Dandy Premix Quarries Pty Ltd
(t/a Yarra Valley Quarries)

WA375 - YARRA VALLEY QUARRY
130 McMahons Road
Launching Place, Vic

PROPOSED EXTENSION OF EXTRACTION AREA

DUST ASSESSMENT

June 2024

Environmental Science Associates
18 Goldsmith Crescent, Castlemaine 3450

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1. INTRODUCTION

Environmental Science Associates (**ESA**) was retained by Dandy Premix Quarries Pty Ltd (t/a Yarra Valley Quarries) to undertake an assessment of potential off-site effects of dust emissions associated with the proposed extension of the extraction area at its hard rock quarry.

1.1 Background

Yarra Valley Quarries (**YVQ**) has owned and operated the quarry at 130 McMahons Road, Launching Place since 2008. The existing quarry has operated since 1964, while the current crushing and screening plant was established in 1987 (when the facility was known as the Warradoo Quarry).

As the available stone resource within the currently approved Work Authority 375 (**WA375**) extraction area (shown by the solid red line in Figure 1) is nearing exhaustion, YVQ proposes to extend the extraction area towards the north and northwest. The proposed future extraction area, which is within land owned by YVQ, is shown by the dashed red line. A variation to Work Authority 375 (**WA375**) will be required to allow the expansion of the WA375 boundary and the extraction area limits into adjoining Lot 50C.

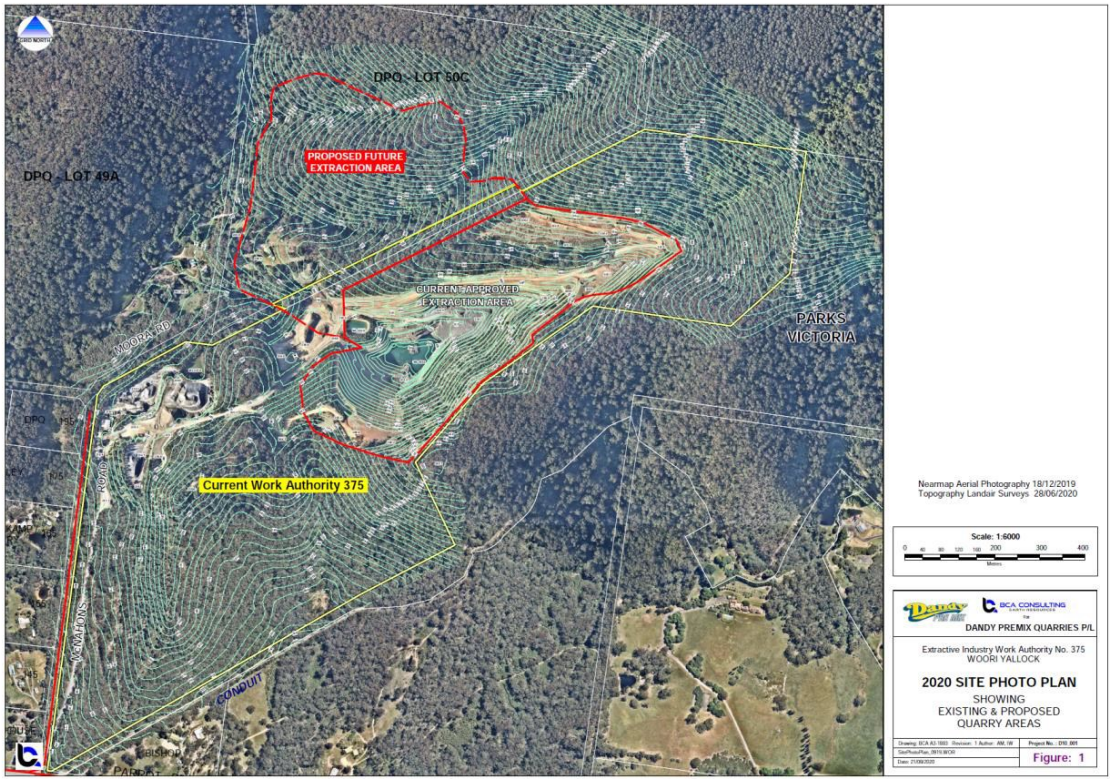

Figure 1. Existing and proposed extraction areas and nearby dwellings

The existing crushing/screening plant, pugmill and product stockpile areas will remain in their current locations, while overburden from the expanded extraction area will be placed into the existing quarry pit (hole) as part of the progressive rehabilitation. It is not envisaged that the proposal will result in any significant increase in the existing hourly processing rate, while the annual sales production rate is expected to increase moderately from about 300,000 tonnes per annum (**tpa**) currently to approximately 375,000 tpa under the Work Plan Variation (**WPV**) application.

1.2 The Site

YVQ's quarry is located in a forested area of the southern foothills of Mount Toolebewong, approximately 4 km north of the Yarra River and 6 km from the nearest town (Woori Yallock). The quarry operations are almost completely shielded from external viewpoints by the landforms and mature trees (Figure 2). WA375 currently occupies an area of 90 ha, while the proposed future extraction zone will extend into the adjoining 41 ha of 30 Moora Road, Mount Toolebewong, 3777, known as Crown Allotment 50C (Figure 2). The quarry access road is sealed for all but approximately 80 m of its length from the crushing plant to the site entrance on McMahons Road.

Figure 2. YVQ extraction area in September 2020

1.3 Zoning and Nearby Land Uses

The existing WA375 area is zoned Special Use Zone 1 (SUZ1), while CA 50C is currently zoned Rural Conservation Zone 3 (RCZ3). Land to the east of WA375 is largely zoned Public Use Zone 1 (PUZ1), while land abutting to the southeast, west and north is zoned RCZ1 or RCZ3.

215 McMahons Road, Mount Toolebewong, 3777 (CA 49A) adjoins the western boundary of CA 50C and is zoned RCZ1. CA 49A is owned by Dandy Premix Quarries Pty Ltd and will be retained and secured in perpetuity as predominantly forested land, being first-party offsets for native vegetation removed in CA Lot 50C, for the proposed WA375 expansion of extractive operations. The existing quarry operations, existing WA375 boundary, proposed expanded extraction area, and nearby dwellings (to the southwest) are shown in Figure 1.

The closest off-site sensitive uses are a number of dwellings on "rural residential/bush blocks" on the western side of McMahons Road (near the bottom-left corner of Figure 1). The closest of these dwellings is at 165 McMahons Road, approximately 300 m southwest from the crushing and screening plant, 600 m from the existing extraction area and 650 m from the proposed future extraction area in Lot 50C. The nearest dwellings to the north and south of the proposed future extraction area are located over 800m away.

1.4 Existing Operations

The primary purpose of YVQ's existing operations is to supply aggregate for Dandy Premix's five concrete batching plants, although approximately 25% of the quarry's crushed rock products are consumed by local contractors and the Yarra Ranges Council (**Council**). The extraction of rock and its processing at WA375 is conducted using conventional methods similar to those used at typical hard-rock quarries. These involve:

- removing overburden by excavator and placing it within the existing quarry hole (topsoil is separately stockpiled in windrows and used for rehabilitation as appropriate);
- drilling and blasting (typically involving a "shot" approximately every 4 weeks);
- loading broken rock into haul trucks and transporting it to the processing area;
- tipping rock into the primary crushing plant feed hopper;
- separating out "scalps" (soil and poor quality material);
- primary and secondary crushing;
- screening to sales product (size) specifications;
- stockpiling the various sized sale products (eg. 20mm, 14/10mm and 7mm aggregates);
- screening and blending secondary sales products using a mobile crusher and screens (eg. Class 3 CR, NDCR and rubble);
- occasional blending some of the aggregate products to customers' specifications in a pug mill; and
- loading of sales products for transport from the site in covered/tarped bulk quarry materials road trucks.

