 2021.

48. More detailed description of the regulatory framework is contained in Section 3.1 of the EES air quality assessment.

3.2.3 Proposed Final Environment Reference Standard

49. On 14 December 2020, the Victorian Government released the Proposed Final Environment Reference Standard (ERS) that is intended to be made under the 2017 Act. The Proposed Final ERS defines the environmental values of the ambient air environment that are to be protected, which are:

- Life, health and well-being of humans
- Life, health and well-being of other forms of life, including the protection of ecosystems and biodiversity
- Local amenity and aesthetic enjoyment
- Visibility
- The useful life and aesthetic appearance of buildings, structures, property and materials

- Climate systems that are consistent with human development, the life, health and well-being of humans, and the protection of ecosystems and biodiversity.

50. The Proposed Final ERS specifies the indicators and objectives that are to be used to measure, determine or assess whether those environmental values are being achieved, maintained or threatened.

51. The indicators and objectives for the ambient air environment that are specified in the Proposed Final ERS are reproduced in Table 2.

Table 2 Proposed Final ERS indicators and objectives for the ambient air environment

Column 1 Indicators	Column 2 Objectives	Column 3 Averaging period	Column 4 Maximum exceedances
Carbon monoxide (maximum concentration)	9.0 ppm	8 hours	1 day a year
Nitrogen dioxide (maximum concentration)	0.12 ppm	1 hour	1 day a year
	0.03 ppm	1 year	none
Sulfur dioxide (maximum concentration)	0.20 ppm	1 hour	1 day a year
	0.08 ppm	1 day	1 day a year
	0.02 ppm	1 year	none
Particles as PM_{10} (maximum concentration)	50 µg/m^3	1 day	none
	20 µg/m^3	1 year	none
Particles as $PM_{2.5}$ (maximum concentration)	25 µg/m^3	1 day	none
	8 µg/m3	1 year	none

4. INFORMATION RELEVANT TO AIR QUALITY SUBMISSIONS

52. The EES submissions raise consistent topics relating to air quality that I have responded to below. My response to individual submissions is at Appendix B of this statement with cross-references to this statement as relevant.

4.1 Assessment against SEPP AAQ environmental quality objectives

53. The submission of EPA Victoria suggests that the results of dispersion modelling should also be compared to the State Environment Protection Policy (Ambient Air Quality) (SEPP AAQ) objectives. This is addressed below.

54. The SEPP AAQ was varied in 2016 to incorporate the standards and goals from the National Environment Protection (Ambient Air Quality) Measure (NEPM AAQ), which was varied in 2015. The SEPP AAQ notes that these standards do not apply to individual sources but to regional air quality. The relevant objectives from the SEPP AAQ are reproduced in Table 3. The SEPP AAQ objectives for PM_{10} and $PM_{2.5}$ are equivalent to the objectives that are specified in the Proposed Final ERS (Section 3.2.3).

Table 3 Environmental quality objectives and goals used to evaluate ambient monitoring data (SEPP AAQ)

Pollutant	Averaging Period	Environmental quality objective
PM_{10}	24-hour	50 µg/m^3
	1-year	20 µg/m^3
$PM_{2.5}$	24-hour	25 µg/m^3
	1-year	8 µg/m^3

55. The EES air quality assessment quantified ground-level concentrations of PM_{10} and $PM_{2.5}$ and assessed them against the air quality design criteria that are contained in the PEM Mining and Extractive Industries, which are reproduced in Table 4.

Table 4 Air quality design criteria for PM_{10} and $PM_{2.5}$ from the PEM Mining and Extractive Industries

Pollutant	Averaging Period	Air Quality Design criteria
PM_{10}	24-hour	60 µg/m^3
$PM_{2.5}$	24-hour	36 µg/m^3

56. Based on the findings of the EES air quality assessment, 24-hour average and annual average concentrations of $PM_{2.5}$ are predicted to comply with the Environmental Quality Objectives of the SEPP AAQ. In relation to PM_{10}, 24-hour and annual average concentrations may exceed the Environmental Quality Objectives of the SEPP AAQ in close proximity to the Project.

57. Since preparing the EES air quality assessment, I have investigated the additional mitigation measures that could be implemented so the the Project achieves compliance with the Environmental Quality Objectives of SEPP AAQ for PM_{10}. This investigation has been completed to address the submissions EPA Victoria and others.

58. My staff, under my supervision, have conducted further assessment works and dispersion modelling to determine what mitigation measures would be required to achieve compliance with the Environmental Quality Objectives of the SEPP AAQ for 24-hour average and annual average concentrations of PM_{10}.

59. The following mitigation measures have been considered:

- Scenario 1:
    - The EES air quality assessment assumed that overburden would be extracted using scapers. This scenario investigates the use of truck and shovel to extract overburden rather than scapers. Kalbar has determined that extraction of overburden by truck and shovel is viable.
    - The EES air quality assessment assumed that grading would occur continuously 24-hours per day. This scenario investigates grading for 12 hours of the day from 6am to 6pm (at the EES activity rate). This control measure is required from a noise abatement perspective.
    - The EES air quality assessment assumed that product haulage would occur 24-hours per day. This scenario investigates product haulage for 11 hours of the day at 2.2 times the EES activity rate. This control measure is required from a noise abatement perspective.
- Scenario 2: The EES air quality assessment assumed that overburden extraction would occur 24-hours per day. The assessment found that for nine days in Year 5, three days in Year 8 and 37 days in Year 12, additional mitigation measures in the form of ceasing certain activities was required to achieve compliance with the PEM objectives. This scenario adopts the mitigation measures described in Scenario 1, and also ceases overburden extraction during the night as a reactive control to be implemented in the event of elevated dust to achieve compliance with the SEPP AAQ environmental quality objectives for PM_{10}. As part of this scenario, the overburden extraction could occur at twice the normal rate during the day (6am to 6pm).
- Scenario 3: The EES air quality assessment assumed that overburden haulage and grading would occur 24-hours per day in the east and west pits. The assessment found that for nine days in Year 5, three days in Year 8 and 37 days in Year 12, additional mitigation measures in the form of ceasing certain activities was required to achieve compliance with the PEM objectives. This scenario adopts the mitigation measures described in Scenario 2 and further, ceases overburden haulage in the east pit and ceases grading in the east and west pits during the day as a reactive control to be implemented in the event of elevated dust to achieve compliance with the SEPP AAQ environmental quality objectives for PM_{10}.

60. Table 5 summarises the outcomes of the additional assessment work, which indicates that the control measures specified in Scenario 1 in addition to the EES controls achieve compliance with the SEPP AAQ objective for annual average concentrations of PM_{10}. Scenario 1 also reduces the number of exceedances of the 24-hour SEPP AAQ objective for PM_{10} to one day per year.

61. This additional exceedance day can be avoided by implementing the additional controls that are detailed under Scenario 2 for Year 8 and 12. For Year 5, both Scenarios 2 and 3 are required to mitigate the additional exceedance. Figure 3 to Figure 5 show the 24-hour average concentrations of PM_{10} on these exceedance days before and after Scenarios 2 and 3 have been taken into account.

Table 5 **Additional control measures to achieve compliance with SEPP AAQ Environmental Quality Objectives for PM_{10}**

Year	Mitigation scenario	Complies with SEPP AAQ[1] objective for annual average concentrations of PM_{10}? (Y/N)	Complies with SEPP AAQ[1] objective for 24-hour average concentrations of PM_{10}? (Y/N), additional exceedance days
Year 5	EES	N	N, 9
	1	Y	N, 1
	2	Y	N, 1
	3	Y	Y, 0
Year 8	EES	N	N, 3
	1	Y	N, 1
	2	Y	Y, 0
Year 12	EES	N	N, 37
	1	Y	N, 1
	2	Y	Y, 0

Note
[1] The SEPP AAQ objectives for PM_{10} are equal to the objectives contained in the Proposed Final Environment Reference Standard

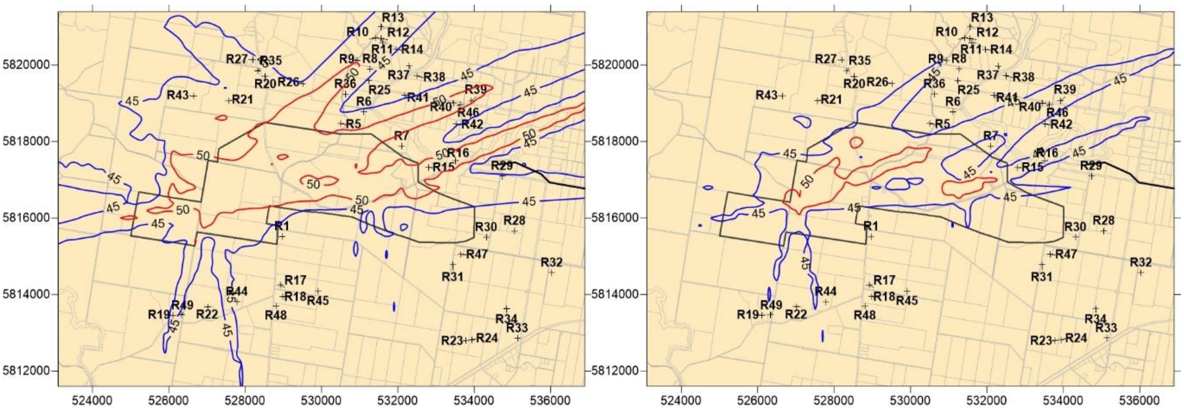

Figure 3 **Year 5: 24-hour average concentrations of PM_{10} (plus background) on the exceedance day without further mitigation (Scenario 1 - left) and with further mitigation (Scenario 3 - right)**

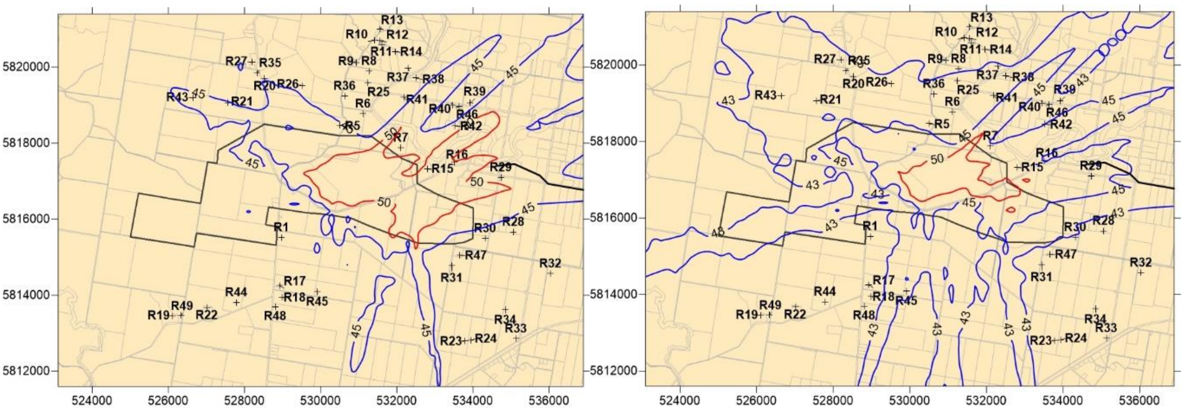

Figure 4 **Year 8: 24- hour average concentrations of PM_{10} (plus background) on the exceedance day without further mitigation (Scenario 1 - left) and with further mitigation (Scenario 2 - right)**

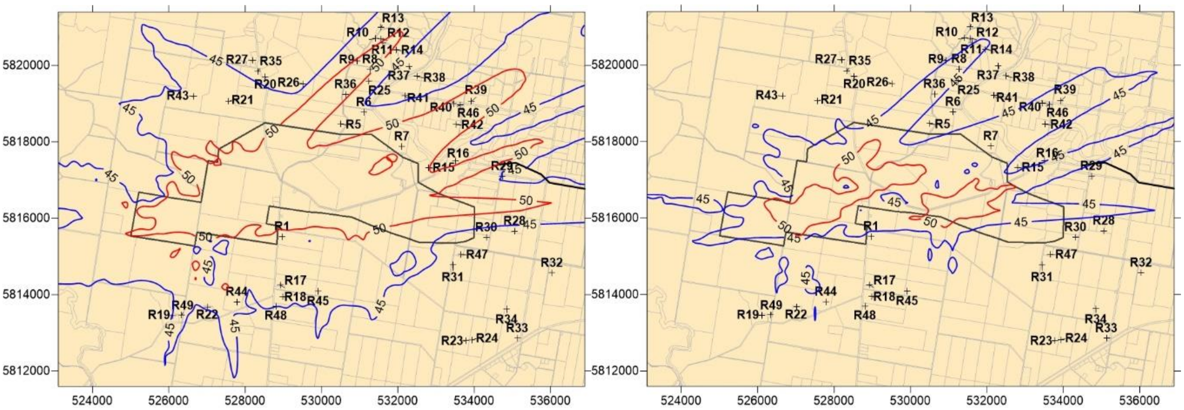

Figure 5 **Year 12: 24-hour average concentrations of PM_{10} (plus background) on the exceedance day without further mitigation (Scenario 1 - left) and with further mitigation (Scenario 2 - right)**

4.2 Modify Plans

62. The discussion below sets out my responses to the EPA Victoria's submission requesting changes to air quality related management plans.

63. The Project's Airborne and Deposited Dust Risk Treatment Plan (Table 6-1) 'Acceptance Criteria' should be amended to include the SEPP AAQ environmental quality objectives for 24-hour average concentrations of $PM_{2.5}$ and PM_{10} of 25 µg/m³ and 50 µg/m³, respectively.

64. The Project's Airborne and Deposited Dust Risk Treatment Plan (Table 7-1) should be amended to include the mitigation measures detailed above under Scenarios 1, 2 and 3.

65. The Project's Airborne and Deposited Dust Risk Treatment Plan (Table 9-1) and the EMF (Table 12.9) should be amended to include a trigger level for 1-hour average concentrations of PM_{10} of 80 µg/m³. These plans should also be amended to include the following: "EPA will be consulted on the development of the Project's air quality management and monitoring sub-plans." Recommended trigger levels are provided in Section 4.3.

66. The Project's Airborne and Deposited Dust Risk Treatment Plan (Tables 7-1 and 9-1) and the EMF (Table 12.9 Monitoring Programs Air Quality) should be amended to include a wind speed trigger level of > 25 km/hr instead of > 40 km/hr.

67. The Project's Airborne and Deposited Dust Risk Treatment Plan (Table 7-1) should be amended to include a tiered vehicle speed limit of 20 km/hr on unsealed project roads in the event of dusty conditions and 50 km/hr under normal conditions. This is to EPA Victoria's submission.

68. The Project's Airborne and Deposited Dust Risk Treatment Plan (Table 9-1) and the EMF (Table 12.9 Monitoring Programs Air Quality) should be amended to include a commitment to conduct continuous visual observation monitoring (e.g. video monitoring) of high dust generation activities if such technology is found to be economically viable.

69. The Project's Rehabilitation Plan (Table 7-1) under 'Rehabilitation amenity and environmental quality' should be amended to include the SEPP AAQ environmental quality objectives for 24-hour average concentrations of $PM_{2.5}$ and PM_{10} of 25 µg/m³ and 50 µg/m³, respectively.

70. The Project's Rehabilitation Plan (Table 7-1) under 'Rehabilitation amenity and environmental quality' should be amended to include the SEPP AAQ environmental quality objectives for 24-hour average concentrations of $PM_{2.5}$ and PM_{10} of 25 µg/m³ and 50 µg/m³, respectively.

71. The Project's Airborne and Deposited Dust Risk Treatment Plan (Table 9-1) and the EMF (Table 12.9 Monitoring Programs Air Quality) should be amended to include a commitment to the monitoring of rainwater tanks and dams for a minimum of twelve months prior to commencement of site works to establish baseline data, and continue during construction and operation of the mine. These plans should include details of corrective actions that should be implemented if monitoring results exceed recommended health-based Australian Drinking Water Guideline limits.

72. The Project's Airborne and Deposited Dust Risk Treatment Plan (Tables 7-1 and 9-1) and the EMF (Table 12.9 Monitoring Programs Air Quality) should be amended to include a commitment to periodic monitoring of deposited dust on nearby crops to validate the assumptions of dust assessments described in the Human Health Risk Assessment. The frequency and period of this monitoring should be agreed to with the local farmers and Community Reference Group. In the event that monitoring results show a likely risk to crop integrity and/or human health, Kalbar should carry out required remedial action in consultation with local farmers and the Community Reference Group.

4.3 Trigger Levels

73. The discussion below sets out my responses to the EPA Victoria's submission requesting revisions to trigger levels.

74. The trigger levels recommended for the Project account for measured particulate concentrations and forecast weather conditions. This is discussed in the EES air quality assessment (Appendix A009, Section 3.7.2).

75. Katestone prepared a draft Air Quality Management Plan for the Fingerboards Project (draft AQMP) since completing the EES air quality assessment. At Section 8 of the draft AQMP, two alert levels are proposed that would be triggered based on data from the real-time dust monitoring network. Particulate levels of 80 µg/m³, 100 µg/m³ and 150 µg/m³ (1-hour average) are proposed, which would trigger three different alert levels. A 24-hour average particulate level of 50 µg/m³ is also proposed.

76. A trigger level based on forecast light winds was also proposed. EPA has advised that a trigger level should be set for wind speeds of 20 km/hour. Kalbar has adopted this as a trigger to prompt additional dust mitigation. This trigger level would be reviewed and adjusted based on Kalbar's experience and obligations to improve outcomes.

77. The following points are relevant to the setting of trigger levels for the project:

    - Dispersion modelling conducted for the Project identified that the highest 1-hour average concentrations of particulates are likely to occur overnight, during periods of light winds (< 2m/s).
    - Sensitive receptors are located in most directions around the mine. Consequently, a wind direction-based trigger is not likely to provide much refinement for dust controls. However, wind direction should be measured and forecast, to assist in determining activities that should be suspended or otherwise adjusted.
    - A trigger that is based on a cumulative particulate measurement throughout a 24-hour period is likely to be beneficial. In addition to individual 1-hour average measurements, this would provide further insights for managing 24-hour average dust levels.
    - All trigger values should be reviewed regularly and adjusted as needed during operation, to ensure they are appropriately set.

4.4 Meteorological Data

78. A number of submissions to the EES suggest that Kalbar's meteorological station is sheltered from prevailing winds. The discussion below provides my response to these submissions.

79. Section 3.2.2 of the EES air quality assessment summarises the meteorological data that was collected at the Project site from 1 October 2017 to 30 September 2018. The meteorological monitoring station is shown in Figure 6.

80. Submission 813 at page 135, suggests that all wind speeds that were measured by the Kalbar meteorological station were below 20 km/hr. This is not correct as can be seen from the analysis that is presented in the EES air quality assessment at Section 3.2.2. For example, Figure 4 of the EES air quality assessment (page 14) shows a wind rose that illustrates the frequency of occurrence of wind speeds (in metres per second – m/s) by 16 compass point wind directions (i.e. north, north-northeast and so on). A wind speed of 20 km/hr is equal to 5.7 m/s. It is clear from this figure that wind speeds exceed 6 m/s regularly. I have calculated from the on-site meteorological data that 8.7% of 1-hour average winds exceed 5.7 m/s.

