Intended for

Audalia Resource Limited

Date

23 June, 2020

AUDALIA RESOURCES LIMITED MEDCALF PROJECT

DUST CONTROL MANAGEMENT STRATEGY

RAMBOLL Bright ideas. Sustainable change.

AUDALIA RESOURCES LIMITED MEDCALF PROJECT DUST CONTROL MANAGEMENT STRATEGY

Project name	**Audalia Resources Medcalf Project – Dust Control Management Strategy**
Project no.	**318000777**
Recipient	**Audalia Resources**
Document type	**Report**
Version	**Final R0**
Date	**23/06/2020**
Prepared by	**Ruth Peiffer**
Checked by	**Martin Parsons**
Approved by	**John Miragliotta**

Ramboll
Level 7
41 St Georges Terrace
Perth
WA 6000
Australia

T +61 8 9225 5199
https://ramboll.com

Ramboll Australia Pty Ltd.
ACN 095 437 442
ABN 49 095 437 442

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Audalia Resources Limited (Audalia) is proposing to develop the Medcalf Project, a vanadium, titanium and iron project located approximately 470 km south east of Perth near Lake Johnston, Western Australia. The proposal includes the development of four open mine pits, beneficiation plant, tailings storage facility, evaporations ponds, process water facility, waste rock landform, private haul road, road train transfer area and associated infrastructure such as laydown areas, borrow and gravel pits, borefield, workshops, administration building and accommodation camp (Figure 1).

Baseline environmental surveys have identified one flora species listed as Threatened under the *Biodiversity Conservation Act 2016* (BC Act) within the Project site; *Marianthis aquilonaris*. In order to mitigate the potential impacts of mining operations on this species, Audalia propose to exclude all sub-populations of *M.aquilonaris* from the mine development envelope; and to implement a buffer zone (a nominal minimum of 30 m) around all sub-populations.

Audalia has requested that Ramboll Australia Pty Ltd (Ramboll) develop a dust management strategy to mitigate potential dust emissions from the proposed Medcalf Project and subsequent dust deposition at the location of the *M.aquilonaris* sub-populations. The dust management strategy has been prepared following completion of a dust deposition assessment to determine the potential dust deposition rates within and around the proposed buffer zones for the *M.aquilonaris* sub-populations; and analysis of the source contributions to the maximum predicted 24-hour average dust depositions to identify the key contributory dust sources (Reference: Ramboll (2020) *Audalia Resources Limited Medcalf Project Dust Deposition Study*).

1.1 Purpose of this Report

This report provides an overview of the source assessment undertaken by Ramboll to identify key fugitive dust sources from the proposed Medcalf Project predicted to contribute to dust deposition at the *M.aquilonaris* sub-populations. A review of potential dust control measures has been undertaken for each source of concern, with consideration given to global and/or local benchmark dust mitigation measures. Based on the outcomes of this review, in conjunction with the findings of the source assessment, recommendations have been made with regard to potential dust control options for nominated sources in order to reduce potential dust deposition at the *M.aquilonaris* sub-populations, as a result of the proposed Medcalf Project.

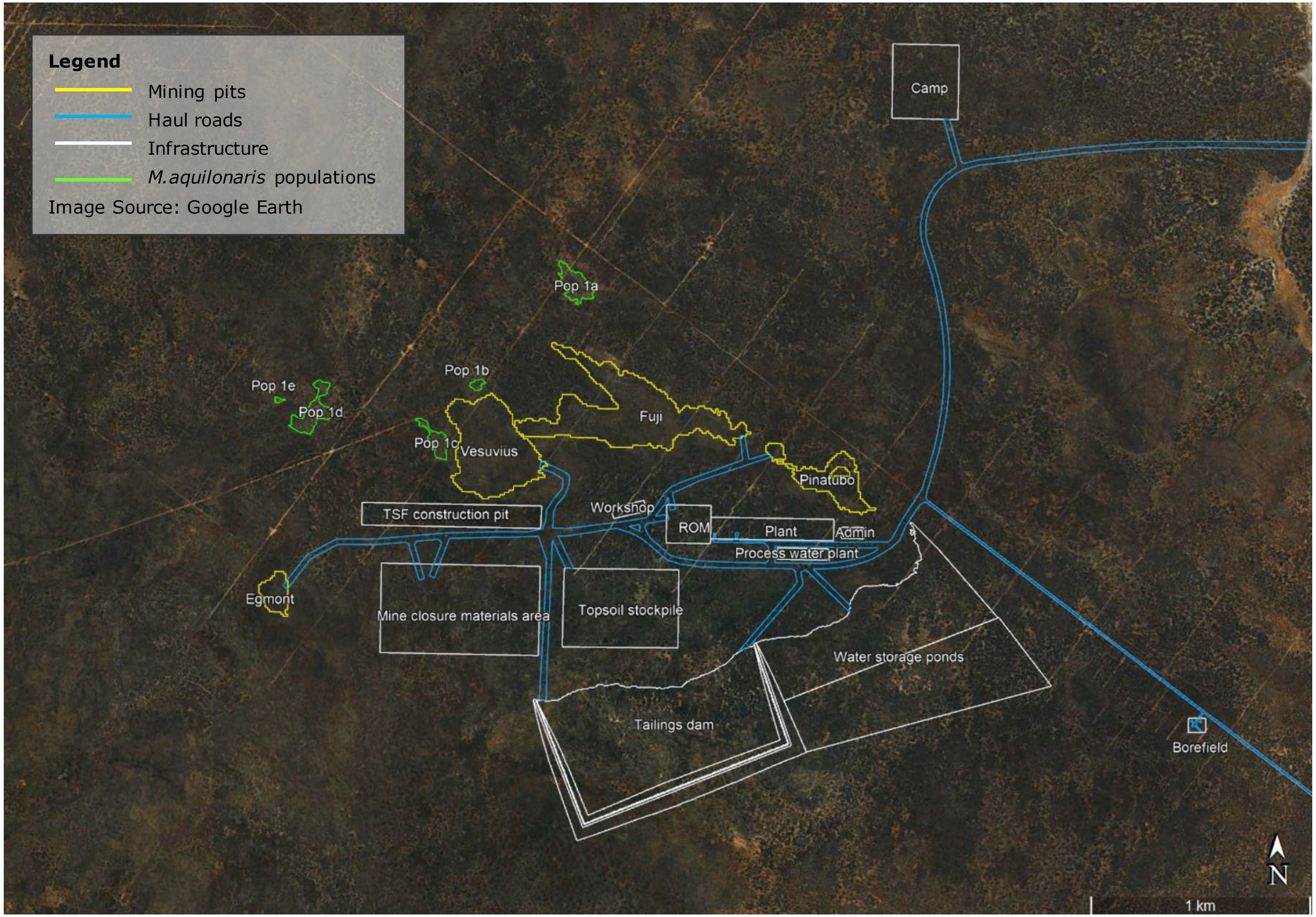

Figure 1: Medcalf Project Proposed Mine Site Layout

2. BACKGROUND INFORMATION

2.1 Operational Overview

The proposed Medcalf Project involves shallow (above the groundwater table) open pit mining for three separate open pits; the Vesuvius, Fuji, Pinatubo and Egmont deposits. The combined ore tonnage inventory is for 19.1 Million tonnes (Mt), with a waste/ore strip ratio of 0.15. The mine schedule indicates a pit life of 13 years and maximum combined ore and waste rock movement of 1.8 Million tonnes per annum (Mtpa) in Year 4 (Figure 2).

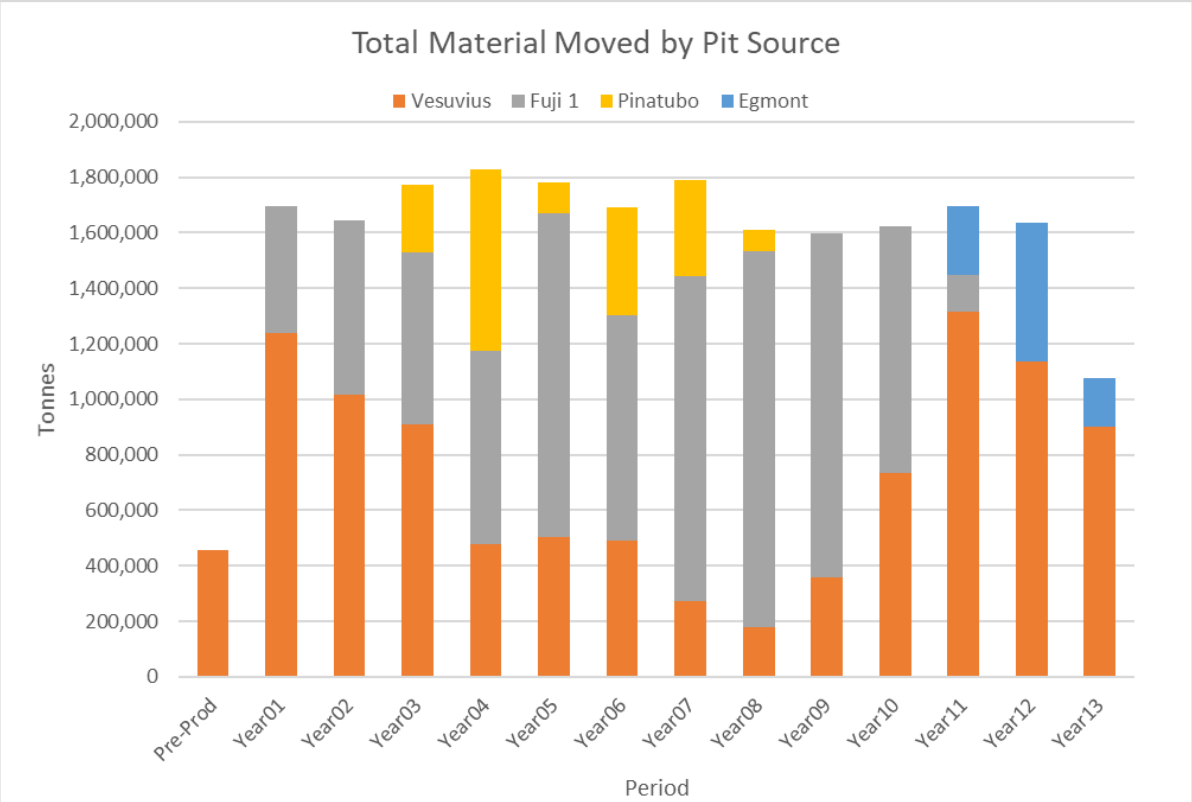

Figure 2: Proposed Mining Schedule

Mining will be by conventional load and haul, but will involve minimal drilling and assumed no blasting. A bulldozer will rip and clear the overburden and an excavator will load out the visible ore onto 50 tonne capacity articulated dump trucks that will deliver the ore to the run of mine (ROM) pad. Waste rock will be transported to a waste rock material storage area located to the south of the Vesuvius pit.