2. EXISTING DUST MANAGEMENT MEASURES

Views to the quarry are very limited by the surrounding topography and extensive tree cover, while "industry best practice" measures are applied to minimise particulate emissions. These include:

- use of a water cart/tanker to control dust generation from haul roads, stockpile areas and the sealed quarry access road on an as-required basis. Ample water for dust control is readily available from the interception and capture of runoff from the local catchment of a drainage line (Tributary 1) in the extraction pit sump. Water is pumped from the sump to the 10 ML capacity Holding Dam. The 8 ML Main Dam collects runoff from its elevated forest catchment and provides water for dust suppression on the crushing/screening plant (refer to photographs of the Holding Dam in Figure 3 and Main Dam in Figure 4);
- water sprays to suppress dust generation are installed at critical points on the crushing/screening plant;

- progressive rehabilitation of worked out benches in the extraction areas; and
- suspension of potentially dusty operations during periods of extreme weather conditions (eg. extremely hot and windy periods/days).

Figure 3. Photograph of Holding Dam

Figure 4. Photograph of Main Dam

Our experience at numerous hard-rock quarries suggests that the above measures should provide a high degree of control over potential dust emissions resulting from both "mechanical" operations (such as vehicle movements and the crushing and screening plant) and from wind erosion of bare surfaces and product stockpiles.

We have been advised by Dandy Premix Quarries Pty Ltd that they propose to seal the additional distance of the quarry access road to the access/egress perimeter of the plant, sales loading hardstand area and to install a truck wheel wash in a location immediately after loaded sales delivery road trucks depart the hardstand area to the weighbridge.

This will substantially reduce the potential for hardstand area mud and fine crushed rock residual materials to be carried from the quarry access road onto McMahons Road. Fine crusher dust, mud and/or quarry related materials deposited on McMahons Road by road trucks exiting the quarry, has been a real source of nuisance dust with amenity impacts that justify the implementation of these additional controls.

We understand that no formal complaints have been lodged with authorities in relation to dust emissions from YVQ's operations. The potential for dust emissions to affect nearby residents to the west and southwest of the quarry has been substantially reduced by the closure and successful revegetation of the former elevated overburden stockpile (located immediately to the east of the quarry access road).

3. OUTLINE OF PROPOSAL

The proposed extension of the WA375 extraction area and staged extraction program is detailed in the BCA Consulting – Earth Resources, Work Plan Description that along with other plans and technical reports form the WPV application. The existing quarry operations and the expanded extraction area in Lot 50C are shown in Figure 1.

Aspects of the proposal which are relevant to this dust assessment are summarised below:

- the existing annual production rate of approximately 300,000 tpa will increase moderately, but is not anticipated to increase significantly, so that a higher level of assessment is not required by the provisions of EPA Publication 1961[1];

- the extraction area will progressively move in a north-westerly direction from its current location (taking it further away from the nearest sensitive receptors);

- the existing crushing/screening plant, pugmill, sales loading and product stockpile areas will be retained and remain in their current locations;

- overburden will continue to be placed in the existing quarry pit (towards its eastern and south-eastern faces where the potential for wind erosion is very low);

[1] EPAV (February 2022). Guideline for assessing and minimising air pollution in Victoria. EPA Publication 1961.

- the existing "industry best practice" dust control program will continue to be implemented, while recent amendments to YVQ's dust management plan (**DMP**) – outlined in Section 11 of this report (and provided as Appendix 3) – includes the following additional measures:
    - on-going continuous monitoring of PM_{10} and $PM_{2.5}$ concentrations (with "alarm" text messages to be sent to the Quarry Manager in the event that elevated 1-hour averaged particulate concentrations detected by the FDS17 exceed a defined "trigger level" – enabling modification or suspension of operations contributing to elevated dust emissions to be implemented without delay).
    - The modelling detailed in Appendix 5 predicts that respirable crystalline silica (**RCS**) concentrations will be well below EPAV's criterion at the nearest sensitive receptor. RCS will be monitored initially each month by co-locating a $PM_{2.5}$ mid-volume sampler beside the FDS17 monitor for 7-day periods and analysing the material collected on the filter for crystalline silica. It is anticipated that monitoring for twelve months will be sufficient to confirm that RCS is not an issue of concern at sensitive receptors..
    - A Weathercast® report will be prepared specifically for YVQ each week by Australian Weatherwatch Meteorological Consultants (refer to Appendix 1 for an example). Each Weathercast® report defines, using a colour-coded tabular format, the predicted need for "contingency measures" to reduce the risk of elevated dust emissions affecting nearby sensitive receptors, based on three weather elements (wind speed, wind direction and dryness index) for each of the next seven days. These contingency measures may include, where appropriate, the proactive (precautionary) application of water to trafficked areas and/or the suspension of potentially dusty operations in advance of extreme weather conditions.
    - An automatic Weather Station (**AWS**) will be installed in an elevated position within the processing plant area, with a display in the Quarry Manager's office. The real-time wind data will assist in deciding on the need for short-term modifications to operations and/or dust control measures, particularly in the event of strong NE winds, which put the nearest dwellings (sensitive receptors) downwind from the quarry operations and potentially at risk of exposure to fugitive dust emissions.
    - A truck wheel wash will be installed near the workshop to remove sediment from the wheels of trucks exiting the sales loading area.

4. POTENTIAL DUST SOURCES

The main dust sources associated with the current and proposed future operations include: (1) the movement of haul trucks and loaders on haul roads and within operational areas; (2) crushing, screening and product stockpiling operations; (3) topsoil stripping and overburden removal; and (4) suspension of dust from bare, erodible surfaces by strong winds. Blasting generates short-term dust emissions and a visible plume (typically lasting for less than ten minutes); however, as blasting only occurs about once a month, it does not make a significant contribution to off-site

dustfall rates or suspended particulate concentrations (EPAV's assessment criteria for airborne particles are based on averaging periods ranging from 24 hours to 12 months).

Emissions from these sources will continue to be minimised by application of the dust management measures outlined above. The proposal can be expected to result in an overall reduction in dust emissions, because: (1) overburden will be placed in a sheltered environment within the existing quarry pit, rather than in the more exposed above-ground location used in the past; and (2) implementation of the additional dust control measures described in the amended DMP (and outlined in the previous section).

5. EPA SEPARATION DISTANCE GUIDELINES

EPA Publication 1518 defines separation distance guidelines for a wide range of operations which have the potential to impact on local amenity through emissions to atmosphere[2]. The publication lists a recommended separation distance of 500 m for "quarrying of hard rock with blasting", and notes that this distance is to be measured between the [main] potential emission source(s) and sensitive land uses.

These guidelines are not mandatory as Publication 1518 provides for them to be varied, where appropriate, to account for factors such as the nature and scale of the operation, the standard of environmental management, local topography, meteorology and vegetation, and complaint history (in the case of existing operations).

6. EPAV's PARTICULATE CRITERIA AND GUIDELINES

This section reviews EPA Victoria's (**EPAV's**) Air Pollution Assessment Criteria and guidelines, which are relevant to the existing and proposed quarry operations and apply at nearby sensitive uses (typically dwellings).

Table 1. EPAV Air Pollution Assessment Criteria (APACs)

Indicator	Includes background	Averaging period	Criterion, µg/m^3
PM_{10}	Yes	24 hours	50
		annual	20
$PM_{2.5}$	Yes	24 hours	25
		annual	8
RCS (as $PM_{2.5}$)	Yes	annual	3

The APACs do not include a dust deposition criterion; however, EPAV acknowledges that an "insoluble solids" deposition rate of 4 g/m^2.month (no more than 2 g/m^2.month above background) represents a useful guideline for assessing whether dustfall is likely to have an effect on local amenity.

[2] EPA (March 2013). "Recommended separation distances for industrial residual air emissions" Publication No. AQ 1518.

In addition, the General Environmental Duty (**GED**) is set out in Part 3.2 of the Environment Protection Act 2017. The GED requires that a person who is engaging in an activity that may give rise to risk of human health or the environment from pollution or waste must minimise those risks , so far as reasonably practicable.