81. In relation to the assertion in various submissions that the meteorological data is not valid because the monitoring location is not fully exposed to the prevailing winds, the following points are relevant:

    a. The meteorological monitoring station has been sited and operated in accordance with the relevant Australian Standards.

    b. The air quality and meteorological monitoring program that was conducted for the Project was conducted in accordance with the requirements of the PEM and was approved by EPA Victoria.

    c. I inspected the meteorological monitoring station in December 2020. I considered the proximity of the monitoring station to trees and local terrain and I am satisfied that the meteorological monitoring station is sited in accordance with the relevant Australian Standards.

    d. I have reviewed terrain and land-use data and have produced a terrain map of the region surrounding the monitoring station (Figure 7). I am satisfied that the monitoring station would produce meteorological data that is representative of the mine site and surrounds. I do not believe that the monitoring site would be subject to significant shielding that would result in wind speeds that are unrepresentative of the mine site and surrounding areas.

82. Several equipment faults occurred during the monitoring, resulting in data loss of 22%. Lightning strikes are the cause of the majority of this data loss.

83. The data loss did not have an adverse impact on the EES air quality assessment. Section A1.2 of the EES air quality assessment describes the evaluation of the data generated by the meteorological model, TAPM, during periods where there was no data available from the on-site weather station. This evaluation considered meteorological data that was recorded at another meteorological monitoring station that was collocated with the continuous dust monitor (BAM). The evaluation concluded that the dataset that was used in the modelling was likely to provide a good representation of conditions on-site.

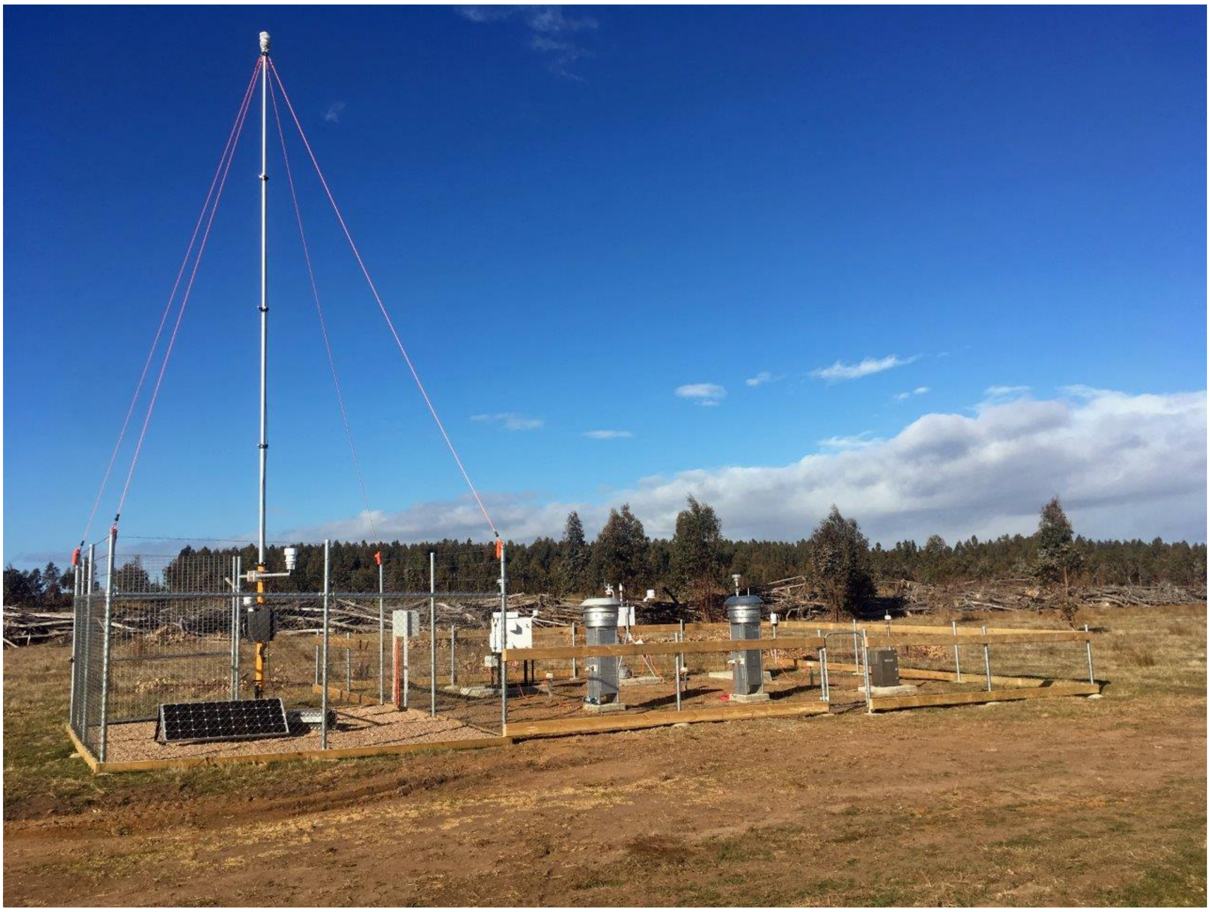

Figure 6 **Meteorological monitoring station**

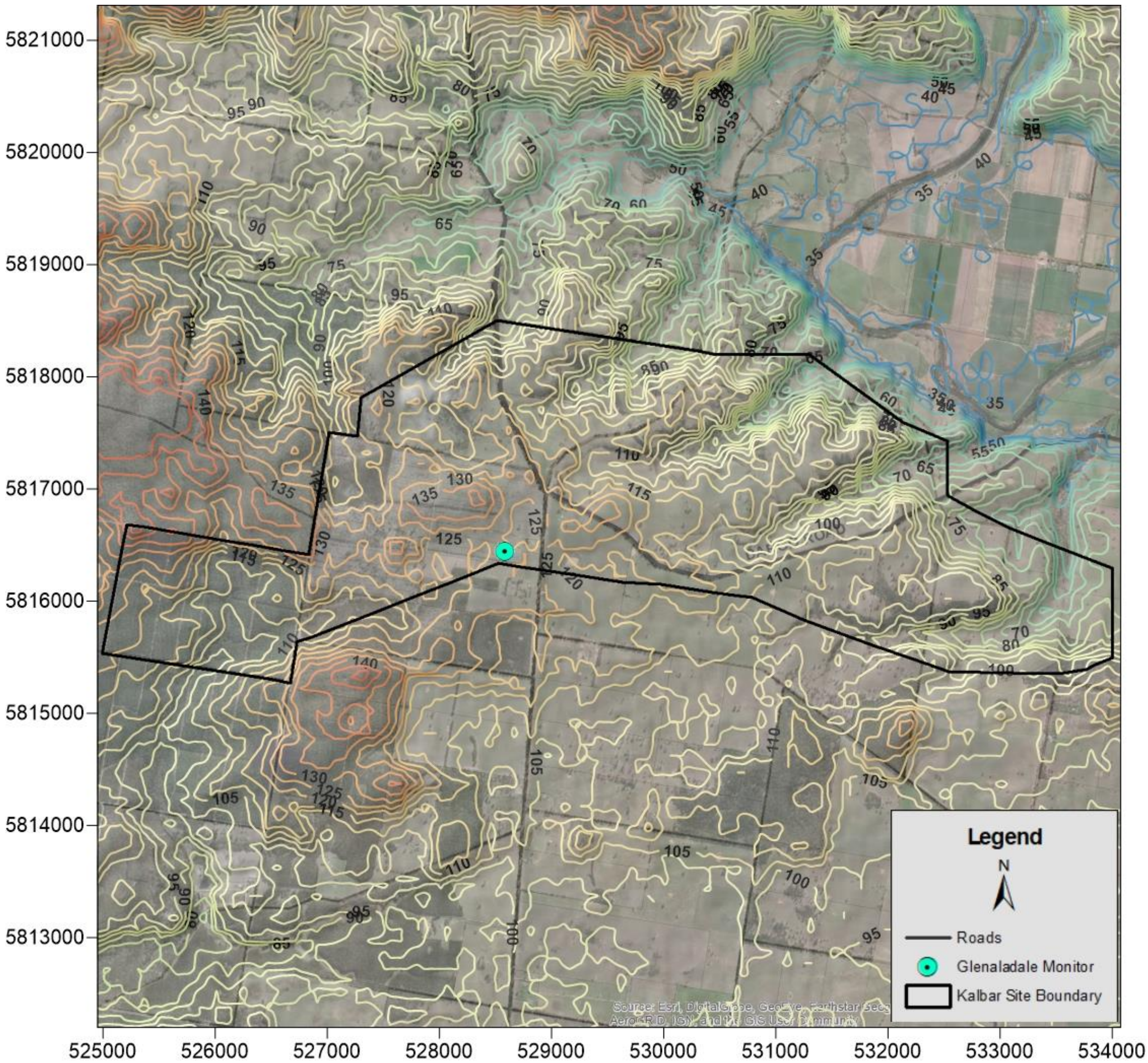

Figure 7 **Terrain in the vicinity of the meteorological station**

4.5 Water availability for dust suppression

84. A number of submissions to the EES suggest that there is insufficient water available for dust suppression. The discussion below provides my response to these submissions.

85. The EES Appendix A006 estimated that 375 ML of water will be required per year for dust suppression by water trucks (Appendix A006, Appendix A, Section 4.6.4, page 36).

86. The estimate of water usage assumes water alone as the suppression agent on haul roads. A range of additives are available that provide for longer-term dust control of haul roads and disturbed areas that would result in significantly less water usage.

87. For example, dust control companies: Dustaside, Rainstorm and WetEarth all have products for haul road and exposed area dust control. Whilst the reapplication frequency of dust suppression products may depend on the material being treated and local weather conditions, these websites indicate applications may last several months. Exposed area treatments can also be combined with seeding, to minimise dust and assist with revegetation.

88. The EES air quality assessment (Table 13, page 37-39) provides a range of dust control measures that will be used in addition to watering to control emissions of dust from haul roads, cleared areas and stockpiles. In addition to watering, proposed dust controls include:

- Haul roads
- Pave surface of product haul roads
- Low silt aggregate for unsealed roads
- Dust suppressants
- Speed limits
- Manage and maintain designated routes
- Minimise haul distances
- Wind erosion of cleared areas
- Chemical suppressants
- Revegetation
- Rehabilitation.

4.6 Certain air pollutants not considered

89. Submission 813 at page 141, states that the EES air quality assessment overlooked a number of recognised air pollutants in dust including: arsenic (inorganic), cadmium, chromium VI, nickel, bismuth, cerium, barium, magnesium, vanadium, lanthanum and gallium. Submission 813 questions, at page 238, the term “zirconia” that is used in the EES air quality assessment.

90. The EES air quality assessment considered arsenic (inorganic), cadmium, chromium III, nickel and vanadium (see, for example, EES air quality assessment, Tables 8, 12, 18, 19, 20, 25, 28 and 31). Throughout the EES air quality assessment, arsenic has been assumed to be in its inorganic form and has been compared to the air quality criterion for inorganic arsenic. Throughout the EES air quality assessment, chromium has been assumed to be the trivalent form (chromium III). Kalbar advised Katestone that any chromium at the site is likely to be the trivalent form. The metals assays that were produced by Kalbar do not contain barium or gallium.

91. The EES air quality assessment presented results for zirconia, calculated using the concentration of zirconia in site materials. Additional results are presented below for all compounds containing zirconium.

92. Results of dispersion modelling of bismuth, cerium, magnesium, lanthanum and zirconium are presented below.

93. Air quality criteria for bismuth, cerium, magnesium, lanthanum and zirconium are not specified in the PEM, SEPP AAQ or Final Proposed Reference Standard. As with the EEA air quality assessment, air quality criteria have been taken from the Texas Commission on Environmental Quality Effects Screening Levels (TCEQ ESL), as recommended by the independent peer reviewer and EPA Victoria. The air quality criteria are shown in Table 6.

94. Dispersion modelling results are presented for Year 12, the operational year with the highest predicted metals concentrations, using standard emission controls. Consistent with the EES air quality assessment, ground-level concentrations of bismuth, cerium, magnesium, lanthanum and zirconium have been estimated based on the total heavy metal emission rate as a fraction of total PM_{10} emissions, and the predicted ground-

level concentrations of PM_{10}. Results are presented in isolation as these air pollutants were not measured in the ambient monitoring program (Table 7).

Table 6 ESLs for additional pollutants and zirconium

Substance	Short-term ESL Health (µg/m³)	Long-term ESL Health (µg/m³)
Bismuth	50	5
Cerium oxide	50	5
Lanthanum	50	5
Magnesium oxide	40	4
Zirconium (elemental)	50	5

Table 7 Predicted ground-level concentrations of additional pollutants and zirconium for Year 12

Parameter	1-hour average			Annual average		
	Maximum concentration at any receptor due to Project (µg/m³)	Air quality design criteria (µg/m³)	Maximum % of air quality criteria	Maximum concentration at any receptor due to Project (µg/m³)	Air quality design criteria (µg/m³)	Maximum % of air quality design criteria
Bismuth	0.00039	50	0.0008%	0.000012	5	0.0002%
Cerium [1]	0.038	50	0.08%	0.0011	5	0.02%
Lanthanum	0.019	50	0.04%	0.00058	5	0.01%
Magnesium oxide	2.74	40	6.9%	0.084	4	2.1%
Zirconium (elemental)	0.11	50	0.2%	0.0034	5	0.1%

Table note:
[1] Assessed against the ESL for cerium oxide

95. The results show that ground-level concentrations of bismuth, cerium, magnesium, lanthanum and zirconium are predicted to comply with the air quality criteria at all receptors for Year 12. By inference, ground-level concentrations of bismuth, cerium, magnesium, lanthanum and zirconium would also comply with the air quality criteria for the construction phase of the Project and for all operating years.

4.7 Additional sensitive receptors

96. Katestone understands that two additional receptors (R2023 and R2024) are located within 2km of the northern boundary of the Project. These receptors are near and to the west of R09 (Figure 8).

97. Katestone has considered the dispersion modelling of the Project in the context of the additional receptors R2023 and R2024. Katestone's dispersion modelling results indicate that predicted concentrations at R2023

and R2024 are essentially the same as predicted concentrations at R09, which was included in the EES air quality assessment (EES Appendix A009 – Stage Two Air Quality and Greenhouse Gas Assessment).

98. The dispersion modelling results at receptors R2023 and R2024 for the construction and operational phases of the Project have been evaluated against the PEM criteria as follows:

- Using standard mitigation measures:
  - Predicted 24-hour average concentrations of PM2.5 comply with the relevant air quality objective
  - Predicted annual average concentrations of respirable crystalline silica comply with the relevant air quality objectives
  - Predicted monthly maximum and annual average dust deposition rates comply with the relevant guidelines.
- Using standard mitigation measures alone, predicted 24-hour average concentrations of PM_{10} are predicted to exceed the PEM objective at receptors R2023 and R2024 on, at most, one day of the year for Year 12. Additional mitigation measures, for example, ceasing overburden transport in both pits, and product transport between 6pm and 7am on selected days are sufficient to prevent these exceedances. These findings are consistent with previous findings for receptor R09.
- The analysis shown in Section 4.1 shows that the Project can be conducted and managed to achieve compliance with the SEPP AAQ objectives for air quality at all sensitive receptors including R2023 and R2024.

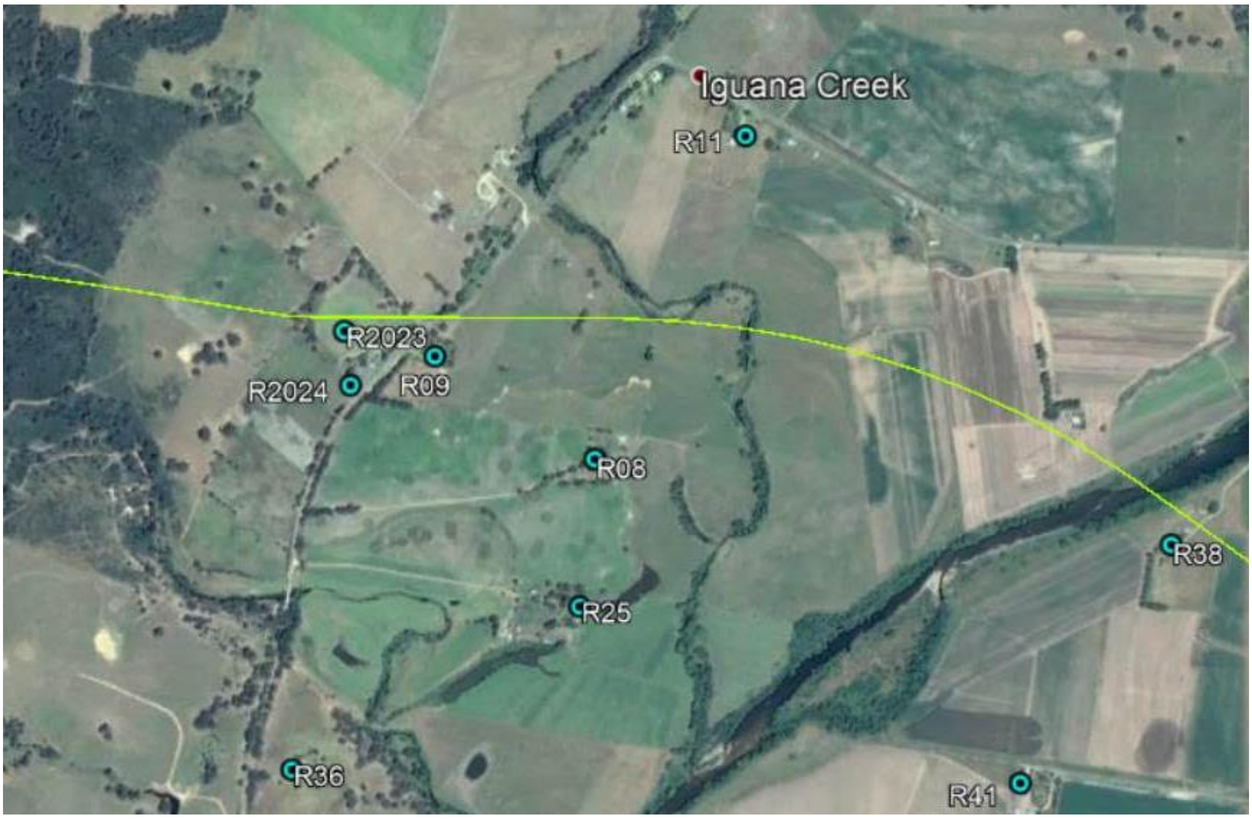

Figure 8 Aerial photograph showning the locations of receptors R2023 and R2024

5. INFORMATION RELEVANT TO GHG SUBMISSIONS

99. The EES submissions raise consistent topics relating to greenhouse gas emissions that I have responded to below. My response to individual submissions is at Appendix B of this statement with cross-references to this statement as relevant.