The ROM ore will be processed onsite at a beneficiation plant, incorporating a comminution circuit (including both crushing and milling processes) and a magnetic separation circuit, upgrading the ROM ore to a primary concentrate. The primary concentrate is dewatered by thickening and filtration, with the filter cake stacked and prepared for transport. The tailings generated from the magnetic separation circuit will be thickened and stored in an unlined tailings storage facility (TSF). Based on the current mining rate of 1.5 Mtpa, approximately 1.2 Mtpa of concentrate will be produced from the beneficiation plant.

The primary concentrate is proposed to be hauled by road trains along a 74 km private haul road from the mine to a dedicated road train transfer area adjacent to the Coolgardie-Esperance

Highway. The primary concentrate will be stockpiled at this transfer area, and then loaded onto highway-approved road trains for the remainder of the journey to the Esperance Port.

Mining, processing and haulage operations will occur during day shifts only, nominally between 06:00 and 18:00 hrs. The mining fleet will nominally comprise:

- 1 x 4.3m^3 bucket excavator
- 4 x 50 t articulated dump trucks
- 1 x water cart
- 1 x grader
- 1 x dozer
- 1 x hammer drill
- 1 x front end loader

Review of the minesite layout indicates the western and northern boundaries of the Vesuvius pit are within closest proximity to any of the identified *M.aquilonaris* sub-populations, abutting the nominal 30 m exclusion zone for populations 1b and 1c (Figure 1). The proposed mining schedule indicates peak activity within the Vesuvius pit is scheduled to occur in Year 1. This year was selected as the 'worst-case' scenario for consideration in the dust deposition study, as it represents the highest mining production rate, within closest proximity to the *M.aquilonaris* sub-populations (refer to Ramboll, 2020).

2.2 Regional Climate

The proposed Medcalf Project is located in the Lake Johnston region of WA. The regional climate is characterised as arid to semi-arid, warm Mediterranean. Mean climate data for the Salmon Gums (91 km south-east of the Project site) and Norseman (98 km north-east of the Project site) Bureau of Meteorology (BoM) meteorological monitoring stations were obtained from the BoM. The long-term mean annual rainfall data for the two sites are presented in Figure 3. These data indicate the highest rainfall at the Salmon Gums site tends to occur between May and August; while the highest rainfall at the Norseman site occurs between May and July. The mean annual rainfall for the Salmon Gums[1] site is 341 mm; and for Norseman[2] is 298 mm.

[1] Source: http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=-290355238&p_stn_num=012070

[2] Source: http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=-290355238&p_stn_num=012009

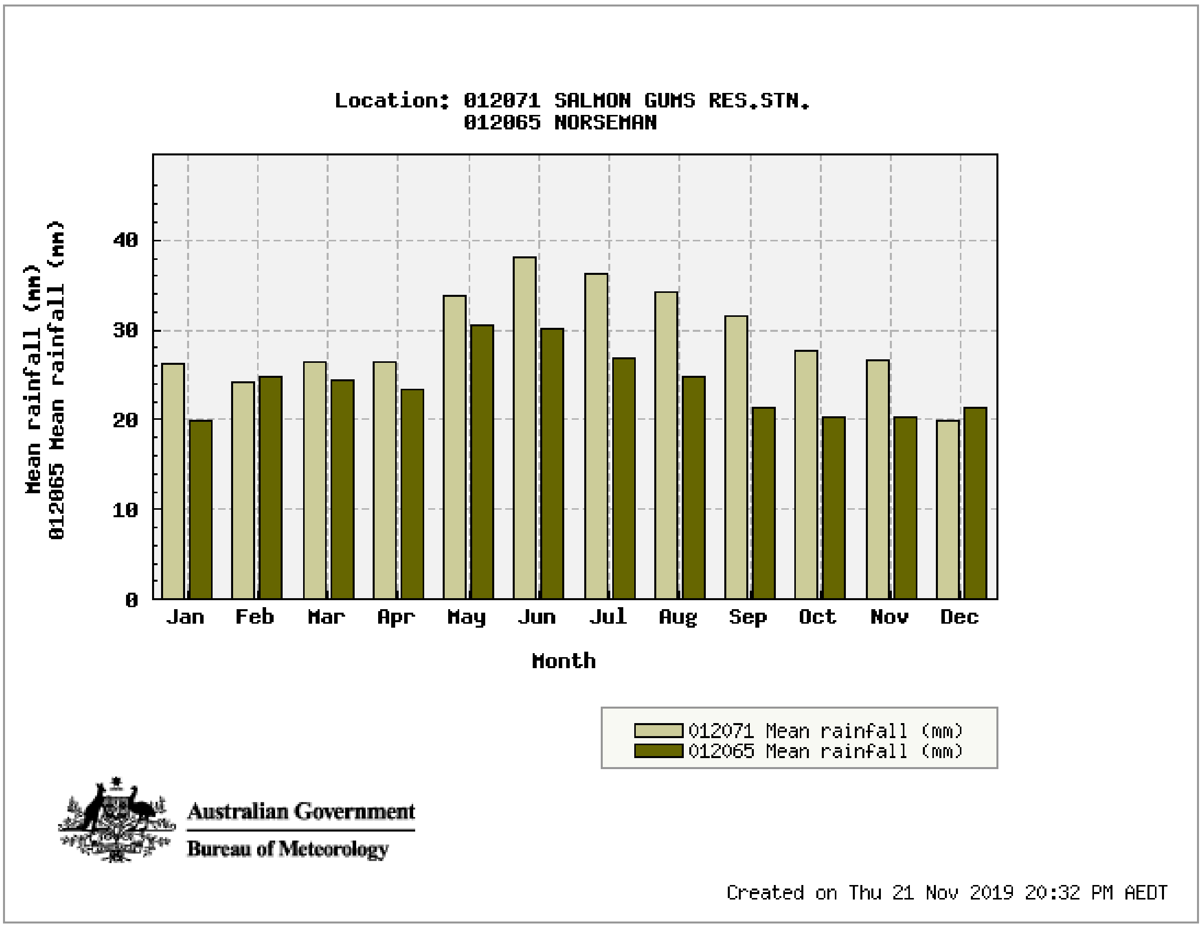

Figure 3: Long-term Mean Monthly Rainfall for Salmon Gums and Norseman BoM Monitoring Sites

Source: BoM

Hourly meteorological data were obtained from the BoM for the Salmon Gums site for a five-year period (from 2014 through 2018). Annual wind roses are presented in Figure 4 and seasonal wind roses in Figure 5. The annual wind roses illustrate a relatively consistent pattern from year to year, with no clearly dominate wind component. However, review of the seasonal wind roses shows a clear distinction between the summer and winter months; moderate to strong easterly-through-southerly winds dominate the summer months, while light to moderate westerly-through-northerly winds characterise the winter months. During the transitional seasons of autumn and spring, the winds remain highly variable.