7. EXPERIENCE WITH SIMILAR OPERATIONS

Our experience in dust investigations at numerous quarries and mines over the past 40 years indicates that, while there is a widely held community perception that such sites are major dust sources, this is generally not the case for well-managed operations. Many of these investigations have been undertaken at sites where the operations are significantly larger than at YVQ.

Experience has shown that one of the most important factors which determines the extent of off-site dust emissions from a particular operation is the calibre of the site management, and their level of commitment to conduct an environmentally sound operation and protect the amenity of nearby residents. A good site manager will make use of weather forecasts and implements additional proactive dust control measures in advance of potentially adverse weather conditions.

Such measures include proactively increasing water application rates in advance of hot windy conditions and deferring or curtailing some site operations during extreme weather conditions. Good managers also seek to establish good relations with neighbours and have effective systems in place to record and respond to any complaints (including modifying operations where appropriate to minimise dust emissions).

This approach invariably results in substantially lower off-site dust levels as compared with operations where a low priority has been placed on protecting local amenity during design, development or operational stages to the overall satisfaction of nearby residents.

Our contacts with YVQ personnel suggest that they are conscious of the potential for dust emissions to impact on nearby residents and have been implementing proactive measures to minimise dust emissions.

We understand that most of the small, nearby community comprising approximately ten residential properties to the south-west of the quarry (in McMahons and Ure Creek roads) are long-term owner/occupiers who have well established relations with the quarry. The relationship fosters first-hand communications and feedback which is valued, invariably justified and acted on by quarry management.

8. DUST DEPOSITION MONITORING

Dust deposition (dustfall) has been monitored by YVQ, in a cleared area of the Dandy Premix Quarries' owned 2 ha property at 195 McMahons Road, which is approximately 200 m to the WSW of the processing plan, for a number of years up until November 2023,

Table 2. Results of Dust Deposition Monitoring

Year	Month	Sampling Period	Rainfall mm	Insoluble Solids g/m2.month	Ash g/m2.month
2021	**Dec**	01/12/21 - 19/01/22	69	1.1	0.7
	Nov	03/11/21 - 01/12/21	106	2.0	0.9
	Oct	05/10/21 - 03/11/21	119	7.9	5.3
	Sep	09/09/21 - 05/10/21	130	5.3	2.9
	Aug	11/08/21 - 09/09/21	77	1.3	0.8
	Jul	30/06/21 - 11/08/21	82	2.3	1.8
2022	**Jan**	19/01/22 - 03/02/22	83	0.8	0.6
	Feb	02/02/22 - 03/03/22	6	0.7	0.4
	Mar	03/03/22 - 04/04/22	68	1.2	0.8
	Apr	04/04/22 - 03/05/22	101	0.9	0.5
	May	03/05/22 - 02/06/22	65	0.9	0.3
	Jun	02/06/22 - 04/07/22	130	3.1	2.1
	Jul	04/07/22 - 03/08/22	62	1.9	1.3
	Aug	03/08/22 - 02/09/22	130	4.2	1.5
	Sep	02/09/22 - 02/10/22	70	3.5	1.0
	Oct	02/10/22 - 02/11/22	130	5.5	4.8
	Nov	02/11/22 - 02/12/22	130	1.8	0.8
	Dec	02/12/22 - 03/01/23	105	2.4	1.6
2023	**Jan**	03/01/23 - 03/02/23	35	0.6	0.4
	Feb	03/02/23 - 06/03/23	41	0.8	0.5
	Mar	07/03/23 - 06/04/23	89	0.3	0.1
	Apr	06/04/23 - 03/05/23	124	2.0	0.5
	May	03/05/23 - 05/06/23	123	1.0	0.5
	Jun	05/06/23 - 04/07/23	109	0.5	0.3
	Jul	04/07/23 - 04/08/23	53	0.2	0.1
	Aug	04/08/23 - 06/09/23	94	2.4	0.9
	Sep	06/09/23 - 03/10/23	35	1.8	0.6
	Oct	03/10/23 - 08/11/23	130	2.4	1.1
	Nov	08/11/23 - 05/12/23	70	1.1	0.8

The results for the final 29 months of the dust deposition monitoring program are presented in Table 2. They indicate that dustfall rates have typically been very low at the monitoring location, which is closer to the quarry's operational areas than the nearest sensitive receptor at 165 McMahons Road (approximately 300m from the processing plant). The findings of the dust deposition monitoring during this period are summarised below:

- Only three of the 29 "insoluble solids" values exceeded the 4 g/m^2.month guideline;
- Only two of the 29 "ash" values exceeded 4 g/m^2.month (the ash values provide an indication of the contribution of particulates derived from rock to dust deposition rates);
- 86% of the ash values were less than 2.0 g/m^2.month; and
- 66% of the ash values were less than 1.0 g/m^2.month.

9. PM_{10} and $PM_{2.5}$ MONITORING

This section summarises the results of continuous PM_{10} and $PM_{2.5}$ monitoring which has been conducted by the FDS17 continuous ambient air monitor (refer to Appendix 4) installed about 200m to the from the YVQ processing plant, close to where the dust deposition gauge was located (in the vicinity of the nearest sensitive receptor). A multi-function automatic meteorological instrument is co-located with the FDS17 monitor – it has an ultrasonic wind speed and direction sensor, and also records air temperature, relative humidity and barometric pressure.

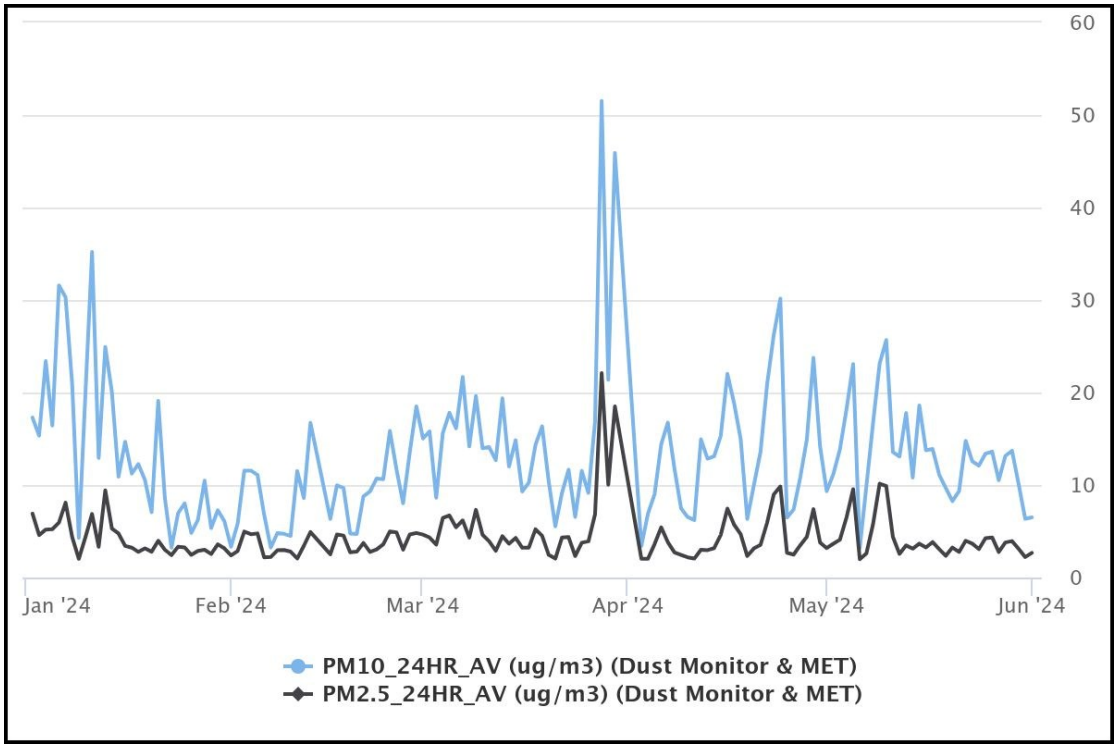

Figure 5. 24-hour PM_{10} and $PM_{2.5}$ concentrations

Figure 5 shows the 24-hour averaged PM_{10} and $PM_{2.5}$ concentrations recorded by the FDS17 monitor during the period from 1 January to 1 June 2024. The vast majority of the PM_{10} and $PM_{2.5}$ values were well below their respective APACs (50 and 25 µg/m^3).