5.1 GHG Factors

100. The EES submission of East Gippsland Shire Council requested, for transparency, that the Scope 3 road and rail emission factors are documented.

101. The emission factors that were used to estimate the Scope 3 GHG emissions from road and rail associated with the Project's product transport are summarised in Table 8.

Table 8 Offsite Transport of HMC - GHG assessment assumptions

Component	Quantity	Units	Source
Articulated truck – diesel usage	36.7	tonne-km/L diesel	Laird, 2005, Revised land freight external costs in Australia
Rail – diesel usage	100	tonne-km/L diesel	
Dry container weight (40ft)	2.3	tonnes	DSV Clobal Transport and Logistics, 2019, Dry container weights (http://www.dsv.com)
Containers per transfer	2	containers	Estimated based on transport configuration
Payload	45	tonnes per transfer	Provided by Kalbar

5.2 Submission 813

102. Submission 813 raises various issues in relation to climate and greenhouse gas emissions. These are addressed at Appendix B.

6. REFERENCES

Ono, D, 2005, Ambient PM2.5/PM10 ratios for Dust Events from the Keeler Dunes, Great Basin UAPCD, Bishop, CA.

Cowherd, C, Donaldson, J, 2005, Analysis of the Fine Fraction of Particulate Matter in Fugitive Dust, Final report prepared for the Western Governors‟ Association, Western Regional Air Partnership (WRAP), MRI Project No. 110397.

Drew, R 2009, Screening Health Risk Assessment of Predicted Dust Emissions from the Wandoan Coal Mine, Toxicos document: TR020909-Rd1 4 September 2009.

NSW Health, 2017, Mine Dust and You, Fact Sheet, 2017.

US Environmental Protection Agency 1996, Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper, Office of Office of Air Quality Planning and Standards U.S. Environmental Protection Agency, EPA-452\R-96-013, July 1996.

US Environmental Protection Agency 2006, Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors, Midwest Research Institute, Western Governors‟ Association Western Regional Air Partnership (WRAP), 1515 Cleveland Place, Suite 200, Denver Colorado 80202. MRI Project No. 110397.

US Environmental Protection Agency 2010, Basic Concepts in Environmental Sciences, Module 3: Characteristics of Particles – Size Distribution.

APPENDIX A – CURICULUM VITAE OF SIMON WELCHMAN

Simon John Welchman — Director – Expert Witness Curriculum Vitae

Simon is an Environmental Engineer with a background of proven success over twenty-four years working as an air quality expert in the private sector and for the environmental regulator. Simon has been a Director of Katestone Environmental Pty Ltd since 2004 during which time he has conducted, managed, supervised or quality assured numerous air quality projects for clients across many sectors including: Local, State and Federal Government, heavy industry, refining, mining, construction, materials handling, intensive agriculture, land development, infrastructure, transport, road tunnels, manufacturing, electricity generation and distribution, waste treatment and disposal, aviation, LNG upstream collection infrastructure and LNG export facilities. Projects have considered the potential effects of many air pollutants on the environment and communities including: odour, dust, particulate matter, criteria pollutants, volatile organic compounds, air toxics, photochemical smog, secondary particulate generation, heavy metals, polycyclic aromatic hydrocarbons, dioxins and furans.

Simon has an extensive knowledge of air pollutants, their emission or formation in the atmosphere and the circumstances that contribute to their impact on the environment and people. Having worked in government and as an expert peer reviewer for Local and State Governments, Simon has a detailed and practical understanding of strategic planning, approval conditions and regulatory approaches to air quality management and control. Simon is expert in the use of regulatory dispersion models, interpretation of air quality data and a proficient and effective communicator of the sometimes complex science and concepts that underpin his work.

Simon is a member of the Institute of Engineers Australia and a Registered Professional Engineer of Queensland. Simon is an expert witness and has given evidence in the Queensland Planning and Environment Court, Queensland Land Court, Queensland Supreme Court, NSW Land and Environment Court, Supreme Court of Victoria and the Victorian Civil and Administrative Tribunal.

QUALIFICATIONS

Bachelor of Engineering (Environmental) (Hons), University of Queensland 1994

Registered Professional Engineer of Queensland (19108)

PROFESSIONAL AFFILIATIONS

Member of the Clean Air Society of Australia and New Zealand

Member of the Institution of Engineers Australia (NER)

Member of the Environmental Institute of Australia and New Zealand

PROFESSIONAL EXPERIENCE

Director of Katestone Environmental (2004-present)

New South Wales Environment Protection Authority (1999 – 2004):

- Acting Manager, Air Technical Advisory Services Unit
- Acting Principal Technical Policy Advisor
- Senior Technical Policy Advisor

Katestone Scientific Pty. Ltd. (1997 – 1999)

HLA Envirosciences Pty. Ltd. Mackay/Brisbane (1995 – 1997)

SPECIALIST SKILLS & EXPERIENCE

- Regulation of air pollutant emissions, benchmarking and assessment of best available control technologies
- Control, mitigation and management of air pollutant emissions and dust from industrial, mining and construction activities
- Air quality impact assessment of major power stations, refining, mining and industrial developments across Australian
- Air quality impact assessment of industrial and mining projects in the following countries: Papua New Guinea, Iraq, New Zealand, Indonesia, United States, New Caledonia, Bangladesh
- Air quality impact assessment of major roads and tunnel projects
- Air quality impact investigations to identify cause(s) of complaints, odours, reported health effects and residues
- Assisting government to develop policy for air quality and odour impact assessment; and, to develop environmental regulations
- Air quality modelling including TAPM, CALMET/CALPUFF, Ausplume, AERMOD, ISC3, Caline, CAL3QHCR
- Air pollutant emission estimation using: measurement, back calculation, mass balance, equipment specifications
- Air pollutant emissions monitoring and ambient air quality monitoring
- Design of air pollutant monitoring programs – equipment selection and siting, selection of pollutants and parameters, regulatory compliance, emissions control and feedback, trigger action response plans
- Risk assessment
- Application of novel techniques to environmental monitoring
- Development of air quality and dust management plans for construction activities and operations
- Odour impact assessment, odour control strategies and management plans for:
    - Agricultural industries: feedlots, mushroom composters, piggeries, broiler farms, poultry breeder farms, abattoirs and rendering plants
    - Waste and wastewater industries: sewage treatment plants, grease-trap waste treatment plants, transfer stations, waste composting and landfills
    - Small industries: food processing, manufacturing, printing and asphalt plants
    - Industry: coal-fired power station, breweries, manufacturing and pulp and paper mills

EXPERT ADVICE AND PEER REVIEW

Prepared expert advice to State and Local Government on:

- The impact of new industrial and infrastructure projects on air quality
- Regulatory and licensing requirements for new sources of air pollution

- Technical veracity of air quality impact assessments

Specific advisory roles have included:

- NSW EPA – Review of the Load Based Licensing Scheme – including inventory based health risk assessment, advice on assessable pollutants and pollutant weightings
- NSW EPA – Hazardous Air Pollutants Study
- NSW EPA – Coal Dust Benchmarking Study – International Best Practice measures to prevent and/or minimise particle emissions from coal mining
- NSW EPA – dust from coal trains
- Queensland Resources Council – dust from coal trains
- QR National – Environmental Evaluation – dust from coal trains
- ARTC – Review Particulate monitoring program
- Bulga Milbrodale Progress Assoc – Consulting advice on air quality and health on proposed expansion to Warkworth mine

LAND COURT QUEENSLAND

- LAND COURT QLD – PEMBROKE OLIVE DOWNS PTY LTD V SUNLAND CATTLE CO PTY LTD & ORS
- LAND COURT QLD – TAROOM COAL PTY LTD V RICHARD SHORLAND MOFFAT, MARGARET LINDSAY MOFFAT AND ANGUS SHORLAND MOFFAT
- LAND COURT QLD – TAROOM COAL PTY LTD V ROBERT GRAHAM ADAMS AND TERRI LORELLE ADAMS-MUNN
- LAND COURT QLD – COLTON COAL PTY LTD V ALDERSHOT AND DISTRICT AGAINST MINING AND ORS
- LAND COURT QLD – NEW ACLAND COAL PTY LTD V FRANK ASHMAN & ORS, AND DEPARTMENT OF ENVIRONMENT AND HERITAGE PROTECTION
- LAND COURT QLD - XSTRATA COAL QUEENSLAND PTY LTD & ORS V FRIENDS OF THE EARTH BRISBANE CO-OP LTD & ORS, AND DEPARTMENT OF ENVIRONMENT AND RESOURCE MANAGEMENT
- LAND COURT QLD – EDGARANGE PTY LTD V REDLAND SHIRE COUNCIL

LAND & ENVIRONMENT COURT NSW

- LAND AND ENVIRONMENT COURT NSW PROCEEDINGS NOS. 10605 TO 10609 OF 2014 - WOOLCOTT GROUP PTY LTD V ROSTRY PTY LTD & TAMWORTH REGIONAL COUNCIL
- LAND AND ENVIRONMENT COURT NSW PROCEEDINGS NUMBER 14015 OF 2014 - WILKS-GILBERT V WAGGA WAGGA CITY COUNCIL
- LAND AND ENVIRONMENT COURT NSW PROCEEDINGS NUMBER 10928/2010 - DELLARA PTY LTD V MINISTER OF PLANNING AND PENRITH CITY COUNCIL

PLANNING AND ENVIRONMENT COURT QUEENSLAND

- P&E COURT NO. 3437/19 QLD SHEILA BLIDGE PTY LTD AS TRUSTEE FOR WPG PROPERTY TRUST V LOGAN CITY COUNCIL
- P&E COURT NO. 4630/18 QLD JAMES FAMILY FUNERAL TRUST V LOGAN CITY COUNCI
- P&E COURT QLD 786/16 PHIPPS PASTORAL V SOMERSET REGIONAL COUNCIL
- P&E COURT QLD 1204/15 COOMINYA PROPERTIES TRUST V SOMERSET REGIONAL COUNCIL
- P&E COURT QLD 3084/14 BORAL RESOURCES (QLD) PTY LTD V GOLD COAST CITY COUNCIL AND STOP THE GOLD COAST QUARRY ASSOCIATION INC
- P&E COURT QLD 920/13 DEENERYGOLD PTY LTD V SCENIC RIM REGIONAL COUNCIL
- P&E COURT QLD 625/14 HOLCIM (AUSTRALIA) PTY LIMITED V BUNDABERG REGIONAL COUNCIL
- P&E COURT QLD 920/13 EBBORN PTY LTD V SOMERSET REGIONAL COUNCIL
- P&E COURT QLD 1292/13 WOODWARD V MACKAY REGIONAL COUNCIL, BORAL CONSTRUCTION MATERIALS AND ORS
- P&E COURT QLD 11785/13 AUSTRALIA PACIFIC LNG PTY LTD V GOLDEN & ORS
- P&E COURT QLD 4500/12 WATTLEVILLA PTY LTD V WESTERN DOWNS REGIONAL COUNCIL & RUSSELL PASTORAL COMPANY
- P&E COURT QLD 5003/12 PHOENIX POWER RECYCLERS V GOLD COAST CITY COUNCIL
- P&E COURT QLD 975/11 MACKAY RESOURCE DEVELOPMENTS PTY LTD V MACKAY REGIONAL COUNCIL &ORS
- P&E COURT QLD D247/11 PARKLANDS BLUE METAL PTY LTD V SUNSHINE COAST REGIONAL COUNCIL
- P&E COURT QLD D166/11 MARQUETTE BOWEN V SUNSHINE COAST REGIONAL COUNCIL
- P&E COURT QLD 3356/11 KARTAWAY (QLD) PTY LTD V BRISBANE CITY COUNCIL
- P&E COURT QLD 83/2010 - AJK CONTRACTING PTY LTD V MACKAY REGIONAL COUNCIL & ORS
- P&E COURT QLD 92/10 MORGAN V TOOWOOMBA REGIONAL COUNCIL & ORS
- P&E COURT QLD 2606/10 WESTLINK PTY LTD V LOCKYER VALLEY REGIONAL COUNCIL
- P&E COURT QLD 99/09 DARRYL & CAROLINE PHILLIPS V CANNING DOWNS SOUTH PTY LTD & SOUTHERN DOWNS REGIONAL COUNCIL
- P&E COURT QLD 1834/09 REFAKA PTY LTD V SCENIC RIM REGIONAL COUNCIL
- P & E COURT QLD D124/2008 ROBERT HARRIS & CO ACITVE INVESTMENTS AND ORS V ROCKHAMPTON REGIONAL COUNCIL - CREMATORIUM IN ROCKHAMPTON
- P&E COURT QLD 3664/07 BASSINGTHWAIGHTE & ANOTHER V ROMA TOWN COUNCIL
- P&E COURT 1212/2007 BLUE EAGLE (RURAL) PTY LTD V BEAUDESERT SHIRE COUNCIL
- P&E COURT QLD BD3438/2007 BARRO GROUP PTY LTD V REDLAND SHIRE COUNCILI - MT COTTON QUARRY EXTENSION
- P&E COURT QLD BD940/2007 SINGH PROPERTIES PTY LTD V BEAUDESERT SHIRE COUNCIL & ORS
- P&E COURT QLD BD1758/2006 GARY PETERS AND PATRICIA PETERS V CABOOLTURE SHIRE COUNCIL - PETERS POULTRY FARM
- P&E COURT QLD BD3145/2006 ACLAND PASTORAL CO. PTY LTDV ROSALIE SHIRE COUCNIL & STATE OF QLD (King & Co)
- P&E 274/06 IPSWICH CITY COUNCIL – V – CHUWAR RECYCLING & LANDFILLING PTY LTD
- P&E 234/06 IPSWICH CITY COUNCIL – V – PARCEL ONE PTY LTD
- P&E COURT QLD 199/05 MLK NEWTON PTY LTD – V – MAROOCHY SHIRE COUNCIL
- P&E COURT QLD 3955/05 CABOOLTURE SHIRE COUNCIL – V – EVANS
- P&E COURT QLD 2/04 KA HALL &ORS – V – NANANGO SHIRE COUNCIL & RT AND VK CULLEN PLANNING
- P&E COURT QLD 3648/04 ACI GLASS PACKAGING (BRISBANE) AND ORS – V – NEO LIDO PTY LTD

SUPREME COURT OF QUEENSLAND

- PN 932/16 FOXLEIGH LAND PTY LTD V KEVIN KENNY AND ORS

SUPREME COURT OF VICTORIA

- AMACA PTY LTD & ORS ATS SWIATEK

VICTORIAN CIVIL AND ADMINISTRATIVE TRIBUNAL

- VCAT P790/2017, P794/2017, P795/2017, P805/2017 & P877/2017, MELTON CITY COUNCIL & ORS V ENVIRONMENT PROTECTION AUTHORITY

AWARDS

- CASANZ Clean Air Achievement Award – 2011 (Katestone)
- Australian Bulk Handling Excellence Award – Dust Management – 2008 (Katestone)

PUBLICATIONS

- Burchill M., Welchman S., 2017, Air Quality and the Law: A Historical Review of Cases in the Queensland Planning and Environment Court, Presented at the 23rd CASANZ Conference, Brisbane, Australia, 15-18 October 2017.
- Burchill M., Welchman S., 2017, The National Pollutant Inventory: Facts and Fiction, Presented at the 23rd CASANZ Conference, Brisbane, Australia, 15-18 October 2017.
- Balch A, Wiebe A, Schloss A, Vernon A, Killip C, Welchman S, 2011, Air Quality and Odour Impact Assessment of an Estate Containing Noxious and Offensive Industry. Presented at the 20th International Clean Air and Environment Conference, Auckland, New Zealand, July/August 2011.
- Wiebe, A.J., Balch, A., Quintarelli, F., Burchill., M, Killip, C., Welchman, S., 2011, Investigation of Regionally specific PM10 and PM2.5, Signatures for the Development of a Technique for use in Cumulative Impact Assessment, 20th International Clean Air and Environment Conference, Auckland, New Zealand.
- Killip C., Leishman N., Heuff D., Schloss A & Welchman S. 2007, 'Is the clean air of Brisbane threatened by future population growth?', presented at the 14thIUAPPA World Congress in Brisbane, Queensland, Australia, 2007
- Welchman S, Brooke AS and Best P (2005), "Is odour intensity all it's cracked up to be?", 17th International Clean Air & Environmental Conference, Hobart, Tasmania, Australia 2005
- NSW EPA Offensive Odours Operations Guidance Manual, co-author
- NSW EPA Draft Policy: Assessment and Management of Odours from Stationary Sources in NSW, review
- NSW Department of Environment and Conservation, Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW, review and preparation of revised draft

APPENDIX B – RESPONSE TO SUBMISSIONS

1.0 GOVERNMENT AND AGENCY SUBMISSIONS

1.02 Air quality

Issue #	Issue description	Submission #	Response
1	Comment that the predicted exceedances of the 24 hour criterion for PM_{10} will need to be mitigated in accordance with a management plan that includes triggers for their application of the mitigation measures.	716	The use of proactive and reactive strategies to manage potential impacts of dust are best practice (see EES air quality assessment, Table 13, page 39). Such approaches have become more necessary and commonplace as regulatory standards for particulate matter have become more stringent.
2	Concern about the approach taken in the air quality assessment to addressing the 11 day gap in PM_{10} and $PM_{2.5}$ data.	716	The EES air quality assessment describes in detail the method that has been used to fill the 11-day gap in PM_{10} and $PM_{2.5}$ datasets in April 2018 (see EES air quality assessment, Section 3.2.4.2.7). The approach to filling data provides a reliable representation of ambient background concentrations during this period because the filled data reflects the frequency of occurrence of PM_{10} and $PM_{2.5}$ concentrations that are measured during autumn. The Peer Reviewer expressed concern that the fill technique may result in the PM_{10} and $PM_{2.5}$ data not being correlated in the same way as the rest of the measured dataset. By design, the fill technique adopted by Katestone will produce PM_{10} and $PM_{2.5}$ values that are correlated in the same way as the autumn dataset. In particular, the $PM_{2.5}$ values follow the same general trend as PM_{10}, which is characteristic of the wider measured dataset. On average, the $PM_{2.5}/PM_{10}$ ratio based on data generated during this 11-day period is 0.27, compared to 0.26 for the raw dataset of monitoring concentrations throughout the 12-month period. Fill values have been randomly selected from the distribution to avoid any bias in the outcome. Katestone considered a range of other potential approaches, including that proposed by the peer reviewer, and concluded that the approach that was adopted in the EES air quality assessment was the most suitable to represent autumn levels of PM_{10} and $PM_{2.5}$.
3	Concern about over-reliance on the precision of the air quality modelling and on ceasing mining works to address potential non-compliance with PM_{10} criteria at receptors.	716	As detailed in the Project Mitigation Register (EES, Attachment H), Kalbar has committed to real-time air quality monitoring, trigger levels and forecast weather conditions (amongst other things) to assist it to manage potential dust impacts from the Project. Consequently, management of dust from operations of the mine do not rely upon precision of air quality modelling. The draft Air Quality Management Plan that was prepared by Katestone for Kalbar (see Appendix C of the Statement of Simon Welchman) proposes various thresholds that would be used to evaluate 1-hour average measurements of various parameters that will be used to trigger certain actions. The thresholds have been set using short-term (1-hour) averaging periods in order to avoid air quality objectives with 24-hour