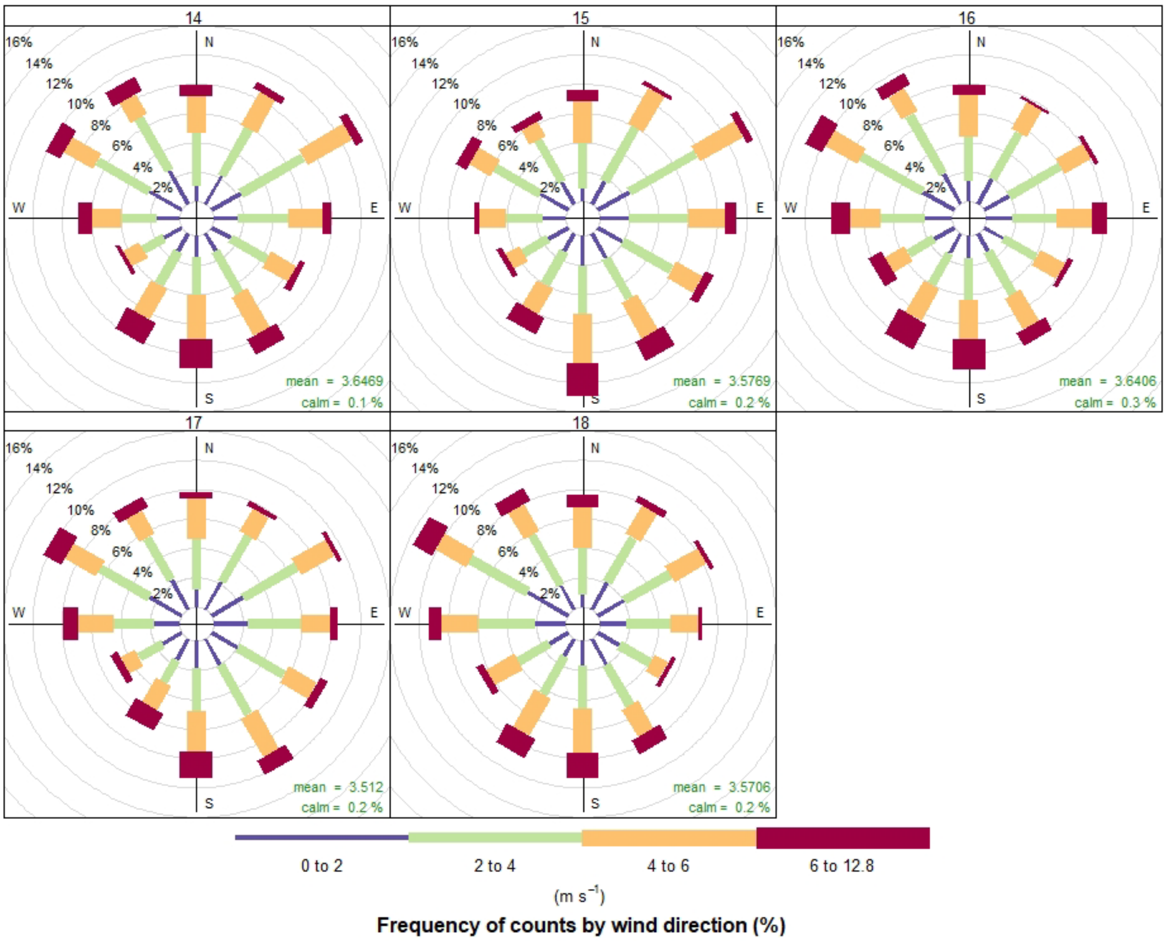

Figure 4: Salmon Gums Annual Wind Roses (2014-2018)

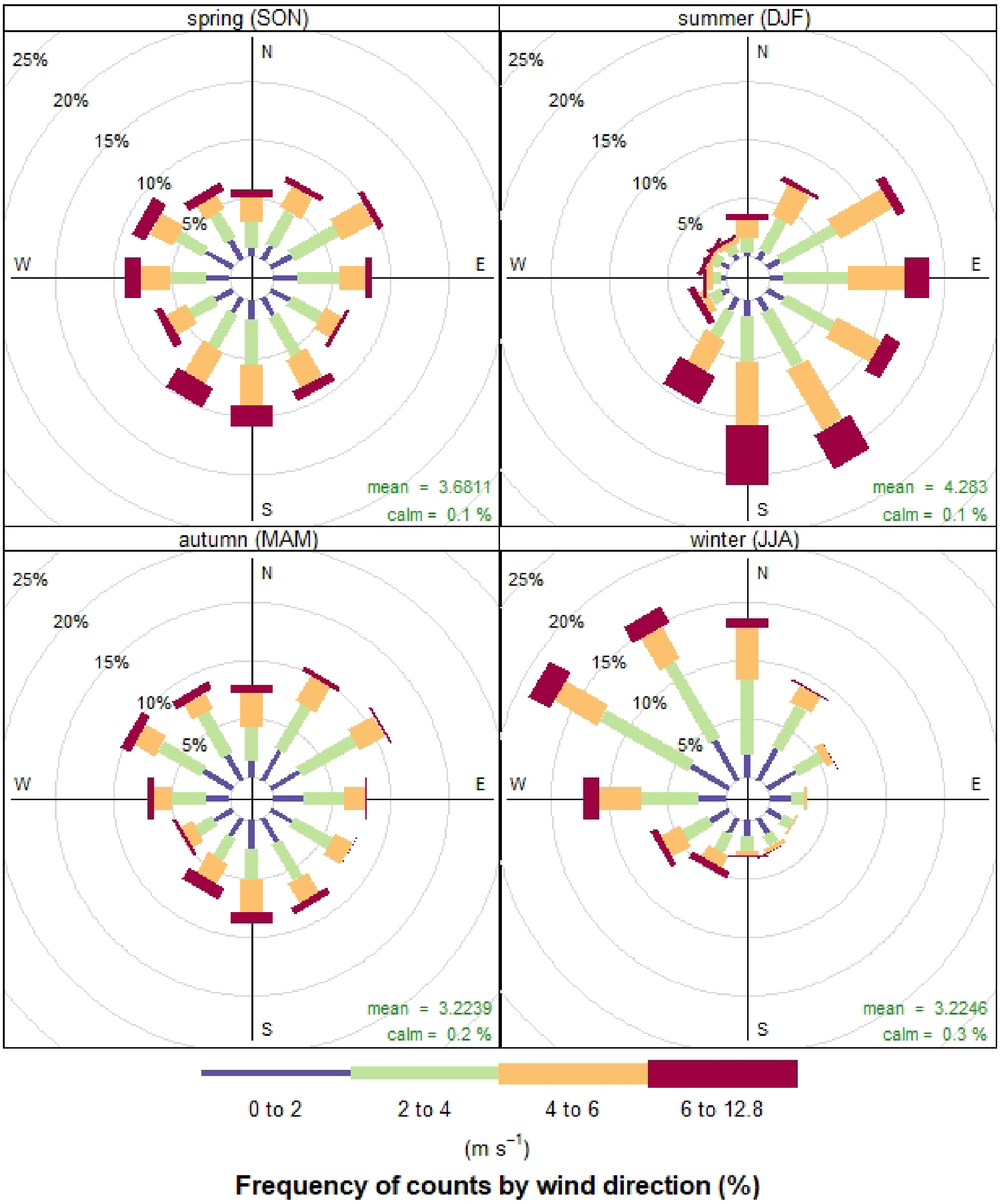

Figure 5: Salmon Gums Seasonal Wind Roses (2014-2018)

For the purpose of Ramboll's (2020) dust deposition study, site specific meteorological data were generated using the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) prognostic meteorological model TAPM (The Air Pollution Model). Annual wind roses derived from the TAPM predicted meteorological dataset are presented in Figure 6 for the calendar years 2014 to 2018. Comparison of these wind roses to those presented in Figure 4 shows similar wind speed and direction to the BoM Salmon Gums site, with no clearly dominate wind component.

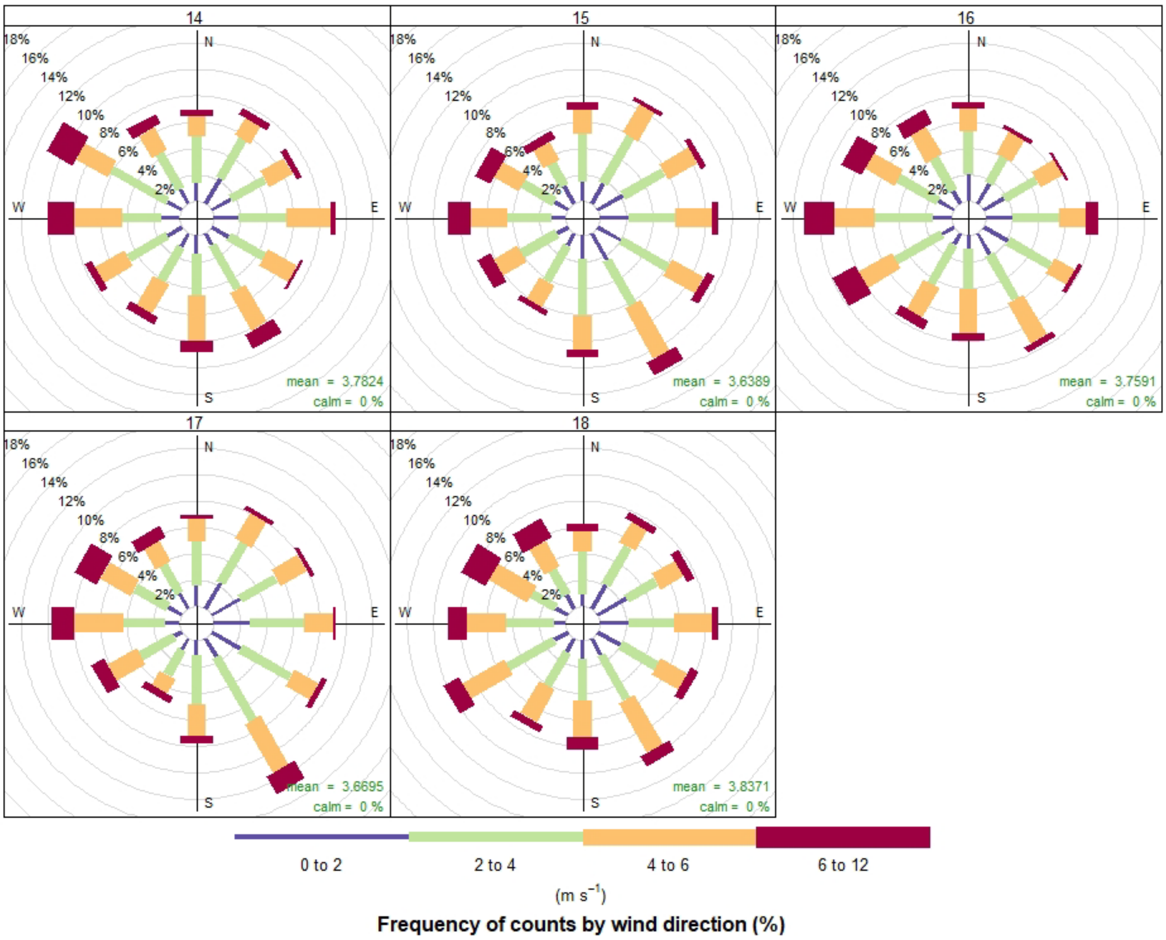

Figure 6: TAPM Predicted Annual Wind Roses (2014-2018)

The TAPM predicted meteorological data for the 2018 calendar year was selected for use in the dust deposition study and source assessment. These data are considered comparable to the available regional meteorological monitoring data. A seasonal wind rose for the 2018 (TAPM predicted) calendar year is presented in Figure 7. This figure illustrates a similar pattern of seasonal wind distributions, as compared to the seasonal wind roses based on the BoM data presented in Figure 5.