Only one APAC exceedance was recorded - a 24-hour PM_{10} concentration of 51.5 µg/m^3 on Wednesday 27 March 2024. An analysis of the 1-hour PM_{10} values and corresponding wind data from the meteorological instrument indicated that the 24-hour

value was dominated by elevated 1-hour concentrations between midnight and 7 am on that day, when the wind speed was typically less than 1 m/s and the wind direction typically from the S and SW.

A similar analysis of the 24-hour PM_{10} concentration of 45.9 µg/m^3 on Friday 29 March indicated that it was dominated by elevated 1-hour concentrations between 9:30 and 10:30 am on that day, when the wind speed was typically less than 1 m/s and the wind direction generally from the S and SE.

Neither the (minor) APAC exceedance on 27 March nor the 24-hour 45.9 µg/m^3 concentration on 29 March are likely to be attributable to emissions from the quarry, because the elevated values which contributed to these 24-hour "peaks" were recorded when the main quarry dust sources were not upwind from the monitor (and on 27 March, peaked well before quarry operations commenced).

The following average particulate concentrations were recorded by the FDS17 instrument for the period between 1 January and 18 June 2024 (these provide a conservative indication of the annual average concentrations for the current scenario, given that this period includes the dustiest months in typical years):

- PM_{10} – 13.01 µg/m^3; and
- $PM_{2.5}$ - 4.34 µg/m^3.

These concentrations are well below the APAC PM_{10} and $PM_{2.5}$ criteria of 20 µg/m^3 and 8 µg/m^3, respectively and, as detailed in Section 12 below, are predominantly attributable to background (non-quarry) sources).

10. CRYSTALLINE SILICA CONTENT OF $PM_{2.5}$ QUARRY DUST

On 13 September 2023, ESA collected a sample of dust which had accumulated on the lower horizontal beam below YVQ's 18 mm screen (Figure 5) and delivered it to the Ektimo laboratory in Mitcham.

As detailed in Appendix 2, Ektimo determined the crystalline silica content of a $PM_{2.5}$ sub-sample of the dust sample as outlined below:

- The dust sample was fluidised (made buoyant in air) inside a temporary enclosure;
- A low volume sampler was used to collect duplicate $PM_{2.5}$ sub-samples from within the enclosure on 47 mm diameter pre-weighed filters;
- The $PM_{2.5}$ samples were weighted and analysed for crystalline silica by Envirolab Services (WA); and
- Ektimo calculated that the average percentage (w/w) of crystalline silica in the $PM_{2.5}$ particulates on the filters was 38%.

Figure 5. The dust sample was collected from the lower, horizontal beam on the 18 mm screen's support structure

11. DUST MANAGEMENT MEASURES

Yarra Valley Quarries **(YVQ)** is committed to ensuring that dust management measures on the site achieve ongoing compliance with all relevant requirements. This section summarises dust management measures which are described in YVQ's Dust Management Plan, which is provided as Appendix 3.

- The dust management objectives compliance/acceptance criteria include:
  - Minimise dust impacts on all sensitive land uses and environments;
  - Applying dust controls at source, to the extent practicable; and
  - Protecting the environmental values of the air in accordance with EPAV's Environmental Reference Standards.

- Relevant compliance criteria and requirements include:
  - The APAC criteria for PM_{10}, $PM_{2.5}$ and RCS;
  - EPAV's dust deposition guidelines; and
  - The Environment Protection Act's General Environmental Duty.

- Acceptance criteria include:
  - Compliance with the APACs;
  - No nuisance dust complaints;
  - Minimising dust emissions, as far as reasonably practicable, in accordance with the GED; and
  - No complaints from local road users.

Essentially all of the measures listed in Section 2, which are broadly consistent with "best practice" dust management at extractive industry operations, are currently being applied. However, YVQ also proposes to install a truck wheel wash and seal a currently unsealed section of the site access road. These additional measures will significantly reduce the potential for dust emissions from the site access road and from sediment tracked onto public roads.

The particulate and meteorological monitoring program described in the DMP will facilitate an adaptive management approach to minimise the impacts of dust generated on the site, as well as assessing compliance with EPAV criteria. The monitoring program is outlined below.

- A Dr Fodisch FDS17 continuous PM_{10} and $PM_{2.5}$ ambient dust monitor and associated meteorological instrument (with wind speed and direction, temperature, barometric pressure and relative humidity sensors) have been installed approximately 200m south-west of the quarry processing plant on YVQ owned land at 195 McMahons Road. The particulate concentrations, along with wind speed and directions, are recorded and stored in a database which can be remotely accessed.

- The alarm function within the FDS17 monitor's (Livesense®) software will send text messages to the Quarry Manager/Supervisor in the event that a "trigger level" is exceeded. Initially, this will be set at a 1-hour averaged PM_{10} concentration of 100 $\mu g/m^3$.

- A supplementary automatic weather station (**AWS**), will be located in an exposed position in the plant processing area to provide a continuous real-time display of wind speed and direction in the Quarry Manager/Supervisor's office.

- Respirable crystalline silica (**RCS**) concentrations will initially be monitored on a monthly basis beside the FDS17 monitor for 7-day periods. It is anticipated that monitoring RCS for twelve months will be sufficient to confirm that RCS is not an issue of concern at nearby sensitive receptors, as predicted by the modelling discussed in the following section.

- When a full year's records are available from the FDS17 instrument, the PM_{10} and $PM_{2.5}$ monitoring data will be compared with the model predictions for the existing scenario to validate the findings outlined in the following section.

Implementation of the dust controls listed in Section 2 will minimise the potential for particulate emissions from the quarry under most weather conditions. However, the risk of dust from YVQ impacting on nearby sensitive receptors will be further reduced by application of the following measures to allow prompt responses upon being alerted to adverse conditions.

- The Weathercast® forecasts;
- The continuous real-time display in the Quarry Manager/Supervisor's office (connected to the AWS in the processing plant area); and
- Text Message alarms based on PM_{10} concentrations recorded by the FDS17 ambient dust monitor.

Additional adaptive measures, which will be implemented to further minimise the risk of elevated dust emissions impacting on nearby sensitive land uses and the environment during periods of adverse weather (typically hot NE winds) will include:

- Additional application of water) on exposed areas, roads, hardstand areas and stockpiles;
- Reducing on-site vehicle use and speeds;
- Ensuring that the distance between conveyor discharge and the top of stockpiles is minimised;
- Suspending potentially dusty operations, including topsoil stripping, earthmoving in exposed locations and blast hole drilling as required to minimise dust generation; and
- Enhanced visual monitoring by all staff for dust leaving the site and notifying the Quarry manager/Supervisor promptly to initiate remedial action.

The YVQ Quarry Manager/Supervisor will be responsible for monitoring all areas and operations of the site that have the potential to generate dust and ensuring appropriate dust control measures are being implemented promptly as required to minimise dust generation and comply with EPAV's GED requirements.

The YVQ Quarry Manager/Supervisor will ensure that all new site personnel are required to familiarise themselves with relevant sections of the DMP during the site induction process and that a copy of the DMP is available in a location which is readily accessible by all site personnel.

The YVQ DMP will be reviewed annually (or earlier if required) and updated as appropriate to ensure that the dust management measures continue to comply with all relevant air quality objectives and compliance/acceptance criteria.

12. PREDICTIVE MODELLING OF PARTICULATES

Dandy Premix Quarries Pty Ltd engaged Dr Graeme Ross of Consulting Air pollution Modelling and Meteorology (**CAMM**) to undertake an air quality modelling assessment of the proposed WA375 WPV, which has been developed for YVQ by Bell Cochrane and Associates (**BCA**) in conjunction with Dandy Premix Quarries. CAMM's modelling report is provided as Appendix 5 and is summarised below.