Issue #	Issue description	Submission #	Response
			averaging periods being exceeded by dust generated by the Project.
4	Concern about assessing $PM_{2.5}$ emissions against dated 24 hour and annual average standards.	716	See Statement of Simon Welchman, Section 4.1 Assessment against SEPP AAQ environmental quality objectives.
5	Concern that the assessment relies on criteria from other jurisdictions rather than SEPP (AAQ) criteria.	716	See Statement of Simon Welchman, Section 4.1 Assessment against SEPP AAQ environmental quality objectives.
6	Comment that there is no regulatory standard for dust deposition on vegetables.	716	There is no regulatory standard for dust deposition on vegetables. The EES air quality assessment predicted dust deposition rates that are below the criterion for amenity affects on people. This issue is addressed in the Horticulture Impact Assessment (EES, Appendix A016).
7	Concern about airborne contaminants reaching raw water storage at Woodglen.	692	This issue is addressed in Health Risk Assessment (EES, Appendix A019).
8	Air Modelling and Monitoring data should be compared to PEM and SEPP criteria. 25 ug/m3 for $PM_{2.5}$ and 50 ug/m^3 for Pm10	514	See Statement of Simon Welchman, Section 4.1 Assessment against SEPP AAQ environmental quality objectives.
9	Include additional mitigation measures which will be implemented in years 5,8 and 12	514	See Statement of Simon Welchman, Section 4.1 Assessment against SEPP AAQ environmental quality objectives.
10	Revision of trigger levels to 1-hr Pm10 80 ug/m3	514	See Statement of Simon Welchman, Section 4.2 Modify Plans and Section 4.3 Trigger Levels.
11	Insert: EPA will be consulted on the development of the Project's air quality management and monitoring sub-plans.	514	See Statement of Simon Welchman, Section 4.2 Modify Plans.
12	Amend wind trigger speed to >25 km/hr	514	See Statement of Simon Welchman, Section 4.2 Modify Plans.
13	Amend vehicle speed limit to 10-20 km/hr	514	See Statement of Simon Welchman, Section 4.2 Modify Plans.
14	Add a commitment to visual observation monitoring to Table 9-1 and Table 12.9	514	See Statement of Simon Welchman, Section 4.2 Modify Plans.
15	Amend rating of risk from "unlikely" to "possible"	514	See Statement of Simon Welchman, Section 4.2 Modify Plans.
16	Add a commitment of monitoring of rainwater tanks be conducted for 12 months	514	See Statement of Simon Welchman, Section 4.2 Modify Plans.
17	Periodic monitoring of deposited dust on nearby crops be conducted to validate the assumptions of dust assessments described in the Human Health Risk Assessment. The frequency and period of this monitoring should be agreed to with the local farmers and Community Reference Group	514	See Statement of Simon Welchman, Section 4.2 Modify Plans.

1.03 Climate change and Greenhouse Gas Emissions

Issue #	Issue description	Submission #	Response
1	A comment is made that the Project is expected to be a relatively minor contributor to state and national greenhouse gas inventories for scope 1 emissions, and that emissions associated with roads/rail transport are a relatively minor contributor to the total scope 1, 2 and 3 emissions.	716	See Statement of Simon Welchman, Section 2.2.
2	Concern that the emissions factors used in the greenhouse gas emission calculations were not documented.	716	See Statement of Simon Welchman, Section 2.2 and Section 5.1.

2.0 OTHER SUBMISSIONS

2.7 Air quality

Issue #	Issue description	Submission #	Response
1	Emissions of dust (including contaminated or radioactive dust , respirable silica and carcinogens) will affect people's health through inhalation, or through contaminating horticultural produce and pasture.	3, 4, 15, 16, 20, 22, 23, 24, 25, 27, 29, 30, 32, 36, 37, 39, 42, 43, 44, 45, 48, 50, 52, 53, 54, 55, 56, 57, 58, 60, 62, 64, 65, 67, 68, 69, 70, 71, 72, 74, 75, 76, 77, 78, 79, 81, 86, 89, 91, 94, 97, 99, 102, 105, 109, 110, 114, 116, 118, 119, 120, 121, 123, 132, 135, 137, 142, 145, 147, 152, 153, 154, 157, 159, 160, 163, 164, 169, 171, 176, 178, 185, 186, 187, 190, 191, 192, 193, 197, 199, 202, 203, 205, 206, 207, 212, 213, 218, 219, 220, 221, 224, 225, 226, 227, 229, 230, 233, 234, 237, 239, 240, 241, 242, 243, 248, 252, 253, 255, 257, 259, 260, 261, 262, 263, 264, 266, 267, 268, 271, 281, 288, 296, 298, 299, 300, 310, 314, 315, 319, 322, 325, 340, 344, 349, 355, 356, 365, 373, 374, 375, 378, 383, 385, 388, 389, 392, 395, 396, 401, 406, 419, 423, 431, 433, 434, 436, 437, 439, 440, 442, 447, 451, 452, 453, 455, 468, 469, 472, 474, 475, 477, 478, 480, 481, 484, 487, 492, 502, 506, 516, 522, 523, 524, 525, 527, 529, 532, 541, 546, 547, 548, 554, 565, 568,	The EES air quality assessment was conducted in accordance with EPA Victoria's requirements using site specific and site representative data. In particular, the EES was conducted in accordance with the PEM Mining and Extractive Industries and with agreement on methodology from EPA Victoria. The EES air quality assessment considered the potential composition of the dust, quantified ground-level concentrations of dust related air contaminants, assessed concentrations against relevant criterion and found that the Project is unlikely to adversely affect air quality at sensitive locations. This issue is addressed in Health Risk Assessment (EES, Appendix A019).

Issue #	Issue description	Submission #	Response
		583, 584, 585, 595, 596, 597, 598, 601, 604, 605, 611, 613, 614, 615, 618, 620, 625, 627, 628, 630, 633, 635, 636, 638, 643, 646, 648, 649, 652, 658, 660, 663, 664, 667, 668, 672, 673, 674, 675, 676, 677, 680, 682, 683, 684, 686, 690, 693, 694, 698, 700, 702, 704, 707, 709, 712, 713, 717, 718, 720, 722, 724, 725, 727, 733, 734, 737, 740, 743, 744, 745, 747, 748, 749, 750 751, 752, 753, 758, 759, 763, 765, 766, 767, 773, 777, 778, 780, 781, 783, 784, 788, 791, 793, 794, 796, 800, 805, 809, 810, 812, 813, 814, 817, 818, 822, 823, 826, 829, 830, 831, 833, 835, 837, 840, 841, 843, 845, 846, 847, 850, 851, 853, 855, 859, 861, 862, 865, 869, 875, 876, 878, 880, 885, 887, 889, 893, 899, 900, 907	
2	Dust emissions on water quality in Woodglen Reservoir/ Mitchell River.	32, 54, 57, 59, 61, 68, 89, 96, 109, 110, 120, 133, 137, 147, 155, 156, 158, 159, 178, 190, 201, 215, 219, 221, 225, 239, 253, 261, 263, 280, 290, 296, 298, 300, 319, 355, 451, 468, 472, 474, 475, 477, 478, 488, 497, 520, 527, 531, 532, 535, 546, 547, 557, 559, 582, 594, 604, 605, 611, 628, 638, 649, 658, 660, 663, 673, 675, 682, 686, 704, 709, 718, 720, 724, 727, 733, 737, 739, 744, 747,	This issue is addressed in Health Risk Assessment (EES, Appendix A019).

Issue #	Issue description	Submission #	Response
		748, 749, 751, 753, 759, 770, 778 791, 793, 813, 814, 816, 817, 818, 819, 820, 823, 826, 830, 831, 832, , 838, 840, 843, 844, 845, 847	
3	Dust emissions will affect water quality in dams and rainwater tanks, pools and solar panels. Submission have also included: • Filtration systems to be fitted to all domestic tank within 50km radius • Ongoing tank monitoring within given radius of the project to provide assurances to residents • Examples were provided from Kanagulk in Western Victoria radioactive dust contaminated water tanks within 7-8 km of the mine site which had to be cleaned twice a year. • Queries about the 12 month data set of monitoring is required so that there will be enough data to establish a robust baseline data set that can be relied on when assessing water quality of rainwater tanks and dams	65, 77, 94, 96, 159, 191, 202, 203, 224, 239, 241, 253, 268, 298, 484, 488, 492, 497, 506, 514, 527, 531, 540, 541, 546, 547, 554, 638, 649, 659, 673, 677, 682, 737, 739, 750, 752, 753, 781, 812, 813, 814, 818, 831, 835, 837, 840, 843, 844, 900	The EES air quality assessment predicted dust deposition rates that are below the criterion for amenity affects on people. See also Statement of Simon Welchman, Section 4.2, paragraph 71. This issue is addressed in Health Risk Assessment (EES, Appendix A019).
4	Concern with scientific modelling and monitoring data sets that were used to develop the air quality assessment. Issues include: a. Concern about the adequacy of the dust forming fraction monitoring, in particular, that meteorological monitoring was only undertaken for 12 months and that the monitors did not work for 22% of that time. b. Victorian EPA standards are outdated and we should be using the USA EPA standards of assessment. c. Some rare earth elements do not have local guidelines so there is no yardstick to measure them d. The methodology used to present the airborne carcinogens in the ore and that they can accumulate in through the food chain. e. The air quality assessment does not map or define the distances that dust will travel under different wind speeds. f. Concern about modelled exceedances of PM_{10} criteria in the *National Environment Protection (Ambient Air Quality) Measure 2016.* g. Concern that the peer reviewer (Denison, 2019) called into	241, 268, 389, 423, 484, 516, 520, 554, 556, 582, 649, 672, 712, 813	Responses: a. In relation to meteorology, see Statement of Simon Welchman, Section 4.4 Meteorological Data. b. In relation to air quality standards, see Statement of Simon Welchman, Section 4.1 Assessment against SEPP AAQ environmental quality objectives. c. Where local air quality objectives do not exist, the EEA air quality assessment used air quality criteria from the Texas Commission on Environmental Quality Effects Screening Levels (TCEQ ESL). This is in accordance with the recommendation of the independent peer reviewer and EPA Victoria. d. In relation to carcinogens, this is addressed in the Health Risk Assessment (EES, Appendix A019). e. The distance travelled by dust under different wind speeds is of no relevance to the outcome of the assessment. The EES air quality assessment demonstrates that concentrations of air pollutants drop significantly with distance from the Project.

Issue #	Issue description	Submission #	Response
	question some of the modelling predictions in the air quality assessment (Katestone, 2020) and these were not addressed. h. The AERMOD modelling undertaken by the consultant has been shown to underestimate contamination from more complex topography…and therefore probably underestimates dust emissions. i. The air quality assessment incorrectly calculates that Kalbar's proposed two water trucks will be sufficient to ensure dust mitigation j. Concern that the mathematical modelling is inadequate for dust modelling and that various measurements involved with the dust assessment fall short of requirements. k. Concern about relying on air quality data from Traralgon in the modelling, which is the second most polluted in Victoria, as a baseline for ambient air at Glenaladale. l. Concern that the modelling did not account for topography of the area. m. Concern that the modelling did not address dust impacts during years 1-3, when dust impacts would be greatest. n. Concern that the assessment relies on outdated standards for nitrogen dioxide, sulfur dioxide and Oxy O3, as the Commonwealth government is reviewing standards in respect of these.		Concentrations beyond 5km are predicted to be very low and of no consequence for air quality. f. See Statement of Simon Welchman, Section 4.1 Assessment against SEPP AAQ environmental quality objectives. The SEPP AAQ objectives are equal to or stricter than the NEPM AAQ standards. g. The comments of the peer reviewer have been adequately addressed. h. The EES air quality assessment estimated emissions from haul roads and vehicle exhaust in accordance the PEM (See EES Appendix A009, Sections 3.4.3 and 3.4.4). The paper cited in submission 813 (Tian, Liang, & Li, 2019) is not relevant to the assessment of the Project. i. See Statement of Simon Welchman, Section 4.5 Water availability for dust suppression. j. The EES air quality assessment was conducted in accordance with EPA Victoria's requirements using site specific and site representative data. In particular, the EES was conducted in accordance with the PEM Mining and Extractive Industries and with agreement on methodology from EPA Victoria. The EES air quality assessment considered the potential composition of the dust, quantified ground-level concentrations of dust related air contaminants, assessed concentrations against relevant criterion and found that the Project is unlikely adversely affect air quality at sensitive locations. k. The EES air quality assessment used data from Traralgon to characterise levels of NO_2 and SO_2 at the Project site. This is an appropriate data source because it will result in an overestimate of these air pollutants due to the Project. l. The air quality modelling did account for the topography of the area. See EES Appendix A009 – Stage Two Air Quality and Greenhouse Gas Assessment Section 2.1, page 5; Section 3.2.1, page 12-13; Appendix A, Section A1.1, page 118; and Appendix A, Section A2, page 124. m. The EES air quality assessment considered the potential impact during construction. See EES Appendix A009 – Stage Two Air Quality and Greenhouse Gas

Issue #	Issue description	Submission #	Response
			Assessment Section 3.5, page 51. Three operational years were selected to explore the extent of the potential impact of the project as described in EES Appendix A009 – Stage Two Air Quality and Greenhouse Gas Assessment Section 3.3.2.2, page 32-33. Overburden extraction during Years 1-3 are half that of Year 5. Accordingly, emission rates of dust during these years of operation would also be approximately half that of Year 5. n. The Project is not likely to generate significant quantities of NO_2 and SO_2. The EES air quality assessment demonstrated easy compliance with the current NO_2 and SO_2 standards. The predicted concentrations of NO_2 and SO_2 that are presented in the EES air quality assessment would also easily comply with the stricter limits contained in the Draft Air NEPM. Given the very low emissions of oxides of nitrogen, ozone is not a significant or relevant air pollutant.
5	Concern about likely effectiveness of dust mitigation measures: a. The water balance does not allow for sufficient volumes of water to suppress dust. b. Concern about management of dust and arrangements for ceasing operations on high-wind days. Will this only be if someone complains? Concern that it will be too late to prevent nuisance if dust deposition levels exceed the trigger values for mitigating actions. Skeptical that a mining operation would actually stop on high wind days c. Under what unfavorable conditions would the mine be closed and rehabilitated rather than just being left in care and maintenance leaving heavy metal sands exposed to the weather? d. Stopping up to 90% of the dust is not very reassuring. Over 15 or so years of mining, followed by 5 years of rehabilitation, even 10% of the total of dust produced could be quite sufficient to cause health issues and contamination issues for the soil in which the vegetables are grown e. Concern about mine running out of water for dust suppression.	57, 213, 484, 831, 225, 239, 481, 524, 541, 559, 763, 649, 675, 813	Responses: a. See Statement of Simon Welchman, Section 4.5 Water availability for dust suppression. b. As detailed in the Project Mitigation Register (EES, Attachment H), Kalbar has committed to real-time air quality monitoring, trigger levels and forecast weather conditions (amongst other things) to assist it to manage potential dust impacts from the Project. Consequently, management of dust from operations of the mine do not rely upon precision of air quality modelling. The draft Air Quality Management Plan that was prepared by Katestone for Kalbar (see Appendix C of the Statement of Simon Welchman) proposes various thresholds that would be used to evaluate 1-hour average measurements of various parameters that will be used to trigger certain actions. The thresholds have been set using short-term (1-hour) averaging periods in order to avoid air quality objectives with 24-hour averaging periods being exceeded by dust generated by the Project. c. This is not an issue for air quality.

Issue #	Issue description	Submission #	Response
			d. EES air quality assessment demonstrated that the residual dust associated with the Project would not cause adverse impacts. e. See Statement of Simon Welchman, Section 4.5 Water availability for dust suppression.
6	The air monitoring was undertaken at an inappropriate location/time. a. Concern that there was only one monitoring station given the size of the Project area. b. Concern that wind speed data used in air quality assessment were not representative of local peak wind speeds. c. Concern that air quality monitoring stations were inappropriately placed, and provided misleading windspeed information d. Concern that only parts of the mining process were assessed as far as dust production e. Concern that the dust monitoring/weather data has a gap during the summer months ((Jan-Apr) and that wind has been under reported.	57, 70, 135, 157, 158, 225, 268, 481, 525, 752, 812, 813, 831, 837	Response: a. The EES air quality assessment was conducted in accordance with EPA Victoria's requirements using site specific and site representative data. In particular, the EES was conducted in accordance with the PEM Mining and Extractive Industries and with agreement on methodology from EPA Victoria. b. See Statement of Simon Welchman, Section 4.4 Meteorological Data. c. See Statement of Simon Welchman, Section 4.4 Meteorological Data. d. All significant sources of dust were considered in the EES air quality assessment. It is well documented that the majority of dust emissions from mining activities are due to a few key sources, namely: i. Dust from haul trucks ii. Truck loading and dumping iii. Bulldozers, scrapers and graders iv. Wind erosion of exposed areas and stockpiles. The EES air quality assessment also quantified emissions from more minor sources such as: i. Ore processing ii. Product transport. e. The data loss did not have an adverse impact on the EES air quality assessment. Section A1.2 of the EES air quality assessment describes the evaluation of the data generated by the meteorological model, TAPM, during periods where there was no data available from the on-site weather station. This evaluation considered meteorological data that was recorded at another

Issue #	Issue description	Submission #	Response
			meteorological monitoring station that was collocated with the continuous dust monitor (BAM). The evaluation concluded that the dataset that was used in the modelling was likely to provide a good representation of conditions on-site. See also response Statement of Simon Welchman, Appendix B, Government and Agency Submissions 1.02 Air Quality Issue #2.
7	Concerns about winds carrying dust to nearby residences, agricultural operations, schools and recreational facilities. Particularly when soils are bare.	58, 123, 267, 347, 365, 374, 385, 389, 395, 418, 419, 423, 436, 440, 441, 442, 445, 546, 780, 813, 862, 863, 881, 886, 887, 892, 893, 896, 899, 900	The EES air quality assessment was conducted in accordance with EPA Victoria's requirements using site specific and site representative data. In particular, the EES was conducted in accordance with the PEM Mining and Extractive Industries and with agreement on methodology from EPA Victoria. The EES air quality assessment considered the potential composition of the dust, quantified ground-level concentrations of dust related air contaminants, assessed concentrations against relevant criterion and found that the Project is unlikely to adversely affect air quality at sensitive locations.
8	Concern there is no regulatory standards for dust deposition levels on vegetables; concern about dust deposition on grapes in vineyard.	243, 509	There is no regulatory standard for dust deposition on vegetables. The EES air quality assessment predicted dust deposition rates that are below the criterion for amenity affects on people. This issue is addressed in the Horticulture Impact Assessment (EES, Appendix A016).
9	Emissions of dust and exhaust pollutants due to earthworks, wind erosion from bare ground and stockpiles, increased project traffic, vehicle movements along unsealed roads, mining equipment and the use of on-site diesel generators have the potential to affect all residents in the nearby area.	481, 664	The EES air quality assessment was conducted in accordance with EPA Victoria's requirements using site specific and site representative data. In particular, the EES was conducted in accordance with the PEM Mining and Extractive Industries and with agreement on methodology from EPA Victoria. The EES air quality assessment considered the potential composition of the dust, quantified ground-level concentrations of dust related air contaminants, assessed concentrations against relevant criterion and found that the Project is unlikely to adversely affect air quality at sensitive locations.
10	Recent changes to legislation and release of the draft 'Environmental Reference Standard' means that future compliance standards for airborne particulates will be 25 ug/m3 for PM2.5 and 50 ug/m3 for PM10. Under the new legislation, operator will be required to reduce	514, 813	In relation to air quality standards, see Statement of Simon Welchman, Section 4.1 Assessment against SEPP AAQ environmental quality objectives. The draft Air Quality Management Plan that was prepared by