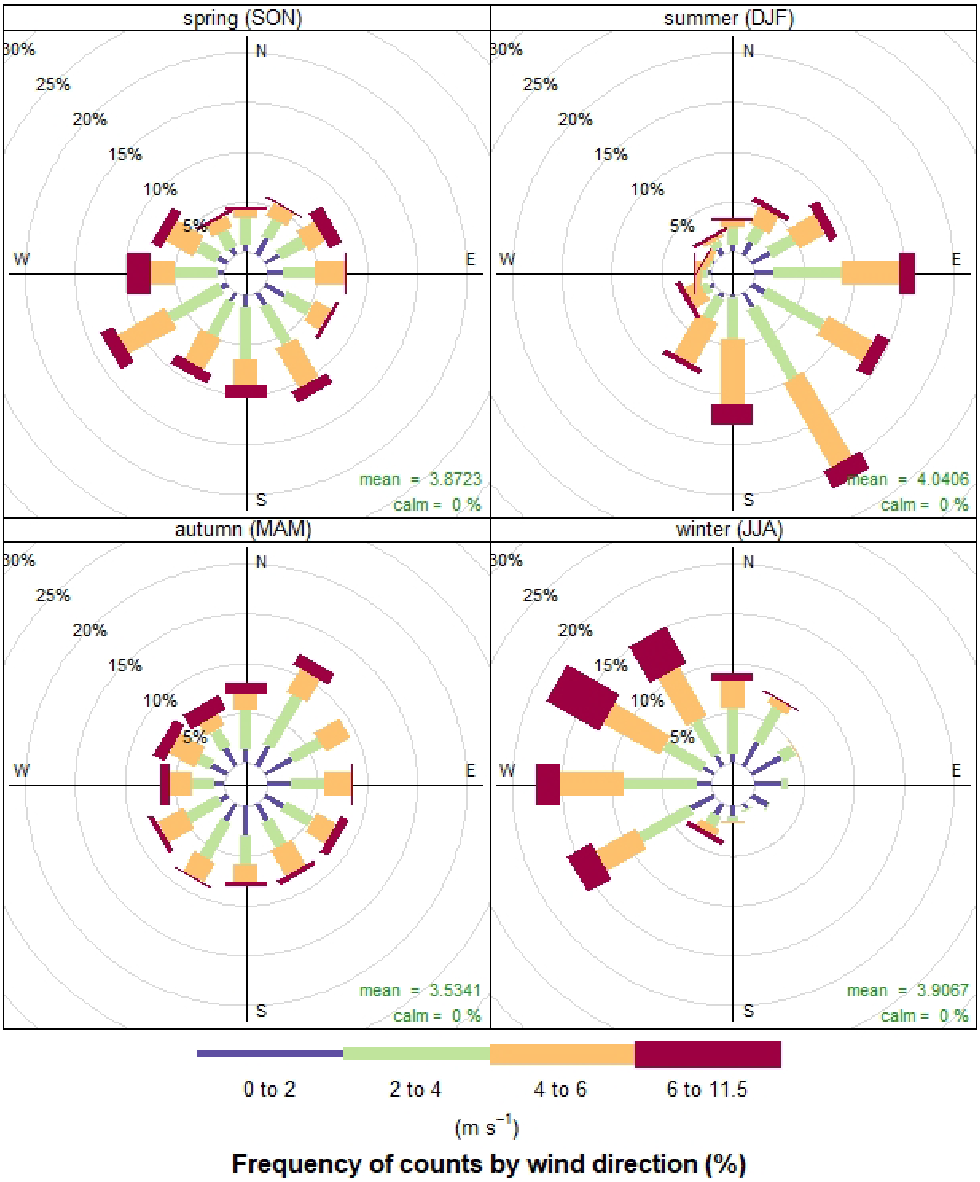

Figure 7: TAPM Predicted Seasonal Wind Rose (2018)

2.3 Existing Dust Deposition

Audalia have undertaken monthly dust deposition monitoring at the Project site since October 2018. The monitoring network comprises 12 dust deposition gauges, the locations of which are presented in Figure 8. Nine of the gauges are located within the mine development envelope (Figure 9) and two are within the proposed haul road envelope (DGM4 and DGM5). A background gauge is located approximately 18 km north-west of the proposed operations (DGM1). Deposition gauges DG1A, DG1B, DG1C and DG1D are located at the respective *M.aquilonaris* sub-populations 1a, 1b, 1c and 1d.

The deposition gauges are collected on a monthly basis and sent to a NATA accredited laboratory for analysis. The samples are analysed in accordance with the applicable standards (AS3580.10.1:2016: Determination of particulate matter – Deposited matter – Gravimetric method) and results are reported for ash content, total soluble matter and total insoluble matter (g/m^2.month).

A summary of the monthly dust deposition monitoring results provided by Audalia is presented in Table 1. Total dust deposition has been calculated based on the sum of the total soluble and total insoluble matter. The average monthly dust deposition rates across all sites range between 0.08 g/m^2.month and 1.5 g/m^2.month.

A graphical representation of the monthly dust deposition rates is presented in Figure 10. The highest monthly deposition rates were reported in March and April 2019, the maximum being 5.2 g/m^2.month at DGM1 in April 2019. The exposure period for the March 2019 samples was 65 days, due to the presence of a regional fire which prohibited access for the monthly collection of the deposition gauges. Comparatively elevated depositions rates were also recorded for the 8 November 2018 sample period at DGM3, and the 29 November 2018 sample period at DGM4.