12.1 Nature of assessment

As the WPV relates to a medium sized quarry in a rural area with the closest sensitive receptor within 500m, EPA Publication 1961[3] specifies that a Level 2 assessment is appropriate. The modelling assessment predicted the ground level concentrations of PM_{10} and $PM_{2.5}$ particulates (and respirable crystalline silica as $PM_{2.5}$ [**RCS]**) for the following three scenarios:

- **Existing WA375 scenario** – representative of 2023/24 WA375 conditions;
- **Stage 1 Year 1-3 WA375 expanded extraction area scenario** - representative of operations during years 1-3 in Stage 1 of the proposed quarry extension; and

[3] EPAV (February 2022). Guideline for assessing and minimising air pollution in Victoria. Publication 1961.

- **Stage 1 Year 7-10 scenario** - representative of operations during years 7-10 in Stage 1 of the proposed quarry extension - this scenario was assessed as being the "worst case" scenario for air quality at the nearest sensitive receptor (a dwelling located at 165 McMahons Road and referred to in CAMM's report as receptor DR165).

12.2 Modelling approach

- The currently approved EPAV regulatory air dispersion model, AERMOD was used and configured following the requirements of EPAV's Publication 1551[4];
- Meteorological data files were prepared specifically for the YVQ site for years 2017-2021, using CSIRO's prognostic model TAPM and compiled in accordance with EPAV's draft Publication 1550[5];
- Section 4.1.1 of the CAMM report notes that the highest 24-hour PM_{10} concentration attributable to YVQ's operations is predicted to occur at the nearest sensitive receptor when the 2017 meteorological file is used; therefore, the AERMOD assessment focuses on the 2017 meteorological year, albeit it that corresponding predictions based on the other four years of meteorology are also provided as appropriate;
- Emission inventories were prepared for each scenario based on: (1) detailed information on the nature and locations of typical activities which generate mechanically-induced particulate emissions and published emission factors (eg. USEPA AP-42 and National Pollutant Inventory); (2) particulate emission rates attributable to wind-erosion from exposed areas, based on wind speed categories; and (3) reductions in emission rates achieved by the application of dust control measures specified by the Dust Management Plan (Appendix 3);
- The background PM_{10} and $PM_{2.5}$ concentrations adopted by CAMM are based on data from EPAV's Traralgon air monitoring station (**AMS**), which represents a conservative approach, recognising the presence of major sources of particulate emissions in the Latrobe Valley. EPAV's recommended approach for PM_{10} and $PM_{2.5}$ assessments is to base background concentrations on a time-series of the observed 1-hour average values;
- Section 5.1 of the CAMM report reviewed data for the Traralgon AMS for Years 2017-2021 and identified:
    - A number of exceedences of EPA's 24-hour PM_{10} and $PM_{2.5}$ criteria, which were variously attributable to bushfires, planned burns, wood smoke from domestic solid fuel heaters and continental-scale dust storms;
    - A marginal exceedance of the annual PM_{10} criterion in Year 2020;
    - The annual $PM_{2.5}$ criterion was exceeded in three of the four years; and
- The CAMM assessment adopted the following representative annual background concentrations, based on the Traralgon AMS data:
    - PM_{10} – 14.15 µg/m^3; and
    - and PM_2 – 7.1 µg/m^3.

[4] EPAV (October 2013). Guidance notes for using the Regulatory Air Model AERMOD in Victoria. Publication 1551.

[5] EPAV (October 2013). Construction of input meteorological files for EPA Victoria's regulatory air pollution model (AERMOD). Publication 1550.

12.3 PM_{10} for existing scenario – WA375

The predicted PM_{10} concentrations at receptor DR165 for the existing scenario (based on EPAV's recommended approach, the 2017 meteorological file and including background PM_{10}) are summarised below:

- The highest predicted 24-hour concentration is 38.4 $\mu g/m^3$, which includes a 9.8 $\mu g/m^3$ increment attributable to YVQ's operations;
- The predicted annual concentration is 14.82 $\mu g/m^3$, which includes a 0.67 $\mu g/m^3$ increment attributable to YVQ's operations; and
- There are no exceedences the 24-hour criterion of 50 $\mu g/m^3$ or the annual criterion of 20 $\mu g/m^3$.

12.4 $PM_{2.5}$ for existing scenario – WA375

The predicted $PM_{2.5}$ concentrations at receptor DR165 for the existing scenario (based on EPAV's recommended approach, the 2017 meteorological file and including background $PM_{2.5}$) are summarised below:

- There is no increase in the number of exceedances of the 24-hour criterion of 25 $\mu g/m^3$ which can be attributed to emissions from YVQ's operations (the highest of which is 0.98 $\mu g/m^3$);
- The five exceedences are attributable to the adopted background values (four resulting from smoke caused by planned burns and the other from domestic wood heaters); and
- The predicted annual concentration is 7.166 $\mu g/m^3$ which includes a 0.066 $\mu g/m^3$ increment attributable to YVQ's operations and is below the annual criterion of 8 $\mu g/m^3$.

12.5 PM_{10} for Stage 1 Years 7-10[6] - WA375 expanded extraction area

The predicted PM_{10} concentrations at receptor DR165 for Stage 1 years 7-10 (based on EPAV's recommended approach, the 2017 meteorological file and including background PM_{10}) are summarised below:

- The highest predicted 24-hour concentration attributable to YVQ's operations is 9.6 $\mu g/m^3$;
- There is no increase in exceedances of the 24-hour criterion of 50 $\mu g/m^3$ attributable to emissions from YVQ's operations;
- The predicted annual concentration attributable to YVQ's operations is 0.71 $\mu g/m^3$; and
- There is no exceedance of the annual criterion of 20 $\mu g/m^3$.

12.6 $PM_{2.5}$ for Stage 1 Years 7-10 – WA375 expanded extraction area

The predicted $PM_{2.5}$ concentrations at receptor DR165 for Stage 1 years 7-10 (based on EPAV's recommended approach, the 2017 meteorological file and including background $PM_{2.5}$) are summarised below:

- The highest predicted 24-hour concentration attributable to YVQ's operations is 1.05 $\mu g/m^3$;
- There is no increase in exceedances of the 24-hour criterion of 25 $\mu g/m^3$ attributable to emissions from YVQ's operations;
- The predicted annual concentration attributable to YVQ's operations is 0.097 $\mu g/m^3$; and

[6] Stage 1 Years 7-10 represents the "worst case" scenario for particulates at receptor DR165.

- There are no exceedances of the annual criterion of 8 µg/m^3.

12.7 RCS for Stage 1 Years 7-10 – WA375 expanded extraction area

This section summarises Section 7.2 of the CAMM report, which reviews available information on background concentrations of RCS (as $PM_{2.5}$) and derives a conservative estimate of the cumulative annual RCS concentration at DR165.

- The results of the literature review suggest a value of around 0.3 µg/m^3 as a conservative RCS background concentration for rural locations with little anthropogenic activity;
- CAMM then adopted a more conservative background concentration of 1.7 µg/m^3, together with an "implausibly conservative" assumption that RCS comprises 100% of $PM_{2.5}$ particulates generated by YVQ's operations, which resulted in the following RCS estimates:
    - A very conservative annual RCS increment of 0.097 µg/m^3 attributable to YVQ's operations (equal to the predicted annual $PM_{2.5}$ concentration); and
    - A cumulative annual RCS estimate of 1.797 µg/m^3 which is 60% of the RCS (as $PM_{2.5}$) criterion of 3 µg/m^3; and
- We note that an even more conservative estimate is justified on the basis of the discussion in Section 9 (above) which found that crystalline silica comprises 38% (w/w) of $PM_{2.5}$ particulates derived from YVQ's processing operations - on this basis, the RCS contribution at DR165 from YVQ's operations during Stage 1 years 7-10 years would be only 0.037 µg/m^3 (1.2% of the RCS criterion).