Issue #	Issue description	Submission #	Response
	emissions so far as reasonably practicable. Submission includes recommendations for 'trigger levels' used in monitoring. Submission also proposes changes to wind speed and vehicle speed action levels described in the Air Quality risk treatment plan (including restricting vehicle speeds on the mine to 10 – 20 km/hr).		Katestone for Kalbar (see Appendix C of the Statement of Simon Welchman) proposes various thresholds that would be used to evaluate 1-hour average measurements of various parameters that will be used to trigger certain actions. The thresholds have been set using short-term (1-hour) averaging periods in order to avoid air quality objectives with 24-hour averaging periods being exceeded by dust generated by the Project.
11	'Based on the information provided in the Human Health Risk Assessment, EPA does not expect dust from the project to adversely affect the integrity of crops grown or human health'. Submission recommends monitoring to validate health risk predictions.	514	As detailed in the Project Mitigation Register (EES, Attachment H), Kalbar has committed to real-time air quality monitoring and provision of results on the Project website. See also response Statement of Simon Welchman, Section 4.2, paragraph 72.
12	Visibility of dust will affect community's assessment of 'acceptability' of dust levels.	813	Dust associated with the Project is not likely to be visible beyond the site boundary.
13	Plume modelling and re-distribution of particulates and metal attenuation into the environment has taken a standardised multi-year approach. It does not however consider future risk scenarios. for instance local weather conditions that exceed +/- standard deviation of existing data series for wind and plume dispersion. These data sets would be of interest for local businesses as future climate change predictions identify a number of changes in weather aspects that affect eastern Victoria.	277	The EES air quality assessment was conducted in accordance with EPA Victoria's requirements using site specific and site representative data. In particular, the EES was conducted in accordance with the PEM Mining and Extractive Industries and with agreement on methodology from EPA Victoria. The EES air quality assessment considered the potential composition of the dust, quantified ground-level concentrations of dust related air contaminants, assessed concentrations against relevant criterion and found that the Project is unlikely to adversely affect air quality at sensitive locations.

2.8 Climate change and Greenhouse Gas emissions

Issue #	Issue description	Submission number #	Response
1	The Project will result in greenhouse gas emissions and exacerbate climate change effects. Kalbar should either purchase renewable energy or install a renewable energy generator given the significant energy consumption.	6, 41, 51, 67, 77, 248, 263, 268, 335, 348, 352, 388, 544, 673, 705, 813	The offsetting of GHG emissions associated with the Project is not a requirement at a state or national level. The Safeguard Mechanism has been put in place to ensure that emissions reductions purchased by the Government through the Carbon Solutions Fund are not offset by significant increases in emissions by large emitters elsewhere in the economy.

Issue #	Issue description	Submission number #	Response
			The Safeguard Mechanism commenced on 1 July 2016 and requires Australia's largest emitters to keep emissions within baseline levels. It applies to around 140 large businesses that have facilities with direct emissions (Scope 1) of more than 100,000 tonnes of carbon dioxide equivalent (tCO_2-e) a year and is expected to cover approximately half of Australia's emissions. With estimated annual emissions of less than 50 $ktCO_2$-e for all years of operation the Project is not subject to the requirements of the Safeguard Mechanism.
2	Claim that Kalbar has made no or a limited effort to mitigate scope 2 and/or scope 3 emissions.	6, 705, 813	Best practice in terms of energy efficiency and associated GHG emissions will be achieved through a range of initiatives including: • Ongoing monitoring and reporting GHG emissions and identifying opportunities to reduce GHG emissions • Equipment selection, operations and maintenance • Load optimisation, production scheduling and logistics planning including route optimisation • Use of solar power to supplement electricity use where practical • Minimisation of grid electricity consumption through power factor correction Three options for the transport of HMC to its first delivery point are under consideration: • Truck haulage of half of the HMC from site to Port Anthony combined with truck haulage of half of the HMC to Maryvale with train freight to Port of Melbourne via Maryvale rail siding. • Train freight of HMC from site to Port of Melbourne via Bairnsdale rail siding • Train freight of HMC from site to Port of Melbourne via Fernbank East rail siding Estimated GHG emissions for train freight of the HMC via Fernbank East rail siding (Option 3, the preferred transport option

Issue #	Issue description	Submission number #	Response
			for the project) of 5,406 tCO2-e are lower than for the other transport options.
3	Comment that removal of over 700 large mature trees will release sequestered CO2 back into the atmosphere.	156	Land clearing calculations are based on FULLCAM (Full Carbon Accounting Model) used in the preparation of the Australian National GHG Inventory. Carbon content of trees applied in the assessment is based on the geographic location of the Project. All carbon content in trees removed due to the Project is assumed to be converted into CO_2 through decomposition. This is a conservative assumption.
4	Query whether Kalbar will be using conventional or unconventional gas.	473	Natural gas is not proposed to be used by the Project.
5	Concern that the GHG emissions calculations are underestimated, targets have not been set for reduction over the life of the project.	705, 813	GHG emissions for the Project have been calculated in line with national guidelines (NGER Scheme methodologies) and internationally regarded protocol for GHG accounting (Greenhouse Gas Protocol).
6	Claim that Kalbar is unlikely to develop the 66kV transmission line due to its costs and will instead rely on diesel generators for power.	813	Not Katestone's issue.
7	The climate costs of the Project outweigh the benefits – resulting in 1.074Mt of GHG emissions per new job, compared to the State average of 41.75 tonnes per job.	813	The calculation of GHG emissions per job for the Project in submission 813 is incorrect because it uses the Project's lifetime emissions of GHG emissions and compares those lifetime emissions per job to Victoria's annual emissions per job. Regardless of this, the average tonnes of GHG emissions per Victorian job is not a reasonable benchmark for an industrial activity such as the Project. Jobs associated with industrial activities are necessarily more carbon intensive than other jobs.
8	Carbon costs are likely to be in the order of $30m based on the carbon price published in the latest Emissions Reduction Fund figures, as opposed to the $16m in the EES.	813	Not Katestone's issue.
9	Criticism of the EES approach to monetizing the externality of greenhouse gas emissions as a ratio of the Victorian population to the global population.	813	Not Katestone's issue.

APPENDIX C – DRAFT AIR QUALITY MANAGEMENT PLAN

Air Quality Management Plan for the Fingerboards Project

Prepared for:

Kalbar Resources Pty Ltd

January 2021

Draft

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Prepared by:	Tania Haigh
Reviewed by:	Simon Welchman
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Contents

Tables

Figures

Glossary

Term	Definition
$\mu g/m^3$	micrograms per cubic metre
µm	micrometres
°C	degrees Celsius
g/m^2/month	grams per square metre per month
km	kilometre
km/h	kilometre per hour
m	metre
m/s	metres per second
m^2	square metres
Nomenclature	**Definition**
HMC	Heavy mineral concentrate
PM_{10}	particulate matter with a diameter less than 10 micrometres
$PM_{2.5}$	particulate matter with a diameter less than 2.5 micrometres
Abbreviations	**Definition**
AQDMP	Air Quality and Dust Management Plan
Kalbar	Kalbar Resources
PEM	Protocol for Environmental Management
NEPM	National Environmental Protection Measure

1. INTRODUCTION

The Fingerboards Mineral Sands Project (the Project) is proposed to be located in the southeast of Victoria, within the Glenaladale Deposit (Figure 1). The Project represents the first phase of mineral sands production (about 20 years) from the Glenaladale Deposit.

Kalbar Resources (Kalbar) is seeking approval of the Project through the preparation of an Environment Effects Statement (EES). Kalbar has commissioned Katestone Environmental Pty Ltd (Katestone) to prepare an Air Quality and Dust Management Plan (AQDMP).

The Project does not have conditions of approval at this stage. The AQDMP has been prepared considering the requirements for Level 1 operations detailed in the *Protocol for Environmental Management (PEM): Mining and Extractive Industries* and other relevant legislation and guidance.

The purpose of the AQDMP is to detail the air quality issues that may arise from the Project and the dust management and monitoring practices that will be implemented by the Project to protect the beneficial uses of the air environment in its vicinity. To achieve this objective, the AQDMP includes performance indicators, responsibilities of site personnel, proactive and reactive dust management procedures, reporting requirements, and regular review and revision of the AQDMP.

Whilst the dust management practices implemented under this AQDMP will be likely to reduce workplace exposure, occupational health and safety responsibilities relating to air quality are outside the scope of this AQDMP.

1.1 Definitions

Key terms relating to dust emissions that are used throughout this AQDMP are defined in Table 1.

Table 1 Definition of key terms relating to dust emissions

Key term	Definition
Particulate matter	Solid or liquid particles that may be suspended in the atmosphere. Often referred to as smoke, soot, haze or dust.
Concentration	The mass of particulate matter that is suspended per unit volume of air. Typically measured in micrograms per cubic metre (µg/m³).
Deposition	Mass of particulate matter that settles per unit surface area. Typically measured in grams per square metre (g/m²).
TSP	Total Suspended Particulates - all suspended particulate matter
PM_{10}	Particulate matter with a diameter less than 10 micrometres
$PM_{2.5}$	Particulate matter with a diameter less than 2.5 micrometres
Dust deposition rate	Mass of particulate matter that settles per unit surface area in a certain time period. Typically measured over a 30-day monitoring period and expressed in units of grams per square metre (g/m²/month).

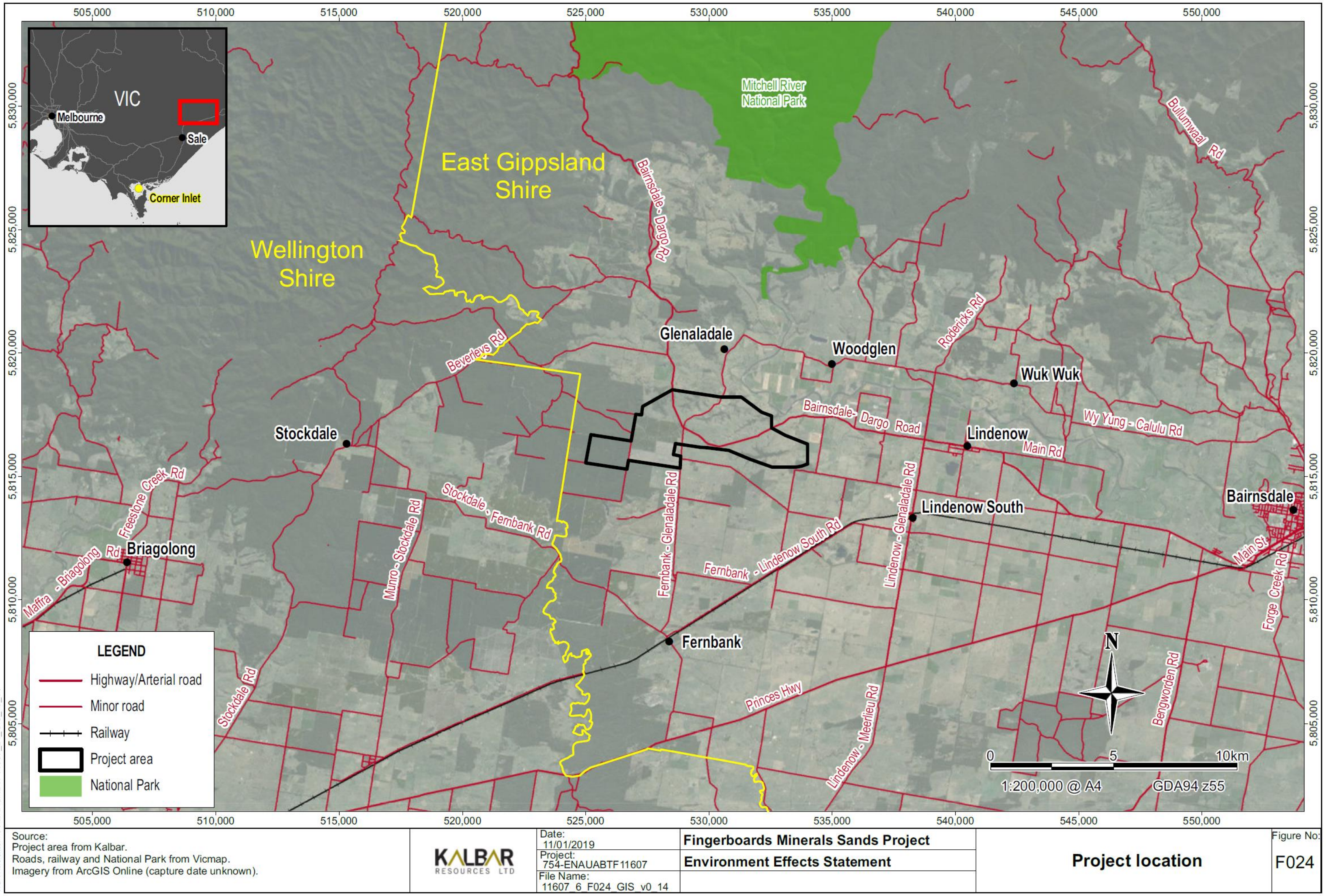

Figure 1 Fingerboards Project Location

2. SITE ACTIVITIES GENERATING EMISSIONS TO AIR

The amount of dust generated during construction and operation of the mine was estimated as part of the Air Quality and Greenhouse Gas Assessment for the Fingerboards Mineral Sands Mine (Katestone, 2019). The assessment considered emissions of dust generated by the Project (as TSP, PM_{10} and $PM_{2.5}$). The dust emitted from the mine may contain arsenic, radionuclides, heavy metals and respirable crystalline silica. The assessment also considered the potential impact of these emissions from the Project on air quality in the area.

The assessment showed that PM_{10} emissions were the key indicator, and that if compliance with the air quality criteria for PM_{10} is achieved, it is likely that compliance with the air quality criteria for other indicators would also be achieved.

The key Project activities that generate dust emissions include:

- Wheel action on unsealed and sealed roads by heavy vehicles including haul trucks
- Overburden excavation
- Wind erosion from exposed and rehabilitated areas
- Topsoil excavation (including scrapers)
- Product haulage
- Grading.

Other activities that also contribute to dust emissions, to a lesser extent include material transfers (e.g. dumping), dozers, ore screening and tailings management. The locations of activities are shown in Figure 2.

Key air quality issues associated with mineral sands mining are discussed further in Appendix A, Section A1.

Features of the local environment, including meteorological conditions, terrain, land uses and existing ambient levels of air pollutants that are relevant to understanding the impact of dust emissions from the mine are discussed in Appendix A, Section A2.

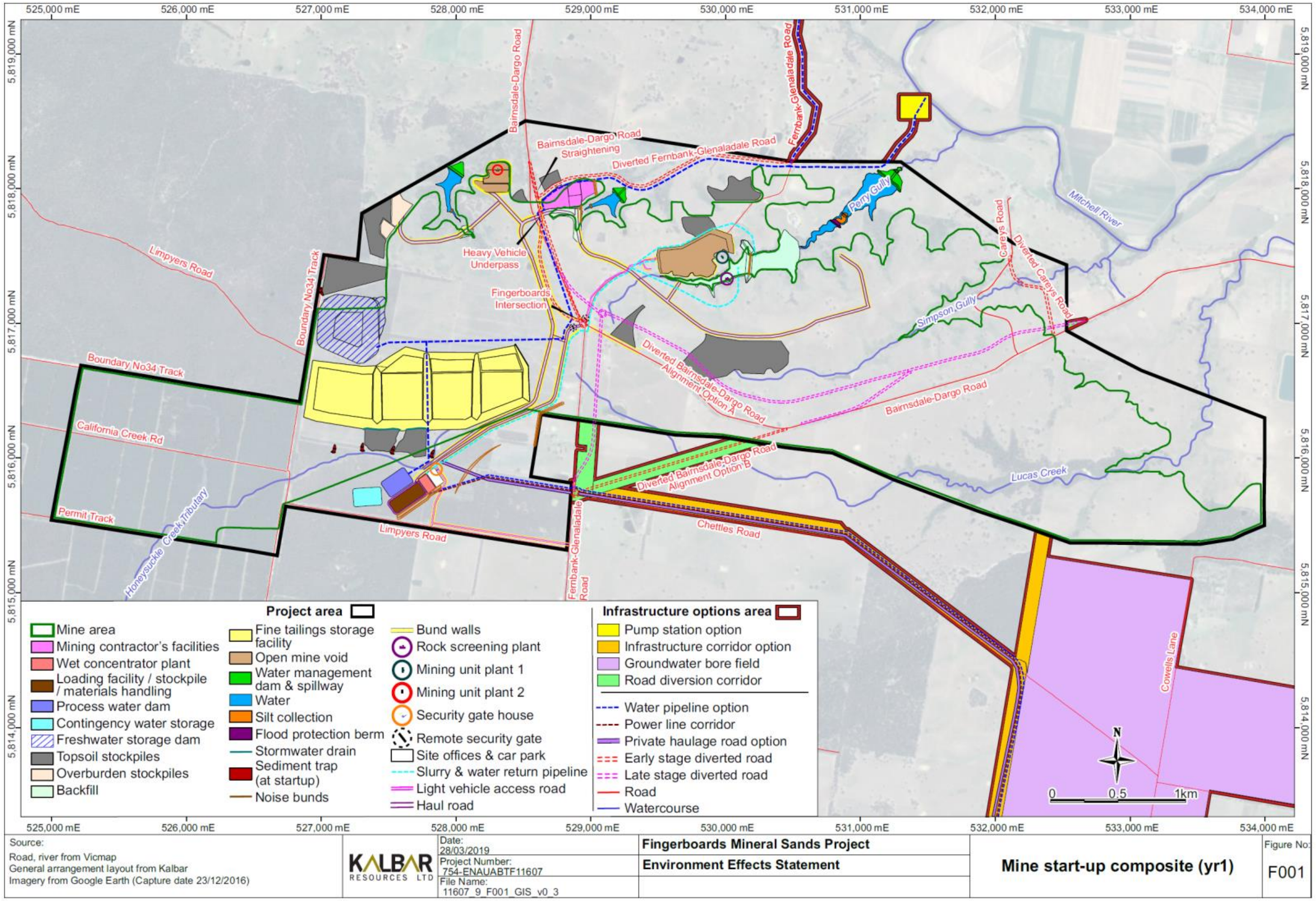

Figure 2 Fingerboards Project General Arrangement Layout

3. CONTROL MEASURES AND RESPONSIBILITIES

3.1 Responsibilities

The delegation of responsibilities outlined in this section will be reviewed prior to commencement of activities to reflect the adopted staffing positions and to ensure all responsibilities have been assigned. Responsibilities for air quality management, and a suggested assignment based on typical mining personnel positions, are as follows:

Mining staff

- Ensure that while carrying out their duties, the dust management measures described in this AQDMP relevant to those duties are adopted. Where this is not possible, report this to the shift supervisor as soon as practical.
- Report any non-compliance, non-conformance or significant dust related incident as soon as practical to shift supervisor, for example, visible dust emissions or malfunctioning dust mitigation equipment.