Figure 8: Locations of Dust Deposition Monitors

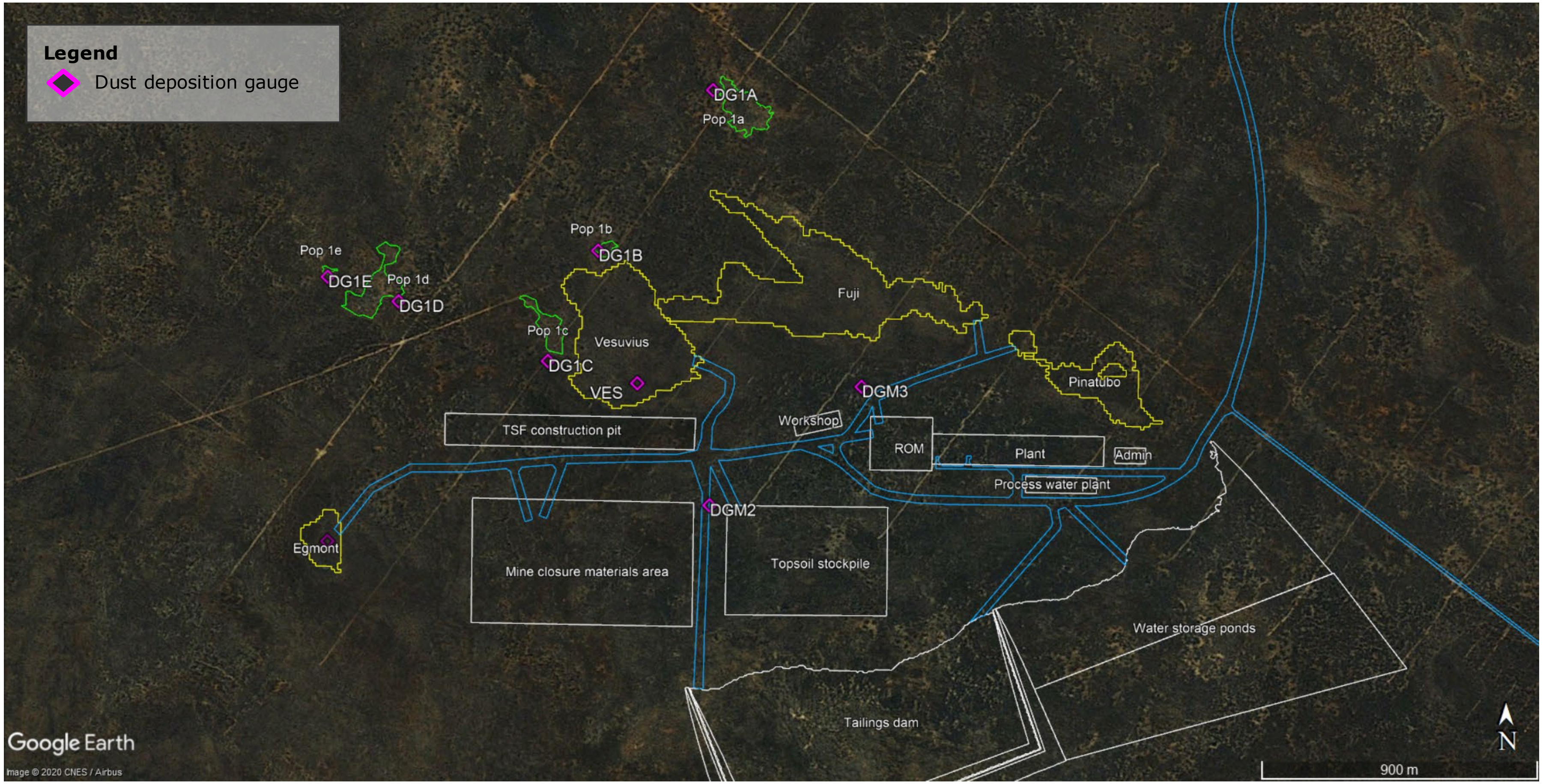

Figure 9: Locations of Dust Deposition Monitors – Mine Envelope

Table 1: Summary of Dust Deposition Monitoring Results

Sampling Period	Exposure Period (Days)[1]	Total Dust Deposition (g/m^2.month)											
		DG1A	Mine Envelope									Haul Road	
			DG1B	DG1C	DG1D	DG1E	DGM1	DGM2	DGM3	VES	EGM	DGM4	DGM5
10/09/18 - 08/11/18	59[2]	0.7	0.5	0.7	0.8	1	0.5	0.7	3	ND	ND	0.7	0.4
08/11/18 - 29/11/18	21	0.9	0.6	0.7	0.9	1.3	0.5	0.4	0.9	0.4	0.6	3.7	1.3
28/11/18 - 08/01/19	41	0.3	0.5	0.4	0.5	0.7	0.9	0.3	0.7	1.5	1.6	0.6	0.7
08/01/19 - 14/03/19	65[2]	2.1	2.2	1.9	2.2	2.2	ND	1.9	2.6	2.0	2.4	1.8	0.9
14/03/19 - 16/04/19	33	2.7	2.1	1.7	3.1	1.2	5.2	1.8	2.3	0.8	0.8	2.6	3.3
16/04/19 - 22/05/19	36	0.4	0.5	0.4	0.6	0.5	2.4	0.3	0.5	0.4	0.5	0.4	2.5
22/05/19 - 03/07/19	42/34[3]	0.3	0.3	0.4	0.4	1.3	0.5	0.2	0.3	1.1	1	0.5	0.4
03/07/19 - 31/07/19	30/36[4]	0.3	0.4	1.1	0.3	0.4	0.5	ND	0.2	0.4	0.6	0.3	0.2
31/07/19 - 29/08/19	29	0.2	0.4	0.2	0.2	0.5	1.6	0.4	0.3	0.6	0.6	0.3	0.5
Average	-	0.9	0.8	0.8	1.0	1.0	1.5	0.8	1.2	0.9	1.0	1.2	1.1

Notes

1. Typical exposure period specified in AS3580.10.1:2016 is 30±2 days.
2. Presence of fire prohibited collection of dust deposition gauge within monthly period.
3. Sample exposure period is 34 days for DGM4 and DGM5 and 42 days for all other gauges.
4. Sample exposure period is 36 days for DGM4 and DGM5 and 30 days for all other gauges.
5. ND = No data.

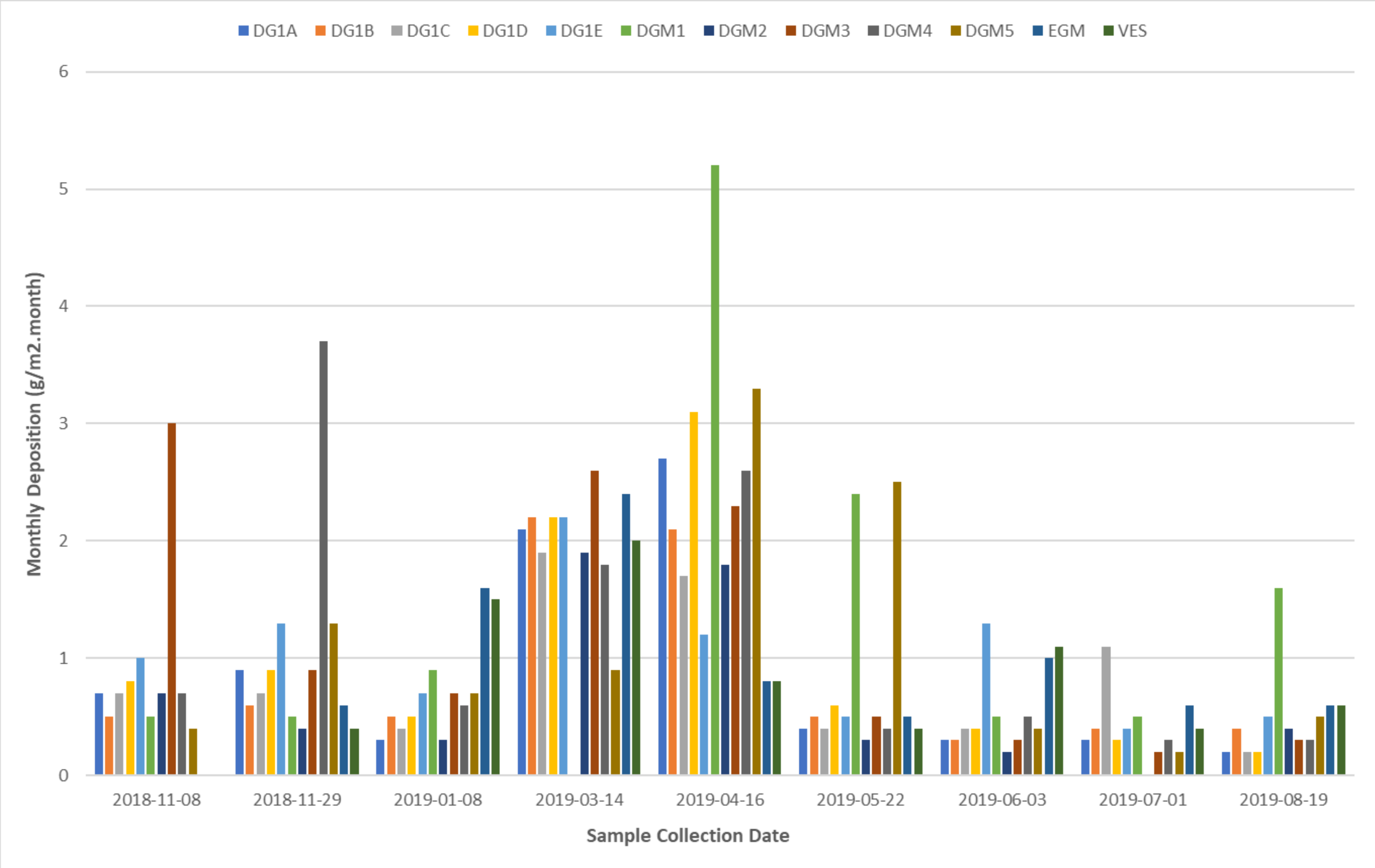

Figure 10: Summary of Monthly Dust Deposition Rates

3. ASSESSMENT CRITERIA

3.1 Particulate Deposition

There are no specific assessment guidelines available for impacts on vegetation from dust deposition, however a number of studies on impacts to vegetation from particulate deposition have been completed in Australia and globally.

Most studies of the effects of mineral dusts on vegetation have focussed on dusts that have chemical effects (e.g. cement dust) or where dust loads exceed 7 g/m^2. Relatively inert mineral dusts, such as those generated in the mining process or from unsealed haul roads principally influence light and temperature relations of leaves.

A study by Doley and Rossato (2010) used published data to assess the impacts of particulate deposition on photosynthesis in cotton leaves and canopies. The study indicated that many plants species have similar ranges of values for the photosynthetic parameters used in assessing the impacts on cotton and it is possible to use the cotton estimates as a general estimate for the purpose of modelling the impacts particulate deposition and thereby the environmental risks associated with dust generating activities. The results of the study indicated that at deposition levels of approximately 0.3 g/m^2/day, the estimated reductions in canopy photosynthesis of cotton plants would be less than 7% with a <1% decrease in productivity (Doley & Rossato, 2010).

Matsuki et al. (2016) sought to assess the relationship between dust accumulation on plant surfaces and plant health and survivorship using data from two medium-term monitoring studies undertaken in semi-arid Australia. The study sites were located at the Windarling Range (approximately 300 km north-west of the Project site), and Barrow Island (approximately 50 km off the Pilbara coast of Western Australia). Plant health and survivorship of a threatened subspecies (*Tetratheca paynterae paynterae*) were measured at varying distances from open pit mining operations at the Windarling Range study site between 2003 and 2014 and compared with dust load (assessed between 2004 and 2010) and dust deposition (measured between 2011 and 2013). At Barrow Island, plant health and floristic composition were measured at varying distances from a construction site between 2009 and 2012 and compared with dust deposition measurements.

Matsuki et al. (2016) report that neither plant health nor survivorship appear to be related to distance from the mining pit at the Windarling Range site. Dust deposition rates ranged between 0.6 to 20.1 g/m^2.month and were slightly higher closer to the edge of the pit (up to approximately 100 m), decreasing rapidly with distance; however, there was no significant difference in plant health condition over the same distance (Matsuki et al., 2016). The authors note that although plants adjacent to the pit showed higher dust loads and physiological signs of stress, this did not appear to have impacted the health condition or survivorship of the species in question. At the Barrow Island study site, dust deposition rates ranged between 0 and 77 g/m^2.month, although no statistically significant relationship was observed between deposition rates and distance from the source (Matsuki et al., 2016). Plant health condition was also reportedly unrelated to distance from the source of dust, instead affected by environmental conditions (namely rainfall).

It should be noted that as the area around the mine is a semi-arid environment, it is likely that natural vegetation in the region would have a degree of tolerance to these conditions. Matsuki et al. (2016) note that plants in semi-arid environments are likely to be exposed to dust naturally and as a result, may be less likely to suffer from short-term impacts of dust. The Doley and

Rossato (2010) study also noted that in more complex plant associations, species that grow in heavily shaded understories are much more likely to be susceptible to dust deposition than plants exposed to direct sunlight. Ramboll understands the vegetation of the region does not typically contain dense undergrowth and this is therefore not considered as a factor for the air dispersion modelling study.

In summary, the Doley and Rosato (2010) study provides a general estimate for assessing the impacts of dust deposition on vegetation, namely that levels of 0.3 $g/m^2/day$ or more may be associated with a reduction in canopy photosynthesis; while the Matsuki et al. (2016) report suggests plants within semi-arid regions, such as that of the Project site, may be able to tolerate higher deposition rates without significant impact to plant health condition.