12.8 Comparison with available monitoring data

When a full year's records are available from the FDS17 instrument, it will be appropriate to compare the model predictions for the existing scenario with the monitoring data. In the meantime, a preliminary analysis of the monitoring data and model predictions at (nearby) DR165, for the period between 1 January and 10 June 2024, suggests that the predictions are conservative (particularly in the case of $PM_{2.5}$) recognising that this period includes the dustiest months in typical years.

	Annual-average model prediction*, µg/m^3	Average monitoring data (1 Jan to 10 June), µg/m^3
PM_{10}	14.82	13.01
$PM_{2.5}$	7.17	4.34

* cumulative predictions for the existing scenario

13. CONCLUSIONS

Our main conclusions are summarised below:

1. Particulate emissions from YVQ's existing operations have not resulted in any formal complaints, which is consistent with the results of dust deposition monitoring, which indicates that dustfall rates have typically been very low in the vicinity of the nearest dwellings.
2. Continuous monitoring using a FDS17 instrument indicates that vast majority of the PM_{10} and $PM_{2.5}$ concentrations were well below their respective EPAV criteria, while the meteorological data confirms that the only exceedance (of PM_{10}) could not have been attributable to YVQ's site or operations.
3. The existing dust control measures are, at least, consistent with "best practice" controls in the extractive industry.
4. The Work Plan variation envisages only a small increase in the existing annual production rate, that the extraction area will move further away from the nearest sensitive receptors, and the existing processing plant will be retained in its current location.
5. The proposed truck wheel wash will significantly reduce both the potential for dust generation on the (sealed) site access road and the deposition of sediment on public roads.
6. Adaptive dust management at YVQ will be enhanced by the proposed reference to the weekly Weatherwatch® reports, the alarm function based on the FDS17 monitor and the automatic weather station with a display in the Quarry Manager/Supervisor's office.
7. The results of predictive particulate modelling are broadly consistent with the results to date from the FDS17 continuous monitor.
8. Modelling for the proposed "worst case" (Stage 1 Years 7-10) indicate that the (conservative) predicted cumulative PM_{10}, $PM_{2.5}$ and RCS concentrations will be compliant with EPAV's respective criteria and that the contributions from background sources will predominate in all cases.
9. Implementation of the dust controls and additional adaptive measures described in the DMP will ensure that the proposed variation to the quarry operation can be undertaken while minimising the risk of harm from dust emissions to human health and the environment, as far as reasonably practicable.

(Dr) Terry Bellair FVEPLA, FEIANZ

June 2024

APPENDIX 1. EXAMPLE OF WEATHERCAST® REPORT

(prepared for Dandy Premix's Grantville sand quarry)

AUSTRALIAN WEATHERWATCH

Meteorological Consultants

EST: 1982

ABN: 58 169 694 588

Office: 6 Gunsynd Court Bacchus Marsh Victoria 3340

WEATHERCAST® FOR Grantville, VICTORIA

Date of Issue:
17 September 2023

Mission Critical Problem:

Dust Management Plan requires additional control measures when there is higher potential for windblown dust causing off-site amenity impact due to:

- A high wind speed (>5 m/s will lift some dust particles and above 30 km/h for a sand quarry)
- Wind direction (from the east)
- Drying unconsolidated surfaces (a lack of recent rain and above average evaporation rate).

Colour coding of weather elements contributing to adverse conditions:

- Green – None or limited
- Amber – Marginal or transitional (will require daily review onsite)
- Red – Higher risk

Forecast Date		Wind Speed	Wind Direction	Dryness Index	DMP Contingency Measures
Monday	18-Sep-23				N
Tuesday	19-Sep-23				N
Wednesday	20-Sep-23				N
Thursday	21-Sep-23				N
Friday	22-Sep-23				N
Saturday	23-Sep-23				Y
Sunday	24-Sep-23				R

Contingency Measures: Y=Yes R=Review N=No

Forecasting notes:

- ✓ Any day with three green requires no additional management measures.
- ✓ Any day with three red requires additional management measures
- ✓ Any day with a single red will require a revaluation of potential for just one element to outweigh the reduced risk from other elements (for example, an east wind with low wind speed is low risk OR an east wind with rain (green dryness index) is low risk).

Weekly Note:

A blast from the west early part of the week – and showers sweeping trogh at times. It then calms down by the end of the week. Drying out significantly by Saturday – just in time for some easterlies to develop – potentially with enough speed to be of 'interest'. Still dry Sunday but wind most likely getting more north than east – but need to keep an eye on.

APPENDIX 2. CRYSTALLINE SILICA CONTENT OF $PM_{2.5}$ QUARRY DUST

Ektimo

Dandy Premix Quarries Pty Ltd, Dandenong South

PM2.5 and % Respirabe Cristalline Silica Pilot Project

Report R015663

ektimo.com.au

Ektimo

Document Information

Client Name:	Dandy Premix Quarries Pty Ltd
Report Number:	R015663
Date of Issue:	17 November 2023
Attention:	Garry Cranny
Address:	PO Box 4112 Dandenong South VIC 3164
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Daniel Balaam
Senior Laboratory Chemist

1 Executive Summary

1.1 Background

Ektimo was engaged by Dandy Premix to assist in determining an appropriate method for estimating the % of respirable crystalline silica (RCS) in the dust (particulate matter) that is generated at the crushing/screening area at the Yarra Valley Quarries site of Dandy Premix Quarries Pty Ltd.

In consultation with Dandy Premix and Terry Bellair (from Environmental Science Associates) it was agreed that we should estimate % RCS of particulate matter <2.5 μm in aerodynamic diameter ($PM_{2.5}$).

2 Procedure, Results and Concluding Comments

Ektimo were delivered a bulk dust sample, collected from the site, by Terry Bellair (from Environmental Science Associates).

This bulk dust sample was fluidised (made buouyant in air) inside a temporary enclosure (designed by Ektimo). A $PM_{2.5}$ air sampler was then to take an air sample from inside the temporary enclosure and to isolate the respirable fraction of the dust (ie particulate matter <2.5 μm in aerodynamic diameter).

The $PM_{2.5}$ dust sample was collected using a Comde Derenda (Model LVS 3.1) low volume sampling kit which has fitted with a $PM_{2.5}$ size selective inlet and 47mm filter holder.

The $PM_{2.5}$ sampler was used to collect 2 x respirable particulate matter samples onto 2 x pre-weighed 47mm filters. These 2 samples were the sent for analysis of % respirable crystalline silica (RCS) in the total $PM_{2.5}$ sample.

The results below detail the % (w/w) of the 2 types of Crystalline silica, α-Quartz and Cristobalite as a fraction of the total $PM_{2.5}$ dust collected. Analysis performed under subcontract by Envirolab Services (WA) Pty Ltd.

	Units	PQL	Sample A (V47428)		Sample B (V47429)	
			Weight (mg)	% of $PM_{2.5}$	Weight (mg)	% of $PM_{2.5}$
$PM_{2.5}$	*mg*	*0.005*	1.3	-	2.1	-
α-Quartz	*mg*	*0.005*	0.58	43%	0.70	33%
Cristobalite	*mg*	*0.01*	0.012	0.90%	0.011	0.52%

3 Quality Assurance/Quality Control Information

A formal Quality Control program is in place at Ektimo to monitor analyses performed in the laboratory and sampling conducted in the field. The program is designed to check where appropriate, the sampling reproducibility, analytical method, accuracy, precision, and the performance of the analyst. The Laboratory Manager is responsible for the administration and maintenance of this program.

4 Analysis Methods

Parameter	Analysis method
Particulate matter††	AS 4323.2
Crystalline silica‡	Envirolab in-house methods DUST-004 & DUST-005

220823

†† Gravimetric analysis conducted at the Ektimo VIC laboratory

‡ Analysis performed by Envirolab, NATA accreditation number 2901.