Shift supervisor

- Consider planned mine activities in the context of weather forecasts and adjust activities to avoid adverse impacts or elevated dust emissions, as required.
- Implement the TARP.
- Communicate changes to mining activities based on AQDMP to relevant staff each day.
- Ensure mine staff comply with dust management practices such as: speed limits, limiting drop heights.

Site environmental manager

- Investigate exceedances of the performance indicator for 24-hour average PM_{10}.
- Investigate complaints and, where relevant, implement corrective actions and produce reports.
- Ensure reports that are required by the AQDMP are completed adequately and in a timely manner.
- Ensure monitoring is conducted as per this AQDMP, including:
  - Ensure regular necessary maintenance and calibration is conducted in accordance with the relevant standards
  - Ensure equipment faults are rectified as soon as practical
  - Periodically review the location and type of stations to ensure these remain relevant.
- Ensure longer-term management practices are implemented (e.g. surface management practices including revegetation and application of suppressants) as per this AQDMP and mine schedule.
- Review dust management measures and identify potential improvements.

Mining engineer

- Ensure mine design and schedule reflects the principles contained in Section 3.2 of this AQDMP (e.g. minimizing haul routes where possible, revegetation as soon as possible).

Mine manager

- Ensure induction and training of all staff in the requirements of the AQDMP, air quality and dust minimisation.
- Maintain all plant and equipment to ensure dust mitigation practices can be implemented as needed.

- Review dust management measures and facilitate improvements to the AQDMP.

Principal contact for complaints

- Record community queries and complaints
- Implement complaints response procedure
- Ensure twenty-four-hour contact details are available to the community through letters and signage onsite.

3.2 Dust Control Measures

Table 2 lists the dust mitigation measures that will be implemented during construction and operation.

Table 2 Dust Mitigation Measures

Activity	Action	Frequency
Administrative actions		
Induction and training	All employees and contractors receive induction and training relevant to their role	At beginning of employment, on an annual basis, and when their roles or responsibilities relating to dust management change
Maintenance – plant and equipment	All plant, equipment and vehicles shall be maintained in a proper and efficient manner, to ensure that dust emissions are minimized	As required
Maintenance – meteorological and air quality monitors	Maintained as recommended by manufacturer and in accordance with Australian Standards to ensure reliable data collection	As recommended by manufacturer and Australian Standards
Standard control measures		
Bulldozing	Minimise travel speed to <10km/hr	Ongoing
	Keep travel routes and materials moist	Ongoing
Truck dumping	Minimise drop height for topsoil and overburden to <1.5m	Ongoing
Haulage - product	Pave surface	Prior to commencement of operation
	Clean road surface and maintain non-dusty condition	Ongoing
Haulage - overburden	Construct roads with optimal size grading of aggregate with road stabilization and compaction agents	Ongoing
	Water or chemical suppressants, and in particular, during drier months	Checked weekly, and applied as necessarily to avoid visible dust
	Implement and enforce speed limits on all on-site haul routes to 40 km/hr	Ongoing
	Ensure haul vehicles travel on designated haul routes only, including restricting access to vegetated or chemically treated areas to minimise disturbances	Ongoing
	Minimise haul distances where possible	Ongoing
Topsoil transport	Use larger vehicles (2-laser tractor scoop rather than single-laser)	Ongoing

Activity	Action	Frequency
Wind erosion	Chemical suppressants applied to fine tailings when required (anticipate during summer months) Water or appropriate chemical suppressants applied to exposed areas and/or stockpiles if revegetation is not yet practical, and in particular, during driver months	Ongoing
	Vegetative ground cover, e.g. applied to stockpiles that will not be disturbed for some time	Ongoing
	Rehabilitation, which will be progressive and as soon as is practicable	Ongoing
Ore transport	Transport ore across site through a pipeline as a slurry	Ongoing
Ore processing	Ore to be screened as a slurry	Ongoing
	No crushing or grinding of ore	Ongoing
Product transport	All product to be transported in sealed containers	Ongoing
All mining activities	Review forecast weather conditions and planned mine activities (such as overburden excavation and transport of overburden and product), and adjust as needed to avoid adverse weather conditions	Daily, prior to commencement of each shift
All mining activities	Implement TARP as detailed in Section 8, including ceasing certain activities including extraction and haulage as required in response to real-time air quality monitoring	Ongoing
Complaints	Recording	As they occur
Complaints	Investigation	As they occur, with report to be completed within 5 working days
Mine Design		
Haulage	Minimise length of haul routes as much as possible	Ongoing
Land clearing	Areas will be cleared in a staged manger, and only as required, to minimise area of exposed ground	Ongoing
Backfilling and rehabilitation	Mine void will be progressively backfilled and rehabilitated, to reduce area of exposed soil, including topsoil and overburden stockpiles	Ongoing
Topsoil stripping	Planned and conducted taking into account forecast and actual weather conditions to minimise dust generation	Ongoing

4. PERFORMANCE INDICATORS

The relevant performance indicators that will be used to assess the performance of this AQDMP are presented in in Table 3. The number and nature of complaints and the outcomes of complaint investigations will also be used to evaluate performance. Compliance with the performance indicators in Table 3 will be determined by monitoring conducted in various locations around the mine, as described in Section 7.

Table 3 Performance indicators

Pollutant	Environmental value	Averaging period	Air quality objective		
			Value	Units	Source
PM_{10}	Health and wellbeing	24-hour	60	µg/m³	PEM
		24-hour	50	µg/m³	NEPM (Air)
		1-year	25	µg/m³	NEPM (Air)
$PM_{2.5}$	Health and wellbeing	24-hour	25	µg/m³	NEPM (Air)
		1-year	8	µg/m³	NEPM (Air)
Respirable crystalline silica	Health and wellbeing	1-year	3	µg/m³	PEM
Dust deposition [1]	Amenity	Annual	2 [2]	g/m²/month	Approved Methods PEM [4]
	Amenity	Annual	4 [3]	g/m²/month	

Table notes:

[1] The PEM notes that the monthly average dust deposition values should be used as an ongoing guide to determine whether additional dust mitigation measures may need to be implemented to ensure compliance with the annual average

[2] Maximum increase in deposited dust due to Project

[3] Total deposited dust (Project plus all other sources in area)

[4] Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA, 2016)

5. REPORTING

A summary Environmental Report should be prepared on an annual basis. This may be required to be submitted to EPA Victoria. This should include:

- Summary of monitoring data and assessment against performance indicators in Section 4
- Summary of management activities taken throughout the reporting period
- Investigation of exceedances, if any
- Summary of the number and nature of complaints received, and outcome of investigations of those complaints
- Evaluation of effectiveness of AQDMP
- Recommendations for amendments to dust management practices.

An exceedance report will be prepared if:

- The 24-hour average concentration of PM_{10} exceeds the performance indicator of 50 µg/m³
- The 24-hour average concentration of $PM_{2.5}$ exceeds the performance indicator of 25 µg/m³.

Exceedance reports will be prepared within five working days of the exceedance. The purpose of the report is to investigate and, if possible, determine the cause of the exceedance in a timely manner, and to facilitate implementation of any changes to dust management that may be required.

The report will include:

- 24-hour average PM_{10} concentrations from all operating monitors over the exceedance period
- Wind speeds and wind direction measurements during the exceedance period
- Location and throughput of mining activities during the exceedance period
- Identification of whether dust management actions were undertaken as required by this dust management plan
- If possible, determine whether the exceedance was likely to be due to the mine
- If relevant, identification of additional dust management practices or modification of dust management practices that would assist to prevent further exceedances.

6. COMPLAINTS HANDLING AND INVESTIGATION

A principal contact person to whom community queries and complaints will be directed will be identified for the project. The complaints response procedure below will be implemented to address any complaints received. Twenty-four-hour contact details for the principal contact person will be provided through letters and signage onsite.

All complaints received should be addressed, including the following actions:

- Complaint is documented.
- Complaint is investigated, including reviewing the site operations (scale and location), weather conditions and dust management practices at the time of the complaint. The aim of the investigation is to determine whether the mine was likely to have contributed to the complaint, and if so, what activities may need to be managed differently in future to prevent complaints
- Results of the investigation are documented.
- Identified improvements are communicated to relevant personnel, and included in AQDMP.
- Feedback on the investigation, including any improvements, is provided to the complainant.

Complaints should be recorded in the complaints register. As a minimum, the following should be recorded:

- Date, time and location of the incident that triggered the complaint.
- Contact details of the complainant (or noting if complainant wishes to remain anonymous).
- Cause of complaint as perceived by the complainant.
- Site activity records during time of complaint.
- Meteorological conditions during time of complaint.
- Dust monitoring data during time of complaint.
- Measures that were implemented to reduce dust as a result of the complaint.

A publicly available complaints logging system, e.g. a website, could be considered to allow members of the public to provide complaints information.

7. AIR QUALITY AND METEOROLOGICAL MONITORING PROGRAM

Air quality monitoring is required in the early stages of the Project's operation to establish compliance with the PEM. Air quality monitoring will also be required on an ongoing basis to provide real-time feedback to inform dust management practices.

The air quality monitoring program needs to fulfill these requirements and should be implemented during construction and throughout the entire mine life. The locations of active mining areas change throughout the mine life. Consequently, the locations and types of monitors should be reviewed periodically to ensure they are appropriate, and adequately situated.

7.1 Summary of Legislative Monitoring Requirements

7.1.1 Compliance Monitoring

Section 6.2 of the PEM discusses monitoring requirements for approved developments. The following points are relevant to the monitoring program:

- Monitoring should be conducted for 12-24 months (as determined in consultation with DPI and EPA) to evaluate the local air quality, including the contribution from the Project, against the assessment criteria
- This compliance monitoring requires $PM_{2.5}$ and PM_{10} monitoring equipment that complies with the Australian Standards and records 24-hour average or real-time concentrations
- Gravimetric sampling for crystalline silica and arsenic (and heavy metals if relevant) must be conducted for a period of up to 1 week each month for an entire year to allow calculation of an annual average (total 12 samples per year)
- Analysis must be undertaken by laboratories NATA accredited for that analysis.

7.1.2 Real-time Monitoring for Reactive Management

Section 4 of the PEM discusses operational control requirements. The following points are relevant to the monitoring program:

- For Level 1 operations, real-time monitoring of PM_{10} should be linked to a reactive management strategy that would allow changes to site operations if particle levels over a short timeframe (1-hour) are reaching levels that may impact on the achievability of the 24-hour health based values.
- Deposited dust is an indicator of the potential for off-site nuisance and should be monitored at the site boundary for most operations. Gauges should be located both upwind and downwind to reflect the impact of mining operations during predominant winds.
- Measured dust levels should be compared against the performance indicators specified in Table 3.

Section 6.3 of the PEM discusses monitoring for reactive management purposes. The following points are relevant to the monitoring program:

- This should be implemented for Level 1 operations and incorporated into the site environmental management plan.
- The need for ongoing monitoring would be reviewed at the end of each 12-month period and the site environmental management plan amended, if needed
- Monitoring for reactive management need not use equipment that conforms to the Australian Standards. A range of portable and relatively inexpensive monitors are available for this type of application.

- EPA should be consulted with respect to the monitoring equipment that is proposed to be used for reactive management. EPA should be consulted in relation to the trigger levels that are proposed to be used to identify when particulate concentrations are reaching levels that may require additional management practices.

7.2 Monitoring Program

7.2.1 Overview

The proposed monitoring network is described in Table 4. The suggested location of key components of the monitoring network and sensitivity receptors in the vicinity of the Project are shown in Figure 3.

It is proposed that PM_{10} and $PM_{2.5}$ be monitored throughout the mine life at approximately five locations, representative of sensitive receptors closest to operations in various areas of the mine site. Most of these monitors can be low-cost sensors that will be used to enable reactive management actions based on real-time monitoring data. Several of the monitors will be Australian Standard compliant, as this is necessary to assess compliance with the indicators in the PEM during the first years of operations as agreed by EPA.

The following monitoring is recommended to be conducted prior to construction (as this will assist in further developing the baseline dataset):

- Dust deposition
- Rainwater tank monitoring
- Respirable crystalline silica.

It is recommended that the remainder of the monitoring network be commissioned to operate during both construction and operations.

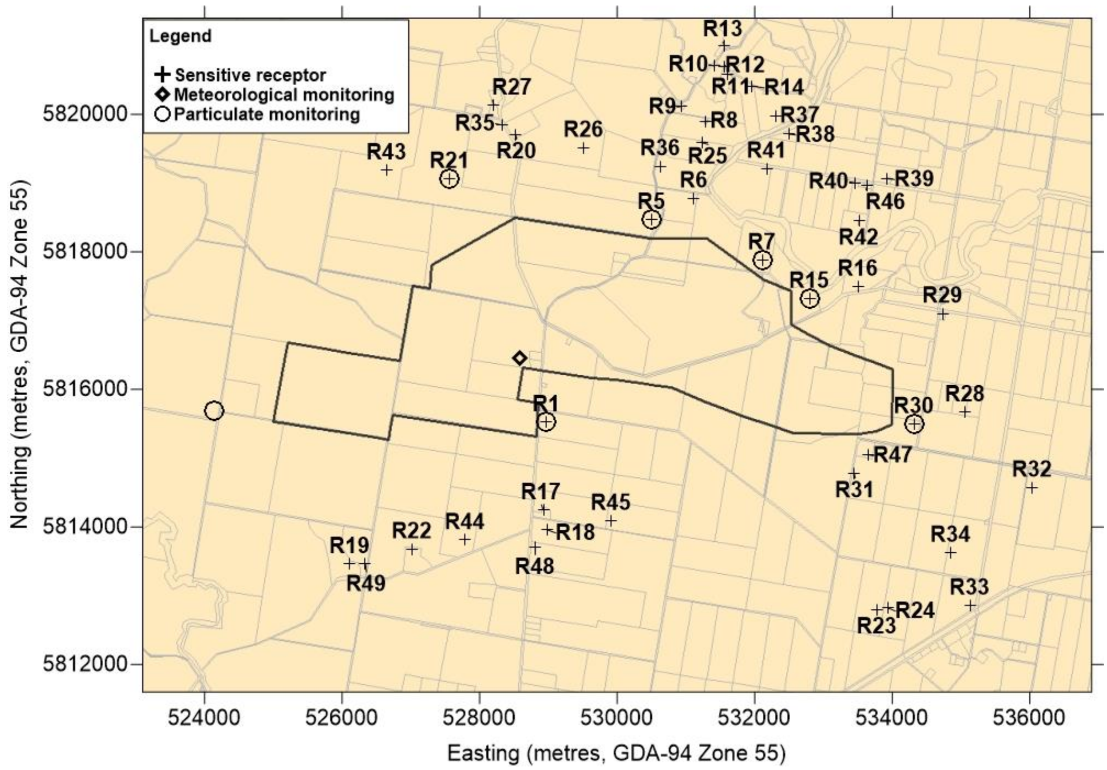

Figure 3 **Sensitive receptors and suggested meteorological and particulate monitoring locations**

Table 4 Monitoring program

Parameter	Measured averaging period	Recommended monitor	Number of monitors	Purpose of station(s) [3]	Recommended Location(s) [4]
Wind speed, wind direction	1-hour	Compliant with AS	1	To assist with dust management decisions, and analysis of monitoring data	Central location representative of wind flows in the vicinity of the Project.
PM_{10}	1-hour [1]	E-BAM or similar (compliant with AS)	2	Compliance monitoring Calibration of real-time monitors	Selected based on likely area with highest concentrations during mine operations. For initial compliance stage, R7 and R21 would be appropriate as mining will occur in the north of the Project area during the early years.
	1-hour [1]	TBC (does not have to be compliant with AS)	4-5	Reactive dust management	Selected based on key receptors likely to be most affected by dust emissions during mining, in each direction. Recommend four of the following locations: R1, R30, R15 or R7, R5 and R21. An additional monitor on the western side of the mine should also be considered as this may assist in determining the likely contribution of mining activities to measured concentrations at receptors. One should be co-located with the E-BAM or similar used for compliance monitoring, in order to enable calibration of the real-time monitors.
$PM_{2.5}$	1-hour [1]	E-BAM or similar (compliant with AS)	1	Compliance monitoring	Selected based on likely area with highest concentrations during mine operations. For initial compliance stage, R7 or R21 would be appropriate as mining will occur in the north of the Project area during the early years.

Parameter	Measured averaging period	Recommended monitor	Number of monitors	Purpose of station(s) [3]	Recommended Location(s) [4]
	1-hour [1]	TBC (does not have to be compliant with AS)	5-6	Reactive dust management	Selected based on key receptors likely to be most affected by dust emissions during mining, in each direction. Recommend the following locations: R1, R30, R15 or R7, R5 and R21. An additional monitor on the western side of the mine should also be considered as this may assist in determining the likely contribution of mining activities to measured concentrations at receptors. One should be co-located with the E-BAM or similar used for compliance monitoring, in order to enable calibration of the real-time monitors.
Respirable crystalline silica (as $PM_{2.5}$)	1-week per month	Partisol, high-volume sampler or similar	1	Compliance monitoring	Selected based on likely area with highest concentrations during mine operations. For initial compliance stage, R7 or R15 would be appropriate given as mining will occur in the north of the Project area during the early years, and the dispersion pattern of dust predicted in the air quality assessment.
Arsenic and heavy metals (as PM_{10})	1-week per month	Partisol, high-volume sampler or similar	1	Compliance monitoring Filters will also to be analysed for radioactivity	Selected based on likely area with highest concentrations during mine operations. For initial compliance stage, R7 or R15 would be appropriate given that mining will occur in the north of the Project area during the early years, and the dispersion pattern of dust predicted in the air quality assessment.
Dust deposition	1-month[2]	Standard dust gauges	5 (receptors) 1 (west of project)	Prevention of nuisance impacts	Selected based on key receptors likely to be most affected by dust emissions during mining, in each direction. Recommend the following locations: R4, R30, R15 or R7, R5 and R21, and a location to the west of the project boundary (for comparison). The PEM notes that monitors should be located both upwind and downwind of the site. A suggested location on the western side of the mine is

Parameter	Measured averaging period	Recommended monitor	Number of monitors	Purpose of station(s) [3]	Recommended Location(s) [4]
			1-2 (horticulture area)		indicated in Figure 3 that is located upwind of the mine during predominant southwesterly winds. In addition, locations representative of the closest portion of the horticultural area to the northeast should also be selected.
Rainwater tank monitoring	Quarterly	TBC	14	Determine impact of mine on levels of heavy metals solids in rainwater tanks. [5]	Rainwater tank monitoring is ongoing at the following locations with the exception of R21. Recommend this is included in the early years of operation when active mining is in the northern part of the Project boundary. R1, R2, R3, R4, R5, R6, R7, R10, R15, R19, R21, R28, R29, R44.