3.2 Amenity

The New South Wales Department of Environment and Climate Change (NSW DECC) have published dust deposition criteria, designed to take into account potential amenity impacts, such as dust depositing on fabrics and buildings. The use of these guidelines serves as a reference as to the potential magnitude of the impacts associated with dust deposition, but are not intended to be used as an indication of acceptability of the predicted impacts.

The NSW guidelines are based on studies undertaken on coal dust deposition in the Hunter Valley in NSW by the National Energy Research and Demonstration Council (NERDC, 1988). While the dust deposition guideline is expressed as $g/m^2/month$, the NSW DECC has indicated that the monthly average deposition (to be compared against the guideline value) is to be determined from data spanning no less than one year, so as to account for seasonal variations.

Table 2: Amenity Dust Deposition Criteria

Pollutant	Averaging Period	Criteria ($g/m^2/month$)
Deposited dust[1]	Annual (increase)[2]	2
	Annual (total)[3]	4

Notes

1. Dust is assessed as insoluble solids as defined by AS 3580.10.1-1991 (AM-19).
2. Maximum increase in deposited dust level.
3. Maximum total deposited dust level.

The NSW Environmental Defender's Office (EDO) advises that the criteria for the maximum increase in deposited dust of 2 $g/m^2/month$ is applicable when baseline data on deposited dust exists, while the total deposited dust criteria of 4 $g/m^2/month$ criteria is applied when no baseline data exists.

4. SOURCE ASSESSMENT

4.1 Fugitive Dust Sources

Fugitive dust emissions associated with mining operations are typically generated from material handling activities, the erosion of stockpiles and open areas, and the movement of vehicles. A summary of the potential dust sources associated with the proposed Medcalf Project is provided in Table 3.

Table 3: Summary of Potential Dust Sources

Source	Description
Mining Operations	Wind entrainment of particulates from open areas
	Scraping of topsoil
	Bulldozers operating on overburden and ore
	Drilling
	Loading of haul trucks with ore, overburden and topsoil
	Dumping of topsoil, ore and overburden
Stockpiles/Open Areas	Particulates generated during stacking and reclaiming
	Wind entrainment of particulates from stockpiles
	Accumulated dust on open surfaces, subsequent entrainment by wind and moving vehicles
Roads	Entrainment of particulates from paved and unpaved roads by wind and moving vehicles
	Fall through of dust from wagons onto the road and subsequent entrainment by wind and moving vehicles
Processing	Reclamation with front-end loaders (FEL) and loading of hoppers
	Primary and secondary crushing and screening operations
	Load out of product to vehicles for transport to road train transfer area

4.2 Source Contributions

Air dispersion modelling was undertaken to predict dust deposition rates associated with fugitive dust emissions from the proposed Medcalf Project (see Ramboll, 2020). While there are inherent uncertainties associated with particulate modelling, it can be useful in determining the potential magnitude of individual source impacts at nominated receptors, which in turn can be used to inform the most efficient allocation of resources to reduce fugitive dust emissions and by association, reduce the deposition off particulates at sensitive receptor locations.

The effective use of air dispersion modelling as a tool to assess source contributions depends on the use of reliable meteorological data and a representative emissions inventory. In the absence of site-specific emission estimates for particulate sources, this assessment utilised default emission factors for mining operations as published by the then Department of Sustainability, Environment, Water, Population and Communities (now Department of the Environment and Energy), for the purposes of National Pollutant Inventory (NPI) reporting. The use of the NPI emission factors to determine emission rates for the various sources is considered conservative and may not be representative of actual emissions from the site. Nevertheless, they do provide a means by which the relative source contributions at receptor locations can be estimated.

A summary of the source contributions to the maximum 24-hour and monthly average dust depositions rates predicted at sub-populations 1a to 1d are presented in Figure 11 and Figure 12. These data indicate that fugitive emissions from mining operations within the Vesuvius pit contribute the greatest proportion to the maximum 24-hour and monthly average dust deposition rates predicted at the nearest *M.aquilonaris* sub-populations 1b and 1c. Fugitive emissions from the processing plant contribute the highest proportion to the maximum predicted 24-hour and monthly average dust deposition rate at sub-populations 1a and 1d.

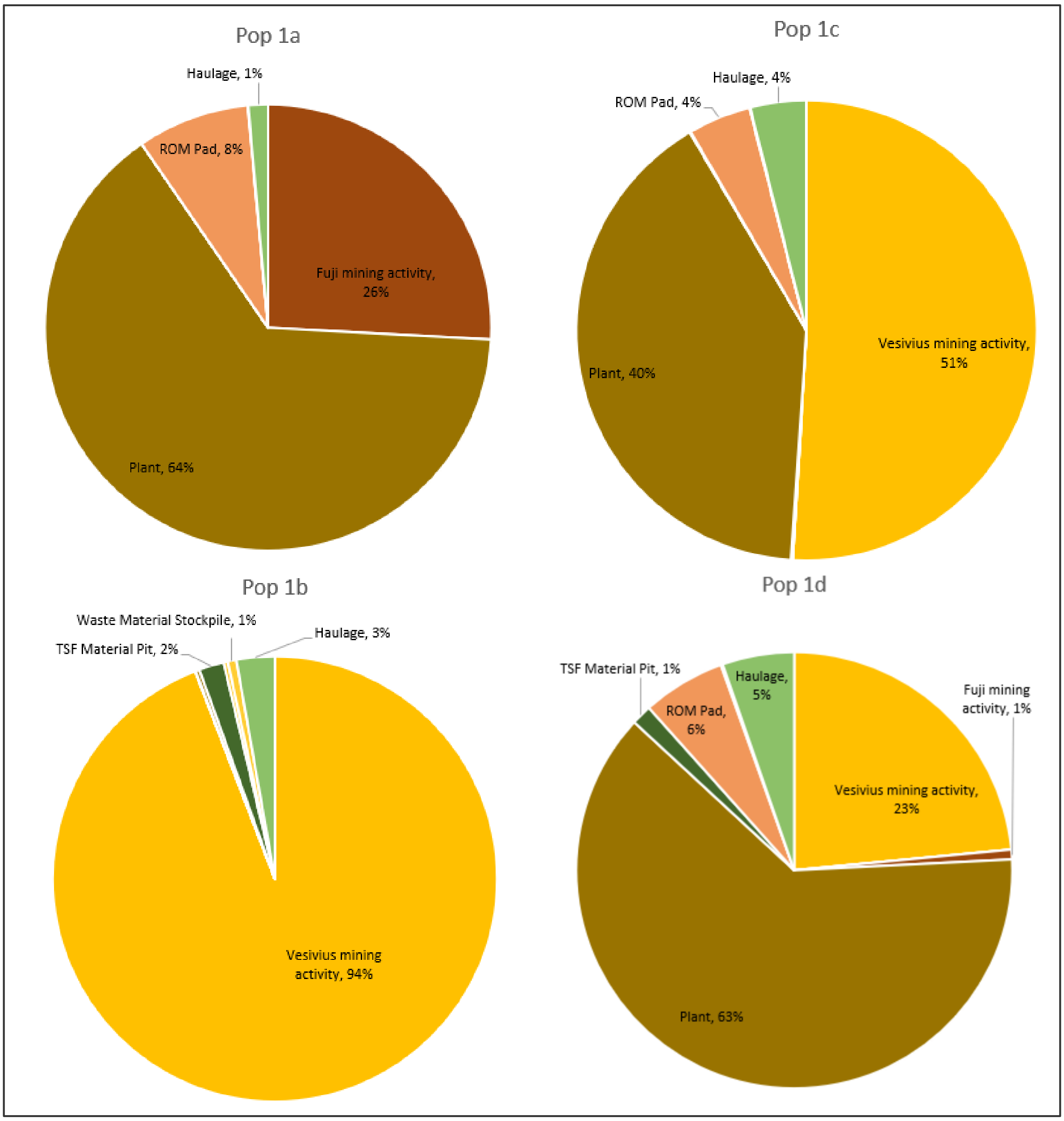

Figure 11: Source Contribution to Maximum Predicted 24-hour Average Dust Deposition Rates (Year 01)