Results were reported to Ektimo on 16 November 2023 in report PEJ1334

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AUSTRALIA

APPENDIX 3. YVQ DUST MANAGEMENT PLAN (DMP) 2024

1. OBJECTIVES AND COMPLIANCE/ACCEPTANCE CRITERIA

Yarra Valley Quarries **(YVQ)** is committed to ensuring that dust management measures on the site achieve ongoing compliance with all relevant requirements. The current objectives, relevant compliance criteria and requirements and acceptance criteria are set out below.

Objectives:

- Manage and minimise offsite dust impacts on all sensitive land uses and environments;
- Apply dust controls at the source to, the extent practicable; and
- Minimise impacts on local amenity and the environment and protect the environmental values of the air as defined in the Environment Reference Standards (ERS)[7].

Relevant compliance criteria and requirements:

- EPA Victoria's (**EPAV's**) Air Pollution Assessment Criteria (**APAC**)[8], which apply at nearby sensitive uses, are set out in the following table.

Indicator	Includes background	Averaging period	Criterion, µg/m^3
PM_{10}	Yes	24 hours	50
		annual	20
$PM_{2.5}$	Yes	24 hours	25
		annual	8
RCS (as $PM_{2.5}$)	Yes	annual	3

- The APACs do not include a dust deposition criterion; however, an "insoluble solids" deposition rate of 4 g/m^2.month (no more than 2 g/m^2.month above background) represents a useful guideline for assessing whether nuisance dust is likely to impact on local amenity.
- The General Environmental Duty (**GED**) defined in Part 3.2 of the Environment Protection Act 2017 requires that a person who is engaging in an activity that may give rise to risk of human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable.

Acceptance criteria:

- Compliance with the APACs;
- No nuisance dust complaints;
- Management of dust emissions to minimise risks to sensitive receptors, as far as reasonably practicable, in accordance with the GED; and
- No complaints from local road users regarding road conditions.

[7] EPA Victoria (June 2021). Guide to the environment reference standard. EPA Publication 1992.
[8] EPA Victoria (February 2022). Guideline for assessing and minimising air pollution in Victoria. EPA Publication 1961.

2. CONTROL MEASURES TO ADDRESS DUST-RELATED RISKS

Control measures will be implemented to minimise risks associated with dust emissions from YVQ's operations as far as reasonably practicable and are summarised below:

- Minimising the extent of potentially erodible areas;
- Topsoil stripping operations will be suspended if dust drifts towards nearby sensitive receptors (within 500m);
- Water will be applied by water-carts/sprinklers, as required, onto exposed areas, eg. haul roads, the site access road, hardstand areas and stockpiles;
- Water sprays will be operated at critical locations on processing plant and hardstand areas;
- Water/mist/fog dust-suppression sprays will be operated at conveyor transfer points;
- The distance between conveyor discharge points and the top of stockpiles will be minimised;
- Excavated material will be wetted, as required, during hot, dry windy conditions;
- Vehicle movements will be restricted to designated areas and haul roads, with speeds limited as required to minimise dust;
- The unsealed section of the site access road near the hardstand area will be sealed and a truck wheel wash installed;
- Drill rigs will be fitted with engineered dust extraction/suppression systems as appropriate;
- Potentially dusty operations, including blast hole drilling, will be suspended during hot, dry, windy condition as required to minimise dust generation;
- Vehicles transporting dusty materials will be covered, or the loads wetted, to minimise dust generation;
- Topsoil and overburden stockpiles (which are to be retained for more than 12 months) and rehabilitated landforms will be progressively contoured and vegetated;
- Grasses will be established and maintained on progressively rehabilitated landforms as soon as practicable, to minimise dust generation;
- Equipment will be maintained in accordance with manufacturers' specifications;
- All staff will continuously monitor (visually) any dust leaving the site and notify the Quarry manager/Supervisor promptly so remedial action can be initiated;
- An air quality monitoring program will be established for nuisance dust, PM_{10} and $PM_{2.5}$, along with wind speed and direction; and
- The deposition of mud and fine material onto the site access road and public roads by departing sales trucks will be minimised by requiring them to use the wheel wash, clean loose dust/sediment

from truck side rails, tailgates and draw bars (such material can be a significant dust source during dry weather).

3. PARTICULATE AND METEOROLOGICAL MONITORING

The particulate and meteorological monitoring program will facilitate an adaptive management approach to minimising the impacts of dust generated on the site as well as assessing compliance with EPAV criteria.

A Dr Fodisch FDS17 continuous PM_{10} and $PM_{2.5}$ ambient dust monitor and associated meteorological instrument (with wind speed and direction, temperature, barometric pressure and relative humidity sensors) have been installed approximately 200m south-west of the quarry processing plant on YVQ owned land at 195 McMahons Road. The particulate concentrations, along with wind speed and directions, are recorded every second and stored in a database (web-based reporting system). Data from the FDS17 can always be remotely accessed and/or downloaded by the Quarry Manager/Supervisor, other company management and contracted YVQ air quality specialists, on laptops, iPads, or iPhones via the Livesense iOT web-based platform.

The alarm function within the FDS17 monitor's (Livesense®) software will send text messages to the Quarry Manager/Supervisor in the event that a "trigger level" is exceeded. Initially, this will be set at a 1-hour averaged PM_{10} concentration of 100 $\mu g/m^3$. An analysis of the initial five month's monitoring data indicates that the 24-hour concentrations of both PM_{10} and $PM_{2.5}$ are typically well below EPAV's respective criteria, including when peak 1-hour PM_{10} concentrations remain below 100 $\mu g/m^3$).

A supplementary automatic weather station (**AWS**), eg. a Davis 6242AU Vantage Vue™ weather station, will be located in an exposed position in the plant processing area to provide a continuous real-time display of wind speed and direction in the Quarry Manager/Supervisor's office via a WeatherLink Console™.

Respirable crystalline silica (**RCS**) concentrations will be monitored initially on a monthly basis by co-locating a $PM_{2.5}$ mid-volume sampler beside the FDS17 monitor for 7-day periods and analysing the material collected on the filter for crystalline silica. It is anticipated that monitoring RCS for twelve months will be sufficient to confirm that RCS is not an issue of concern at nearby sensitive receptors, as predicted by the modelling undertaken by Dr Graeme Ross.

When a full year's records are available from the FDS17 instrument, the PM_{10} and $PM_{2.5}$ monitoring data will be compared with the model predictions for the existing scenario to validate Dr Graeme Ross' findings.

4. ADAPTIVE DUST CONTROL MEASURES

Implementation of the dust controls summarised above will minimise the potential for particulate emissions from the quarry under most weather conditions and are broadly comparable with "best control practice" in extractive industry operations. However, the risk of dust from YVQ impacting on nearby sensitive land use (receptors) will be further reduced by application of the following adaptive measures in response to adverse conditions.

Prediction and identification of adverse weather conditions

Weathercast® forecasts, prepared specifically for YVQ by Australian Weatherwatch Meteorological Consultants, will be emailed to the Quarry Manager/Supervisor on a weekly basis. Each forecast will present predicted wind speed, wind direction and dryness index for the following seven days, using a

colour-coded tabular format which also specifies the likely need for contingency measures (as Y=Yes, R=Review or N=No) to reduce the risk of elevated dust emissions affecting nearby sensitive receptors. The Weathercast® forecasts will enable the Quarry Manager/Supervisor to anticipate potentially extreme weather conditions several days ahead, so that operations can be planned to minimise the risk of elevated dust emissions on the "Y" days.

The continuous real-time display in the Quarry Manager/Supervisor's office (connected to the AWS in the processing plant area) will assist in deciding on the need to modify operations and/or dust control measures in the event of adverse weather conditions (strong NE winds, which put the nearest dwellings downwind from the quarry.