Table notes:

[1] 1-hour averaging period is recommended to assist with calibration of other real-time monitors. 24-hour averages can be calculated and used for compliance assessment.

[2] Monitored on a monthly basis, however, assessment criteria is for the annual average

[3] All monitors used for compliance purposes must comply with the relevant Australian Standards for monitoring those parameters (see Section 7.3)

[4] Locations will depend on accessibility of sites

[5] The evaluation of the data collected from rainwater tank monitoring is outside the scope of this AQDMP.

[6] Monitors that are not compliant with Australian Standards may require calibration or comparison against data collected from the compliance monitors. In addition, data collected from these cannot be used to determining compliance with the performance objectives in this AQDMP.

7.2.2 Meteorological Monitoring

Meteorological monitoring should be conducted at a location that is representative of wind flows in the region. Meteorological monitoring assists with understanding local conditions, dispersion patterns, exceedance analysis and can improve forecasting for the project.

Monitoring should be conducted in compliance with *AS/NZS 3580.14:2014 - Methods for sampling and analysis of ambient air - Meteorological monitoring for ambient air quality monitoring applications*.

7.2.3 Particulate Monitoring

7.2.3.1 PM_{10} and $PM_{2.5}$

Particulate monitoring will be required to demonstrate compliance with the air quality performance indicators over the first 1-2 years of operation or as agreed with EPA, which will include PM_{10}, $PM_{2.5}$ and respirable crystalline silica monitoring. In addition, particulate monitoring will be required to enable reactive management strategies that adjust mining to prevent exceedances of the performance indicators.

The proposed monitoring network includes a total of five monitoring locations for PM_{10} and $PM_{2.5}$. This should be reviewed periodically.

The following monitoring locations (or nearby locations that are representative) for PM_{10} should be considered during the early stages of the mine:

- Compliance monitors: R7 and R21
- Real-time monitors: R7 or R21, and also four of the following locations R1, R30, R15 (or R7), R5.

The following monitoring locations (or nearby locations that are representative) for $PM_{2.5}$ should be considered during the early stages of the mine:

- Compliance monitors: R21
- Real-time monitors: R21, and also five of the following locations: R7, R1, R30, R15 (or R7), R5.

Most other sensitive receptors are located in the same general directions from mine activities as these key locations. These key receptors are therefore likely to capture the highest particulate concentrations due to mining activities due to their proximity to the mining lease.

The mine schedule shows that the proximity of receptors to active mining activities will vary throughout the Project lifetime as the deposit is mined from the north to the south in several horizontal passes, with two active mining areas at one time. This variation in the location of active mining activities should be considered when the monitoring program is being reviewed to ensure that the receptors most likely to be affected by dust emissions continue to be represented in the monitoring program, and to reflect any changes in the location of sensitive receptors.

It is recommended that monitoring be conducted at each of these locations throughout the life of the mine, given the proximity of receptors to active mining areas.

7.2.3.2 Respirable crystalline silica

Monitoring for respirable crystalline silica requires gathering samples for a period of about 1 week which should be done approximately once per month for a year in order to determine an annual average concentration. So, whilst respirable crystalline silica is determined from $PM_{2.5}$, the longer sampling period means that a different monitor is required than that used for real-time or $PM_{2.5}$ compliance purposes.

The filters should be analysed for α-quartz. In addition, analysis to determine the cristobalite fraction should also be considered at least during the initial years of operation.

Monitoring for respirable crystalline silica should be conducted at one location. A location near R7 or R5 is recommended during the early stages of the mine.

7.2.3.3 Arsenic, heavy metals and radionuclides

Collection of samples for arsenic, heavy metals and radionuclide analysis also ideally should be conducted for a period of 1 week, approximately once per month for a year to determine annual average concentrations.

Monitoring for arsenic, heavy metals and radionuclides should be conducted at one location. A location near R7 or R5 is recommended during the early stages of the mine.

7.2.4 Dust Deposition Monitoring

Dust deposition monitoring should be conducted at locations representative of residences neighbouring the mine, as well as at locations representative of the horticultural areas to the northeast.

Monitoring sites upwind and downwind of the mine have been considered, to provide some indication of the likely contribution of the Project to measured dust levels.

The following locations should be considered for dust deposition monitoring:

- R4
- R30
- R15 or R7
- R5
- R21
- One location to the west of the Project boundary
- 1-2 locations near the horticulture activities to the east.

7.3 Relevant Australian Standards

Air quality monitoring shall be conducted, and monitoring stations maintained, in accordance with the following standards (or their latest version) where relevant:

- AS/NZS 3580.1.1:2016 – Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment
- AS/NZS 3580.14:2014 - Methods for sampling and analysis of ambient air Meteorological monitoring for ambient air quality monitoring applications
- AS/NZS 3580.10.1:2003 – Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited matter – Gravimetric method
- AS/NZS 3580.9.11:2016 – Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM_{10} beta attenuation monitors
- AS/NZS 3580.9.12:2013 - Methods for sampling and analysis of ambient air Determination of suspended particulate matter - $PM_{2.5}$ beta attenuation monitors

- AS/NZS 3580.9.6:2015 - Methods for sampling and analysis of ambient air Determination of suspended particulate matter - PM_{10} high volume sampler with size selective inlet - Gravimetric method
- AS/NZS 3580.9.14:2013 - Methods for sampling and analysis of ambient air Determination of suspended particulate matter - $PM_{2.5}$ high volume sampler with size selective inlet - Gravimetric method
- AS 3580.9.10:2017 - Methods for sampling and analysis of ambient air Determination of suspended particulate matter - $PM_{2.5}$ low volume sampler - Gravimetric method - partisol
- AS 3580.9.9:2017 - Methods for sampling and analysis of ambient air Determination of suspended particulate matter - PM_{10} low volume sampler - Gravimetric method.

8. TRIGGER ACTION RESPONSE PLAN

Data from the real-time monitoring network will be used to assist in triggering implementation of additional dust management measures where necessary. Two alert levels are proposed, which are described in Table 5. Different actions are required from various on-site personnel due to the alert level, as detailed in Table 6.

When a Level 1 alert has been issued, the primary course of action is to ensure all routine mitigation measures are occurring as they should be, and if not, rectify this. In addition, the cause of the elevated particulate level should be investigated and if appropriate, measures taken to address this.

When a Level 2 alert has been issued, additional mitigation measures should also be taken to reduce dust emissions through reduction of activity rates or increasing separation distance to receptors. Forecast weather conditions should be considered prior to relocation, to identify whether relocation or ceasing certain activities is a more appropriate response.

Table 5 Alert Levels

Alert Level	Description of response
Level 1	Ensure all routine management measures are being implemented. Observations on site to check for visible dust emissions on-site and implement additional measures as soon as possible to reduce dust emissions. Reduce vehicle speeds to 30 km/hr. Determine likely cause of the elevated particulate levels through: • Site inspection to identify any sources of visible dust • Review of activity rates and locations of mining activities • Review of data recorded at dust monitoring sites and the on-site weather station.
Level 2	As for Level 1, in addition: Slow, cease and/or relocate activities. The following activities would be reduced, relocated or stopped in order of preference (based on these either being non-essential activities, or significant contributors to off-site dust impacts), though other activities may also require restriction: • Rehabilitation works • Topsoil excavation, handling and transport • Overburden extraction, handling and transport • Product haulage. Relocation of activities could be considered e.g. to one mining area rather than both, as this could increase separation distance between dust generating activities and affected receptors. Ceasing activities, particularly overnight when dispersion conditions are poor, would reduce dust impacts. In the event that it is determined unlikely that mining activities contributed to the elevated particulate level, operations may continue. This decision should be recorded, including the data used to make this decision.

Table 6 TARP responsibilities

Responsibility	Level 1 Alert Review mitigation and investigate	Level 2 Alert Slow, cease and/or relocate
Site Environmental Manager	Notify shift supervisor of meteorological conditions (from on-site monitor, and forecast).	As for Level 1. Complete an exceedance report (if a 24-hour average trigger level)
Shift Supervisor	Ensure all routine management measures are being implemented. If not, correct or cease activities that cannot be mitigated. Determine likely cause of elevated particulate levels (see Section 8.1). Record this, including data used in determination. Determine if additional mitigation is appropriate, and if so, communicate to mining staff.	As for Level 1, in addition, identify activities to slow, cease and/or relocate. Communicate to mining staff. Record changes in activities and/or mitigation.

8.1 Data Checks

When a trigger level has been reached, the alert should be evaluated to determine whether the mine is a likely cause by considering one or more of the following:

- Wind direction and location of the monitor in relation to mine activities, and the scale/activity rate of mining activities
- Particulate concentrations at other monitors, to determine the likelihood of a regional event raising dust levels at all monitors.

The determination of whether mine activities are likely to have contributed to the alert level should be recorded.

8.2 Trigger Levels

The trigger values presented in Table 7 are recommended to identify times during which additional mitigation should be considered. However, as these are based on an analysis of dispersion modelling results and meteorological data from the air quality assessment, they should be reviewed shortly after commencement of operations and at regular intervals throughout the operation of the mine to ensure that they continue to be appropriate,.

Due to the proximity of the nearest residential receptors to the project boundary, data from each monitoring station should be assessed against the same trigger values.

Table 7 Triggers values from real-time PM_{10} monitoring

Parameter	Trigger Value *	Alert level
1-hour average PM_{10}	80 µg/m^3	Level 1
1-hour average PM_{10}	100 µg/m^3	Level 2
1-hour average PM_{10}	150 µg/m^3	Level 3
24-hour average PM_{10}	50 µg/m^3	Level 3

The dispersion modelling conducted for the Project identifies that the highest 1-hour average concentrations of particulates occur overnight, and generally during periods of light winds (< 2m/s). Given this, Table 8 provides a trigger level for extended periods of light winds. In determining additional mitigation measures that are appropriate to implement, consideration should include forecast wind direction.

Table 8 Triggers values from meteorological parameters

Alert level	Trigger
Level 1	Measured or forecast winds > 25 km/hr
Level 2	Forecast of light winds (< 2m/s) for more than 18 hours over the next 24 hours

8.3 Conditions for resuming operations

In the event that operations have been reduced, stopped, or relocated due to elevated particulate levels, operations may resume after particulate concentrations have remained below the trigger value for two successive hours.

If adverse weather conditions were resulting in dust emissions from the mine contributing to elevated particulate levels, operations should not recommence until these weather conditions have eased.

8.4 TARP Review and Trigger Level Optimisation

After operations commence, it is recommended that the TARP and trigger levels be reviewed within the first few months.

After initial optimization, the TARP should be reviewed on an annual basis or more frequently if required.

The review should include:

- Feedback from onsite personnel regarding whether conditions onsite reflect the alert levels generated.

- Comparison of data recorded by the real-time monitors with that recorded by the compliance monitors, and adjustment of trigger levels and/or calibration factors to ensure triggers are set appropriately for each type of monitor.
- Frequency of alert generation, to ensure alerts capture sufficient periods of elevated dust, whilst minimizing false or unnecessary alerts.
- Review of meteorological conditions recorded on-site and particulate levels, to identify whether additional triggers would be beneficial.

9. REVIEW AND REVISION

The draft AQDMP should be reviewed and if necessary, revised, to accommodate:

- Approval conditions issued for the mine
- Consultation with EPA regarding appropriate trigger levels after approval conditions are issued
- Changes in monitoring requirements due to completion of compliance monitoring
- Changes in site conditions that are relevant to dust management
- Changes in dust management technology or legislation
- Changes in responsibilities of staff on-site.

To ensure the AQDMP remains relevant and up to date, annual reviews shall be conducted that consider the following:

- The number and location of air quality monitors, as these may need to be adjusted based on changes to the mine plan that are anticipated throughout the mine lifetime
- The content of the TARP, including:
  - Frequency of trigger occurrence
  - Correlation between triggers and measured dust levels, including an analysis of false positives and misses (false negatives)
  - Correlation between triggers and complaints.
- Dust management practices and responsibilities, including:
  - Any improvements in dust management
  - Changes in technology or legislation
  - Changes in conditions of approval.

It is recommended that the AQDMP be reviewed at the following intervals initially, particularly the trigger levels implemented in the TARP:

- Prior to commencement of construction, responsibilities should be updated to reflect the role of personnel/positions that will be employed at the mine
- Several months after operations commence
- One year after operations have commenced, including a review of recorded weather station data to determine if triggers could be optimised.

10. INDUCTION AND TRAINING

All employees and contractors will go through an induction and training program appropriate for their level of involvement in dust management at the mine.

It is recommended that the induction and training include the following for all employees and contractors:

- Introduction to the key issues associated with mineral sands mining, including inhalable dust, respirable crystalline silica, heavy metals and dust deposition (see Appendix A, Section A1)

- Key features of the area that influence how emissions disperse from the mine, including local meteorological patterns (see Appendix A, Section A2)
- The location and proximity of receptors to mining activities (see Appendix A, Section A2).

The following should also be included in training, subject to the responsibilities of staff members:

- The key components of the monitoring program
- Dust management practices on-site, including the TARP and its implementation
- Responsibilities of each staff member relating to air quality management
- Record keeping requirements.

Training should also be provided when changes in dust management occur to ensure that all relevant personnel are aware of their ongoing roles and responsibilities.

11. REFERENCES

New South Wales Environment Protection Authority (EPA), 2016, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, published January 2017.

Katestone, 2019, *Stage Two Air Quality and Greenhouse Gas Assessment for the Fingerboards Mineral Sands Project V1.4*, prepared for Kalbar Resources (October 2019).

Protocol for Environmental Management, State Environment Protection Policy (Ambient Air Quality) Mining and Extractive Industries, Publication 1191, EPA Victoria, 2007 (PEM).

RCMG, 2019, *Fingerboards Mineral Sands Project Horticultural Impact Assessment*, Final Draft Report V2, prepared for Kalbar Resources Ltd, January 2019.

SEPP 2001, State Environment Protection Policy Air Quality Management Environment Protection Act 1970. Victoria Government Gazette, Special No. S 240 Friday 21 December 2001. Victorian Government Printer.

APPENDIX A BACKGROUND INFORMATION

A1 KEY ISSUES ASSOCIATED WITH MINERAL SANDS MINING

The key air pollutant associated with a mineral sands project is dust. Dust emissions will occur as a result of the construction and operational stages of the mine. Dust emissions occur as a result of material handling, wind erosion of exposed area and stockpiles, and from wheel generated dust as vehicles transport material across the site.

Key issues associated with dust emissions from mineral sands mining include:

- Amenity impacts, for example:
    - Short-term reduction in visibility
    - Build up of particulate matter on surfaces within homes resulting in the occupant needing to clean more frequently
    - Soiling of washing
    - Build up of particulate matter on the roofs of houses and, during rainfall, the flushing of the particulate matter into rainwater tanks potentially affecting quality of drinking water or tank capacity.
- Health impacts due to elevated particulate concentrations, including heart and respiratory diseases.

The potential effect of particulate matter on the environment, human health and amenity depends on the size of the particles, the concentration of particulate matter in the atmosphere and rate of deposition. Particulate matter with an aerodynamic diameter greater than 10 micrometres (µm) tend to be associated with amenity impacts, while particulate matter less than 10 µm are associated with health impacts. For this reason, particulate matter is sub-divided into a number of metrics based on particle size as detailed in Table 1.

The majority of particulate matter emitted from mineral sands mining consists of large particles generated from activities such as mechanical disturbance of rock and soil materials by bulldozing and vehicles on dirt roads. Dust is also generated from wind erosion of stockpiles and bare ground.

Very fine particles (such as $PM_{2.5}$) are mostly generated through combustion processes and vehicle exhaust. Laboratory and epidemiological studies have identified that these particles, if present in elevated levels, have the potential to cause adverse health impacts in susceptible people. Such studies form the basis of the current ambient air quality standards that are used in Australia.

Dust emissions from mineral sands mining can also include heavy metals, including radionuclides such as uranium and thorium. Respirable crystalline silica can also be emitted, and this is most commonly formed during crushing and grinding of ore. Elevated levels of respirable crystalline silica are known to cause silicosis. The Fingerboards Project does not require crushing and grinding of ore, nonetheless, management and monitoring of respirable crystalline silica is a key component in the AQDMP.

A2 ENVIRONMENTAL CONSIDERATIONS

A2.1 Local meteorology

Meteorological monitoring commenced at the Project site in May 2017. Figure 4, Figure 5 and Figure 6 illustrate the annual, seasonal and diurnal distributions of winds recorded between 1 October 2017 and 30 September 2018.

Predominant winds in the area are westerly. Winds from the west-southwest persist throughout the seasons (Figure 5). Winds from this direction would disperse emissions from mining activities towards the Lindenow Valley to the northeast of the Project boundary. The frequency of north-westerlies varies throughout the year, with these being most frequent during winter, and the frequency of south-easterlies also varies, with these most frequent in summer.

The variation in winds throughout the day and night was also analysed. Light winds are more frequent overnight (6pm – 6am) than during the day, which typically leads to less dispersion of air pollutants in the air. Winds from the west-southwest persist throughout the day and night. The afternoon (midday – 6pm) is characterised by predominant south-easterlies. During the evening (6pm – midnight), south-easterlies reduce in frequency and north-easterlies increase and persist overnight (midnight – 6am) and during the morning (6am – midday).