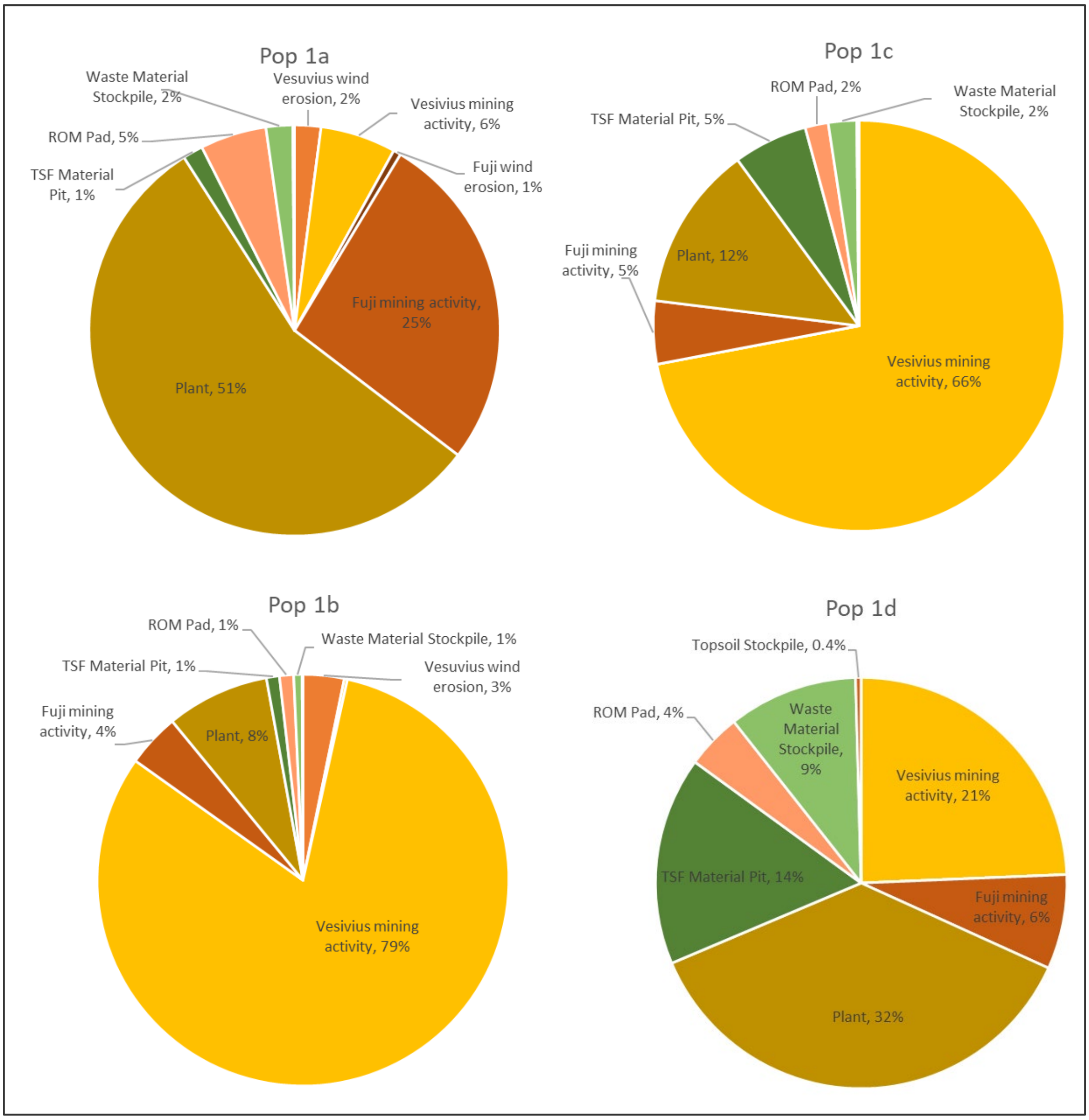

Figure 12: Source Contribution to Maximum Monthly Average Dust Deposition Rates

Analysis of the modelling results indicates that dust deposition rates at the *M.aquilonaris* sub-populations located closest to the proposed mining operations are most likely to be influenced by mining operations (i.e. excavation and truck loading) within the Vesuvius pit. Ramboll note initial assessment of the potential impact of fugitive dust emissions from the proposed Medcalf Project identified dozing operations within the Vesuvius pit as the primary emission source contributing to predicted deposition rates at the *M.aquilonaris* sub-populations 1b and 1c. Following discussion with Audalia, subsequent revisions of the air dispersion modelling assessment assumed the implementation of operational controls to restrict dozing activity within the Vesuvius pit when the wind direction falls within nominated 'arcs of influence' for sub-populations 1b and 1c (refer to 5.1.3). Determination of the source contributions as described above is therefore based on the same assumption (i.e. that operational controls are implemented to restrict dozing activity within the Vesuvius pit when the wind direction falls within the 'arcs of influence' for sub-populations 1b and 1c).

5. RECOMMENDED DUST CONTROL MEASURES

The dust control measures recommended for the proposed Medcalf project are presented in order of priority with consideration to the predicted source contributions at the sensitive receptor locations. In determining these recommendations, Ramboll has also given consideration to best practice guidelines. These include (but is not limited to):

- *Leading Practice Sustainable Development Program for the Mining Industry – Airborne Contaminants, Noise and Vibration* (Department of Resources, Energy and Tourism [DRET], 2009).
- *Dust Management Leading Practice Guidelines* (Pilbara Ports Authority, 2015).
- *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Katestone, 2011).

5.1 Mining Activity

The results of the source assessment indicate fugitive dust emissions from mining operations within the Vesuvius pit contribute the greatest loading to the predicted dust deposition rates at *M.aquilonaris* sub-populations 1b and 1c. Dust generation is associated with the following activities:

- Dozing of topsoil and overburden;
- Excavation of overburden and ore; and
- Loading of haul trucks.

Descriptions of the key factors influencing dust emissions in relation to these activities and the recommended dust control measures are presented in the following sections.

5.1.1 Dozing

Dozing emissions are determined primarily by activity rates (hours of operation) and material silt and moisture content. The prevailing wind speed and the nature of the dozing operation also determine the extent of emissions (although these parameters are not accounted for in emission factors). Dust generation may also be influenced by dozer cooling fans and exhaust systems, when airflow vents are angled towards the material being handled or traversed over.

The following control measures are recommended for dozing operations at the Medcalf Project site:

- Avoid dozer operations at wind exposed areas during adverse meteorological conditions;
- Minimising the travel speed and distance travelled by bulldozers;
- Designate and maintain dozer routes between work areas;
- Application of water to keep travel routes moist;
- Visual monitoring of dust levels from dozer operations by trained personnel, with operations modified or ceased when elevated dust levels are observed to occur; and
- Modification of mobile plant to redirect the air blast from their cooling and exhaust emission systems away from the material being traversed and/or handled (where practicable).

In order to avoid dozer operations within the Vesuvius pit during adverse meteorological conditions, Ramboll recommend an operational control strategy be implemented to schedule dozing activity to occur under favourable meteorological conditions (refer to Section 5.1.3).

5.1.2 Excavation and Truck Loading/Unloading

Factors which influence the extent of emissions associated with the excavation and truck loading/unloading of ore and overburden include the volume of material handled, material moisture and silt content, wind speed and the extent to which operations take place within the pit or other sheltered areas.

The following control measures are recommended for the excavation and truck loading/unloading of ore and overburden at the Medcalf Project site:

- Modifying or ceasing operations during adverse meteorological conditions;
- Visual monitoring of dust levels from operations by trained personnel, with operations modified or ceased when elevated dust levels are observed to occur;
- Avoiding the double handling of material where possible; and
- Minimising the drop height when loading and dumping.

As with dozing, an operational control strategy is recommended to schedule excavation and truck loading within the Vesuvius pit to occur under favourable meteorological conditions (refer to Section 5.1.3).

5.1.3 Operational Control Strategy

The results of the dust deposition assessment indicate mining activity within the Vesuvius pit is predicted to have the greatest impact on dust deposition rates at the nearest *M.aquilonaris* sub-populations (1b and 1c) (see Ramboll, 2020). In the absence of source-specific mitigation measures that are likely to result in significant reductions of fugitive dust emissions associated with dozing, excavation and haul truck loading within the pit, an operational control strategy is recommended to restrict mining activities within the Vesuvius pit during unfavourable meteorological conditions, or when visible dust is thought to be impacting at sensitive receptor locations.

Figure 14 illustrates the broad extent of the directional arcs of influence for *M.aquilonaris* sub-populations 1b and 1c. However, on the basis that mining activity is likely to be localised within the pit at any one time, a refined arc of influence could be determined to align with the location of the activity on a given day. Review of the wind roses presented in Figure 7 indicates winds are most likely to occur within the directional arcs of influence during the summer months; and least likely to occur within the directional arcs of influence during the winter months. In order to minimise the potential restriction of in-pit operations based on wind direction, it is recommended that mining activity within the Vesuvius pit be scheduled to during favourable meteorological conditions.

It is noted an operational control strategy based on wind direction requires reliable wind direction data. It is recommended an on-site meteorological monitoring station be installed, in line with the requirements of *AS3580.14:2014 Methods for sampling and analysis of ambient air Meteorological monitoring for ambient air quality monitoring applications*.

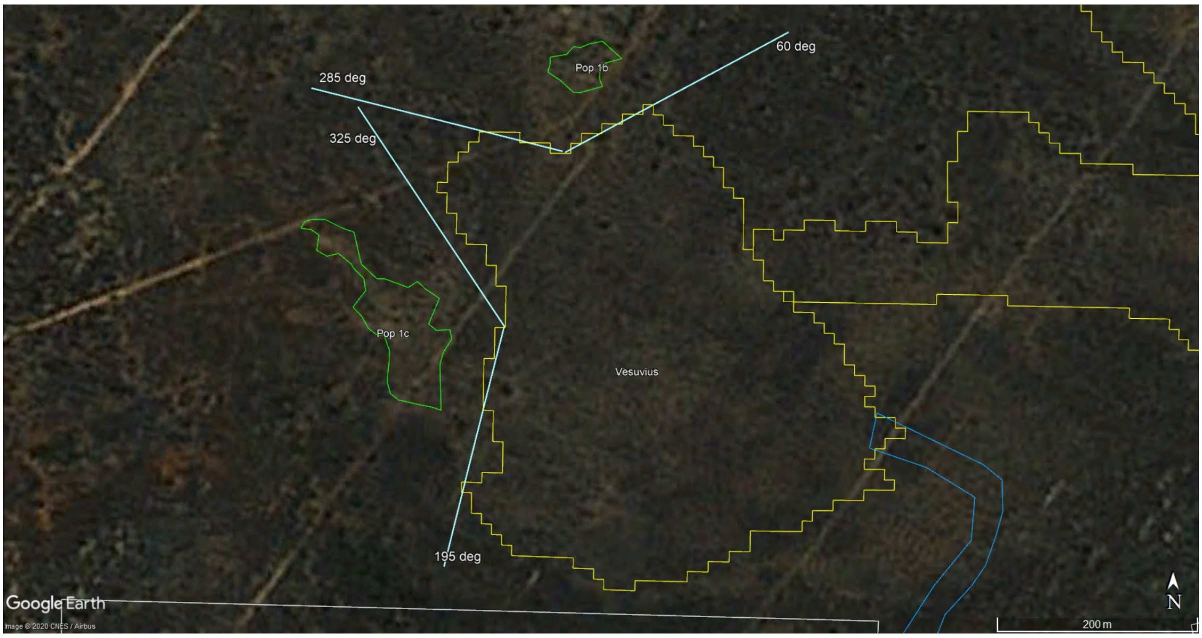

Figure 13: Wind Direction Arcs of Influence for Sub-Populations 1b and 1c

5.2 Screening and Crushing Plant

Sources of dust within the proposed processing plant include primary and secondary crushing, screening and material transfers. Dust emissions associated with crushing and screening operations are primarily determined by the volume of material handled and material moisture content. Wind speed can also influence fugitive dust emissions associated with material handling operations, as particulate emissions from handling can increase with increasing wind speed.

The following control measures are identified for reducing the fugitive dust emissions from the crushing and screening plants:

- Use of water sprays and fogging systems on transfer points;
- Utilisation of internal water sprays on crushing plant;
- Housekeeping measures to remove spillages in and around the plant.

Enclosure of crushing and screening plants is commonly recommended in line with best practice dust control measures. However, Ramboll understands the crushing and screening plants at the proposed Medcalf Project site will not be enclosed. Although fugitive dust emissions from the proposed plant are predicted to contribute the greatest proportion to dust deposition rates at *M.aquilonaris* sub-populations 1a and 1d, the predicted dust deposition rates themselves remain low (i.e. < 2.0 g/m^2.month).

While there is opportunity to further reduce fugitive dust emissions from the processing plant by means of enclosure, it is not considered to be a priority action based on the distance between the proposed processing plant and the location of the *M.aquilonaris* sub-populations (i.e. >1.4 km). The greatest impacts associated with dust emissions from the plant are predicted to occur within 100 m of the plant boundary, with predicted deposition rates decreasing rapidly at distances greater than this (refer to Ramboll, 2020).

5.3 Exposed Surface Areas

Particulate matter emissions due to wind erosion of exposed surface areas is a function of the size of the exposed area, the velocity of the wind at the surface, moisture content and particle size distribution of the exposed material, and the extent to which the surface has crusted. Cleared or exposed open areas in the mining pits, ROM stockpiles, TSF and waste rock landform are all susceptible to wind erosion.

The following control measures are identified for reducing the wind erosion potential of exposed surface areas:

- Minimise the footprint of non-operational open areas;
- Strategic use of watering, suppressants and hydraulic mulch seeding depending on circumstances;
- Use water cannons to deliver water to stockpile surfaces;
- Progressive rehabilitation, with rehabilitation progressing as soon as practical after a landform has obtained its final height. Rehabilitation comprises use of vegetation and land-contouring to produce the final postmining land-form;
- Application of interim stabilisation (vegetation; chemical suppression) for overburden emplacement areas which are to be in place for extended periods prior to reaching the required heights for final landforming and rehabilitation; and
- Restricting vehicle access to formed roads within areas such as the waste rock landform.

In relation to the TSF, the following control measures are recommended:

- Rotating the discharge points to keep the tailing surface wetted to inhibit dust generation; and
- Ensuring once tailings are dry and have crusted that there are no mechanical disturbances or vehicles tracking upon the surface.

5.4 Haul Roads

Dust emissions from haul roads is influenced by traffic activity (vehicle kilometres travelled [VKT]), vehicle weight and speed, silt content of the road surface material and moisture content of the road (a function of the precipitation and evaporation).

Control measures identified to reduce fugitive dust emissions from the Project's haul roads comprise:

- Regular application of water or ideally a chemical suppressant on unpaved haul roads;
- Minimising VKT by taking the most direct route and/or using larger trucks to minimise trip numbers;
- Ensure vehicles keep to the speed limits and drive within clearly demarcated areas;
- Optimise base materials to reduce silt content and increase the retention of larger aggregates, particularly at intersections; and
- Regular resurfacing of high traffic areas such as intersections to reduce silt build up.

Additional preventative measures include:

- Avoid overloading haul trucks which could result in spillage;
- Provide for storm water drainage to prevent water erosion onto stabilised unsealed roads;
- Prevent wind erosion from adjacent open areas; and
- Ongoing visual monitoring of dust.

It is noted that the use of a chemical suppressant is not necessarily sufficient in itself to control emissions from roads at site. Rainfall can increase degradation of the product, reducing its efficiency and particulate loading on the roads can quickly render the chemical suppressant ineffective. Regular monitoring is required to trigger the application of additional suppressant or watering. This may include visual monitoring of dust above the deck, wheels or tray of the haul trucks.

5.5 Dust Monitoring Program

As described in Section 2.3, Audalia have undertaken monthly dust deposition monitoring at the Project site since October 2018, with deposition gauges located at *M.aquilonaris* sub-populations 1a, 1b and 1c. Deposition gauges DG1A, DG1B, DG1C and DG1D are located at the respective *M.aquilonaris* sub-populations 1a, 1b, 1c and 1d. Ramboll recommend the dust deposition monitoring program be continued through the construction and operation of the proposed Medcalf Project, in order to measure dust deposition rates at the *M.aquilonaris* sub-population locations. It is also recommended that the dust deposition monitoring program is coupled with ongoing vegetation health surveys to monitor the health of the *M.aquilonaris* sub-populations.

6. SUMMARY

Ramboll undertook a source assessment to identify key fugitive dust sources from the proposed Medcalf Project predicted to contribute to dust deposition at the *M.aquilonaris* sub-populations. The results of the assessment indicate that fugitive emissions from mining operations within the Vesuvius pit contribute the greatest proportion to the maximum 24-hour and monthly average dust deposition rates predicted at the nearest *M.aquilonaris* sub-populations 1b and 1c. Fugitive emissions from the processing plant contribute the highest proportion to the maximum predicted 24-hour and monthly average dust deposition rate at sub-populations 1a and 1d.

A review of potential dust control measures has been undertaken for each source of concern, with consideration given to best practice guidelines. An operational control strategy restricting mining activities within the Vesuvius pit during unfavourable meteorological conditions is one of the priority recommendations, in order to minimise the potential impact of fugitive dust emissions on deposition rates at the nearest *M.aquilonaris* sub-populations.

A summary of the recommended dust mitigation measures is presented in Table 4.

Table 4: Summary of Recommended Dust Management Actions

Activity	Recommended Dust Management Actions
Dozing	Implementation of an Operational Control Strategy to avoid operations during dry, windy conditions
	Minimise travel speed and distance travelled by bulldozers
	Designate and maintain dozer routes between work areas
	Application of water to keep travel routes moist
	Visual monitoring of dust levels from dozer operations, with operations modified or ceased when elevated dust levels are observed
	Selection/modification of mobile plant to redirect cooling and exhaust emission systems away from the material being traversed and/or handled (where practicable)
Excavation and truck loading	Implementation of an Operational Control Strategy to avoid operations during dry, windy conditions
	Avoiding the double handling of material where possible
	Minimising the drop height when loading and dumping.
Crushing and Screening	Use of water sprays and fogging systems on transfer points
	Utilisation of internal water sprays on crushing plant
	Housekeeping measures to remove spillages in and around the plant.
Exposed surfaces	Minimise the footprint of non-operational open areas
	Strategic use of watering, suppressants and hydraulic mulch seeding depending on circumstances
	Application of interim stabilisation (vegetation; chemical suppression) for exposed areas which are to be in place for extended periods
	Progressive rehabilitation

Activity	**Recommended Dust Management Actions**
	Rotating the discharge points within the TSF to keep the surface wetted
	Restricting vehicle access to formed roads within exposed areas
Vehicle movements	Application of dust suppression on unsealed haul roads within mining operations
	Ensure vehicles keep to the speed limits and drive within clearly demarcated areas
	Optimise load efficiency of haul trucks by not over or under-loaded to minimise spillage
	Optimise base materials to reduce silt content and increase the retention of larger aggregates
	Regular resurfacing of high traffic areas such as intersections to reduce silt build up.

7. REFERENCES

Department of Resources, Energy and Tourism (DRET) (2009). 'Leading Practice Sustainable Development Program for the Mining Industry – Airborne Contaminants, Noise and Vibration.' DRET, Commonwealth of Australia, October 2009.

Doley, D. & Rossato, L. 2010 'Mineral Particulates and Vegetation: Modelled effects of Dust on Photosynthesis in Plant Canopies', *Air Quality and Climate Change*, Volume 44 No.2, May 2010.

Katestone (2011). 'NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining.' Report prepared for Office of Environmenta and Heritage, June 2011.

Matsuki, M., Gardener, M., Smith, A., Howard, K. & Gove, A. 2016. 'Impacts of dust on plant health, survivorship and plant communities in semi-arid environments', *Austral Ecology*, Volume 41, pp 417-427.

National Pollutant Inventory (NPI). 2012. 'Emission Estimation Technique Manual for Mining.' Version 3.1, January 2012.

NSW EPA (2016). 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'. State of New South Wales and the Environment Protection Authority, November 2016.

Ramboll Australia (2019). 'Audalia Resource Limited Medcalf Project – Dust Depositino Study'. Report prepared for Audalia Resources, 19 December 2019.

8. LIMITATIONS

Ramboll prepared this report in accordance with the scope of work as outlined in our proposal to Audalia dated 7 June 2019 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent Ramboll's professional judgement based on information made available during the course of this assignment and are true and correct to the best of Ramboll's knowledge as at the date of the assessment.

Ramboll did not independently verify all of the written or oral information provided during the course of this investigation. While Ramboll has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Ramboll was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

8.1 User Reliance

This report has been prepared for Audalia and may not be relied upon by any other person or entity without Ramboll's express written permission.