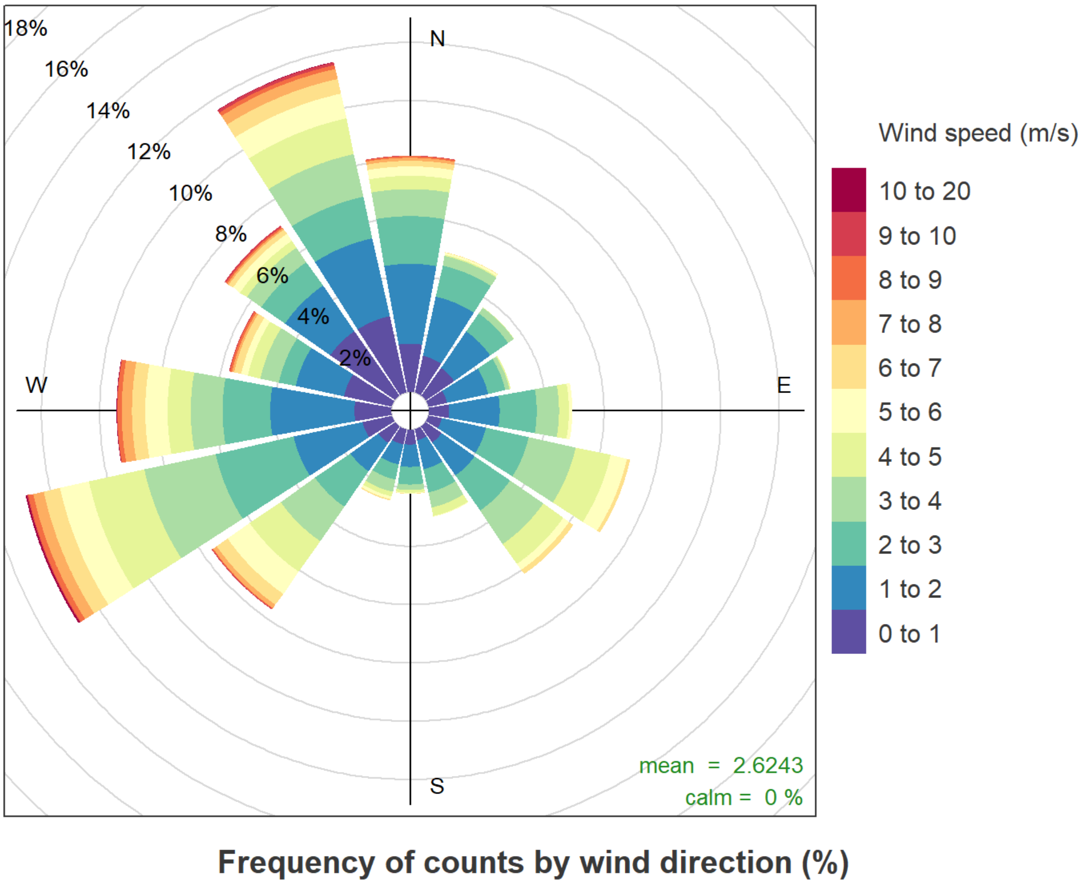

Figure 4 **Distribution of winds recorded at the on-site meteorological monitoring station**

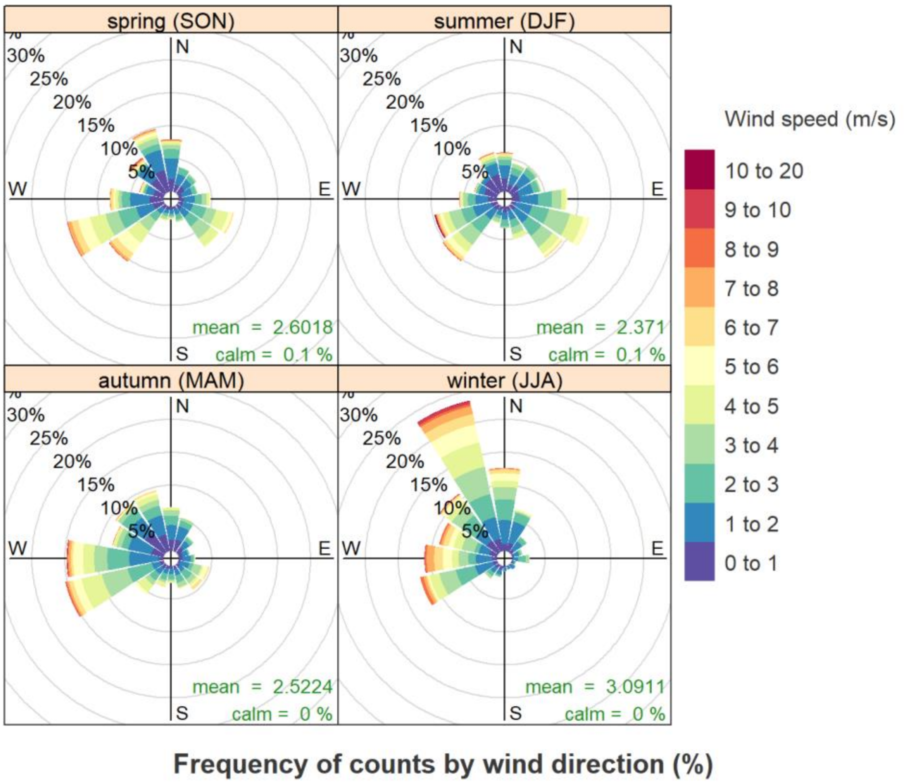

Figure 5 Seasonal distribution of winds recorded at the on-site meteorological monitoring station

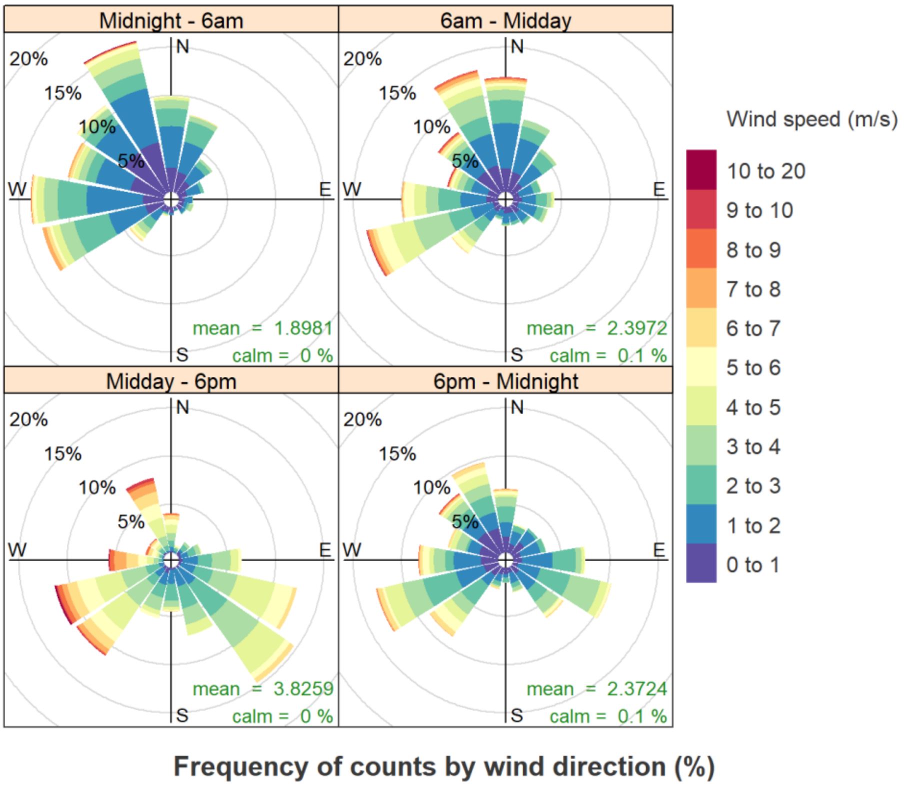

Figure 6 Diurnal distribution of winds recorded at the on-site meteorological monitoring station

A2.2 Terrain and land uses

The Project is located approximately 34 km from the eastern coastline of Victoria, at an elevation of 80-120m with terrain generally sloping from the west to east across the Project site. Terrain falls gently from the Project site to the east and south. To the northwest, terrain rises and becomes complex with peaks over 500m in elevation approximately 10km from the Project boundary in the foothills of the Great Dividing Range. Terrain to the northeast initially decreases from the Project boundary and beyond several kilometres rises rapidly to a hilly area with peaks over 500m in elevation.

Land uses in the vicinity of the Project include grazing, dairy, irrigated horticulture, hobby farms, plantations, state forest, and residential, leisure and commercial uses in small rural settlements, the closest of which is Glenaladale. The low-lying area to the northeast of the Project boundary is used for horticulture.

A2.3 Sensitive receptors

The nearest sensitive receptors are shown in Figure 7 and Table 9, the majority of which are isolated rural residences. The properties at locations R2 and R3 are owned by Kalbar and will not be occupied during construction or operations. R4 is the Project site office. These three locations are not considered as sensitive receptors for the purpose of compliance and ongoing dust management and monitoring purposes.

Areas of commercial horticultural operations also exist in the vicinity of the Project and are discussed in further detail in the Horticulture Impact Assessment (RMCG, 2019).

Table 9 Nearest sensitive receptors to the Project

Receptor ID	Easting (km)	Northing (km)	Description	Distance and direction from the Project Boundary	Receptor ID	Easting (km)	Northing (km)	Description	Distance and direction from the Project Boundary
R1	528975	5815522	Residence	0.1km S	R26	529517	5819511	Residence	1.1km N
R2*	528790	5816141	Residence (recently acquired by Kalbar)	0.2km S	R27	528208	5820127	Residence	1.7km N
R3*	528794	5816481	Residence (will not be occupied during construction or operation)	Inside boundary	R28	535065	5815665	Residence	1.1km E
R4*	530508	5817778	Kalbar site office	Inside boundary	R29	534736	5817100	Residence	1.1km E
R5	530504	5818463	Residence	0.3km N	R30	534321	5815494	Residence	0.3km E
R6	531118	5818774	Residence	0.6km N	R31	533447	5814778	Residence	0.6km SE
R7	532109	5817878	Residence	0.2km NE	R32	536038	5814570	Residence	2.2km SE
R8	531278	5819897	Residence	1.7km NE	R33	535132	5812855	Residence	2.9km SE
R9	530938	5820117	Residence	1.9km NE	R34	534853	5813624	Residence	2.1km SE
R10	531409	5820703	Residence	2.5km NE	R35	528333	5819844	Residence	1.4km N
R11	531602	5820582	Residence	2.4km NE	R36	530633	5819243	Residence	1.0km N
R12	531563	5820692	Residence	2.5km NE	R37	532301	5819973	Residence	2.0km NE
R13	531557	5820990	Residence	2.8km NE	R38	532507	5819711	Residence	1.9km NE
R14	531959	5820411	Residence	2.3km NE	R39	533930	5819064	Residence	2.2km NE
R15	532798	5817318	Residence	0.3km E	R40	533464	5819000	Residence	1.8km NE
R16	533507	5817495	Residence	0.9km E	R41	532183	5819206	Residence	1.3km NE

Receptor ID	Easting (km)	Northing (km)	Description	Distance and direction from the Project Boundary	Receptor ID	Easting (km)	Northing (km)	Description	Distance and direction from the Project Boundary
R17	528930	5814244	Residence	1.1km S	R42	533517	5818455	Residence	1.4km NE
R18	528987	5813955	Residence	1.4km S	R43	526650	5819185	Residence	1.5km NW
R19	526114	5813457	Residence	1.9km SW	R44	527790	5813809	Residence	1.7km S
R20	528524	5819707	Residence	1.2km N	R45	529914	5814086	Residence	1.6km S
R21	527569	5819058	Residence	0.9km NW	R46	533639	5818968	Residence	1.9km NE
R22	527018	5813673	Residence	1.6km S	R47	533657	5815047	Residence	330m SE
R23	533781	5812799	Residence	2.6km SE	R48	528810	5813696	Residence	1.6km S
R24	533943	5812818	Residence	2.6km SE	R49	526338	5813464	Residence	1.8km SW
R25	531245	5819585	Residence	1.4km N					

Table note:

* Not included as a sensitive receptor in the air quality assessment

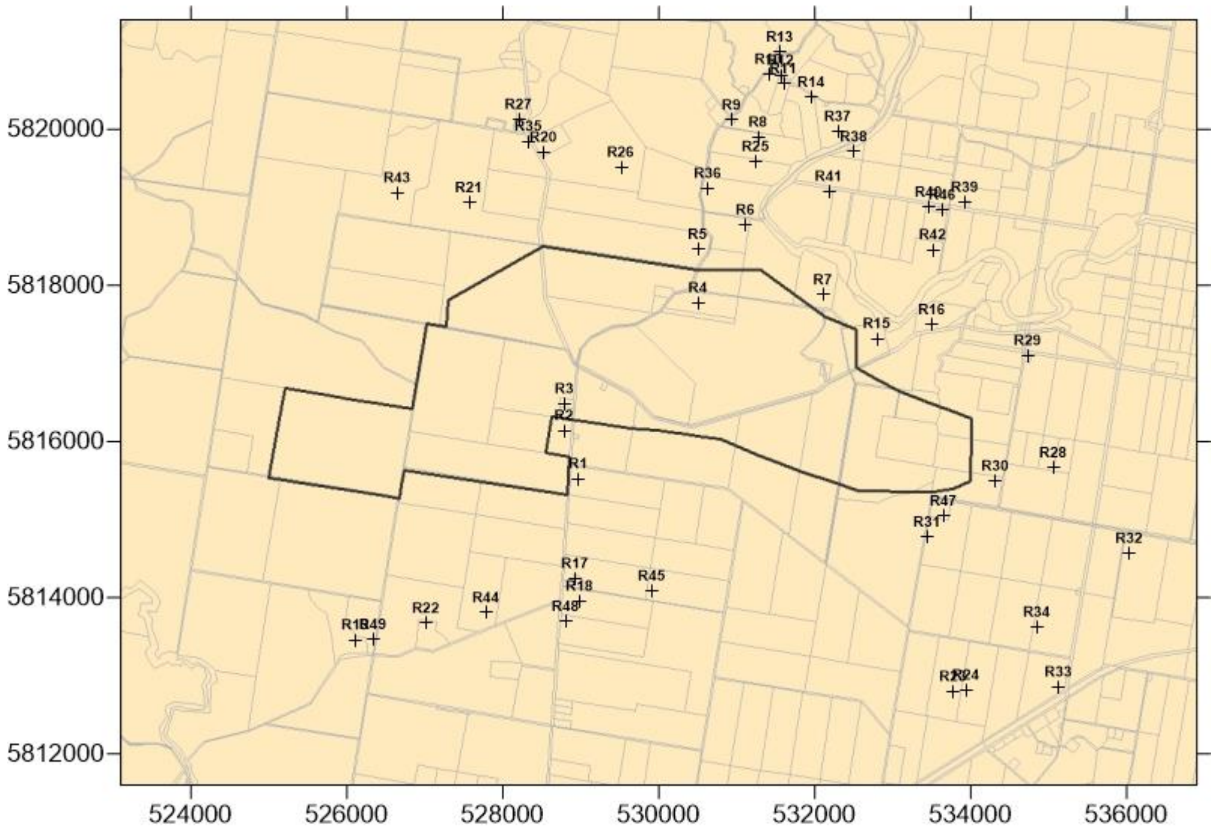

Figure 7 **Locations considered in selection of sensitive receptors for the air quality assessment**

A2.4 Existing ambient levels of air pollutants

Ambient monitoring data has been collected at the site. Key features of the collected data that are relevant to ongoing dust management of the mine include:

- PM_{10} is the key indicator relative to the performance indicators
- There is a seasonal variation in particulate levels, with higher concentrations recorded during winter
- 24-hour average concentrations of PM_{10} in the region have been near or above the performance indicators at times, likely due to unusual events such as fires or dust storms.

These trends can be seen in the 24-hour average concentrations of PM_{10} recorded from 1 October 2017 to 30 September 2018 presented in Figure 8. Further analysis can be found in the Air Quality and Greenhouse Gas Assessment for the Fingerboards Mineral Sands Project (Katestone, 2019).

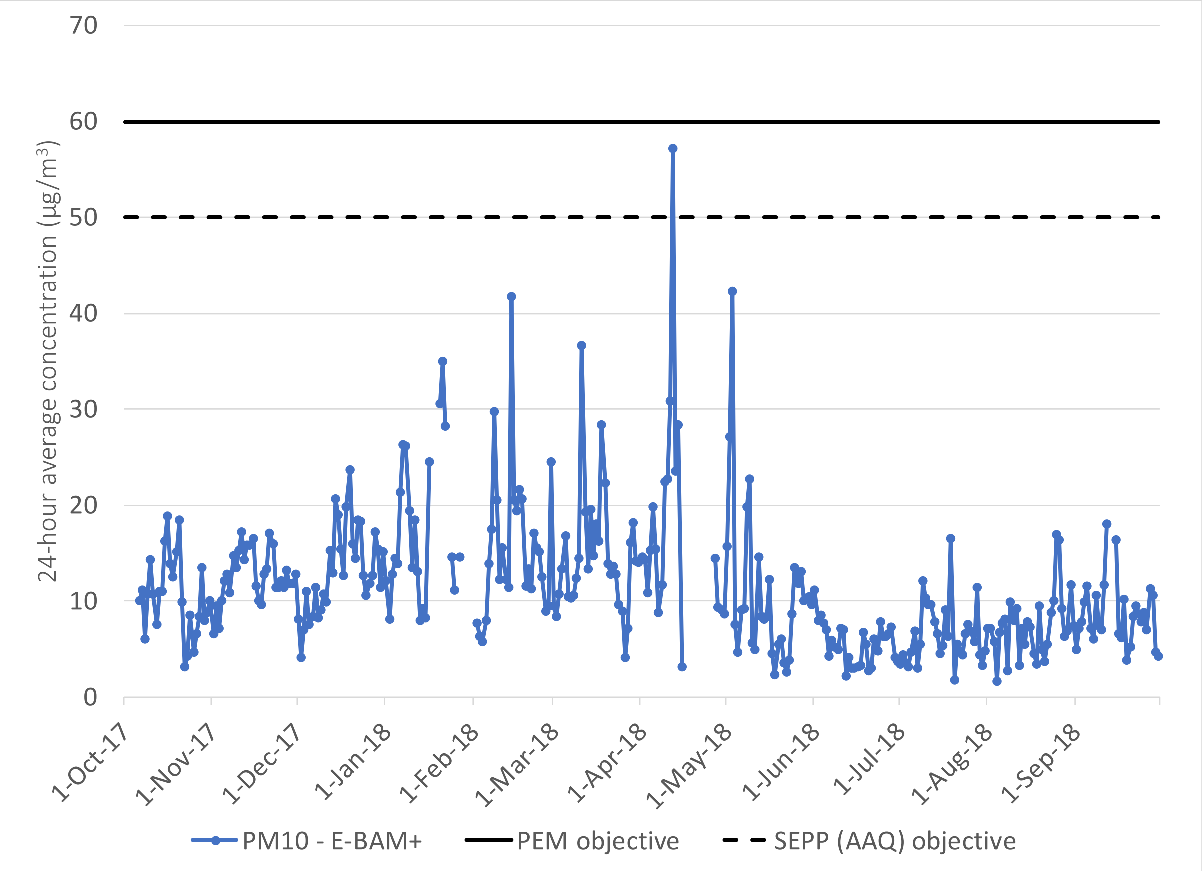

Figure 8 **24-hour average concentrations of PM_{10} from 1 October 2017 to 30 September 2018 ($\mu g/m^3$)**

A3 SUMMARY OF AIR QUALITY ASSESSMENT

A key outcome of the *Air Quality and Greenhouse Gas Assessment for the Fingerboards Mineral Sands Project* was that additional mitigation measures would be required on some days during the year. It was predicted that additional measures would be required between two and 14 days of the year in order to ensure compliance with the PEM air quality objectives, depending on the scale and location of activities that change throughout the mine life.