The FDS17 continuous PM_{10} and $PM_{2.5}$ ambient dust monitor, located approximately 200m south-west of the quarry processing plant, has an alarm function which can immediately alert the Quarry Manager/Supervisor by text messages in the event that particulate concentrations exceed a pre-set concentration (initially a 1-hour averaged PM_{10} concentration of 100 $\mu g/m^3$).

Additional adaptive dust control measures during adverse conditions

The adaptive measures which will be adopted to further minimise the risk of elevated dust emissions impacting on nearby sensitive land uses and the environment during periods of adverse weather (typically hot NE winds) will include:

- Additional application of water (by water carts/sprinklers, as required) on exposed areas, roads, hardstand areas and stockpiles;
- Reducing on-site vehicle use and speeds;
- Ensuring that the distance between conveyor discharge and the top of stockpiles is minimised;
- Suspending potentially dusty operations, including topsoil stripping, earthmoving in exposed locations and blast hole drilling as required to minimise dust generation; and
- Enhanced visual monitoring by all staff for dust leaving the site and notifying the Quarry manager/Supervisor promptly to initiate remedial action.

5. SITE SUPERVISION

The YVQ Quarry Manager/Supervisor will be responsible for monitoring all areas and operations of the site that have the potential to generate dust and ensuring appropriate dust control measures are being implemented promptly, as required, to minimise dust generation and comply with EPAV's GED requirements.

The YVQ Quarry Manager/Supervisor will ensure that all new site personnel are required to familiarise themselves with relevant sections of the DMP during the site induction process and that a copy of the DMP is available in a location which is readily accessible by all site personnel.

6. REVIEW OF DMP

The DMP will be reviewed annually and updated as appropriate to ensure that the dust management measures continue to achieve compliance with all relevant air quality objectives and compliance/acceptance criteria. If at any stage in the quarry's development it is found that the DMP's objectives or compliance/acceptance criteria are not being consistently achieved, an immediate review of the DMP will be undertaken by quarry management.

APPENDIX 4. FDS17 AMBIENT AIR MONITOR BROCHURE

Ektimo

AMBIENT DUST MONITORS

PM10, PM2.5
Weather sensors
Remote Access

FDS15 and FDS17

Ektimo's ambient dust monitors are designed for ultimate operation at tough and remote areas and are equipped with components of the highest quality and standards in the market. Systems are tailored for each application, so we study each project and design a system that meet the requirements. Major components we use in an ambient dust monitor include:

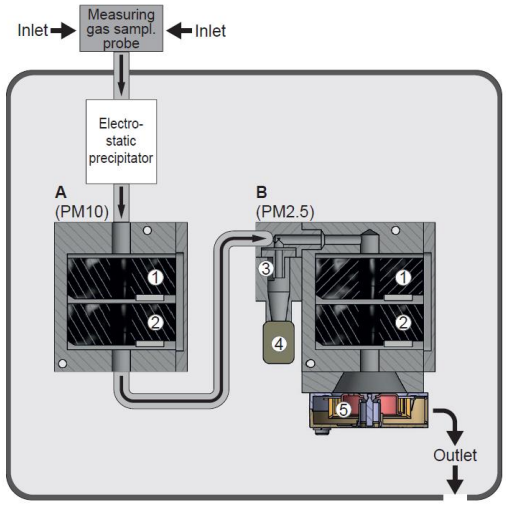
- German made FDS modules to monitor PM particles with high reliability and accuracy.
- Australian made dataTaker DT80 data loggers
- Mains or solar power based on project requirements
- Optionally weather sensors such as ultrasonic wind sensor or multifunction sensors which also measure temperature, humidity, barometric pressure, rainfall and solar radiation

Ektimo's ambient dust monitors have been installed and operated across Australia at various climatic conditions including seaports, tropical parts of Queensland, outback areas and urban sites. FDS particulate matter sensors have several patented and innovative features which make them suitable for various applications.

Ektimo provides innovative air quality monitoring systems for purchase or rental. We also execute monitoring campaigns and cover supply, installation, operation and maintenance of equipment and deliver monitoring report to clients.

FDS 17 Sensor Module

The fine dust sensor FDS 17 is an optical sensor for continuous, simultaneous measurement and control of fine dust contents PM10 and PM2.5. It can be integrated into several applications. The device is factory-calibrated and applicable in the measuring range of 2...2000 µg/m³. It has two sensor modules, each with two conditioned scattered light sensors for improvement of the stability.



1 Measuring sensor 2 Reference sensor
3 Pre-separator 4 Residual dust reservoir 5 Fan

The determination of the dust content in the FDS 17 is based on the method of scattered light measurement. Sample is aspirated by a fan at the outlet of FDS17 module. Flow rate of 2 l/min is chosen in a way that particles are determined representatively. After the fine dust of the ambient air has entered the device via the measuring gas sampling probe and has passed a patented electrostatic precipitator, the fine dust concentrations for PM10 and PM2.5 are measured in succession by the respective sensor module. For the analysis of alveolar particle fractions (PM2.5) an integrated pre-separator with residual dust reservoir is used.

In the device there is a periodic control and correction of zero point and reference point which is enabled by the electrostatic precipitator with integrated high voltage module. A high zero-point stability is achieved by evaluation of the internal measuring signals. Measuring sensor is responsible for continuous operation and measurement while reference sensor only operates at certain intervals to check function of measuring sensor and correct any deviation due to drift and aging. This feature allows FDS 17 module to require optical calibration every 24 months only.

FDS modules have no consumables to replace. Other similar products on the market need periodic maintenance to replace zero filter and pump protection filter and to rebuild or replace pump.

For communication besides the standard RS485 Modbus interface there is the option of a 4...20 mA current loop or integrated WLAN module.

FDS 15 has same features as FDS 17 but has one sensor module for PM10 or PM2.5 measurement, to be specified at time or order.

FDS 17 module has been tested in Australia by collocating to an EPA reference station for 366 days and compared to results from a TEOM 1405DF instrument. Without applying any correction factor to FDS reading, incredible R^2 correlation factor of 0.96 for PM10 and 0.94 for PM2.5 was achieved. Report and dataset are available upon request.

FDS 17
Technical Specifications

Dr. Födisch
Umweltmesstechnik AG

Features

- Simultaneous real-time measurement of PM10 and PM2.5 with scattered light technology
- Two sensor modules, each with two conditioned scattered light sensors for improvement of the stability
- Patented electrostatic precipitator (e-filter) for zero-point setting
- FDS 17M mobile version in aluminium transport case

Specifications

Measuring method: scattered light measurement → measurement of fine dust according to DIN EN 481
Sensors: 2x sensor module with two optical sensors for each; separated control and signal evaluation
Measuring range: 2 … 2000 µg/m³
Detection limit: 2 µg/m³
Sampling flow: 2 l/min fan aspirated
Housing: compact aluminium sensor housing
Heating: measurement chamber and pre-separator
Dimensions: 200 mm x 313 mm x 121 mm (w x h x d) - approx. 4 kg
Power supply: 100-240VAC, 0.7A, 50-60Hz (optional 12-24VDC, 2.1A)
Ambient conditions: Temperature -20...+50 °C and Relative humidity 0…95%
Outputs: Modbus RS485 and optional 4...20 mA current loop, WLAN module

FDS 15
Technical Specification

Specifications

Measuring method: scattered light measurement → measurement of fine dust according to DIN EN 481
Sensors: 2x optical sensor; separated control and signal evaluation
Measuring range: 2 … 2000 µg/m³
Detection limit: 2 µg/m³
Sampling flow: 2 l/min fan aspirated
Housing: compact aluminium sensor housing
Heating: measurement chamber and pre-separator
Dimensions: 130 mm x 160 mm x 90 mm (w x h x d) - approx. 2 kg
Power supply: 100-240VAC, 0.7A, 50-60Hz (optional 12-24VDC, 2.1A)
Ambient conditions: Temperature -20...+50 °C and Relative humidity 0…95%
Outputs: Modbus RS485 and optional 4...20 mA current loop, WLAN module

dataTaker DT80 series

Data Loggers

Features

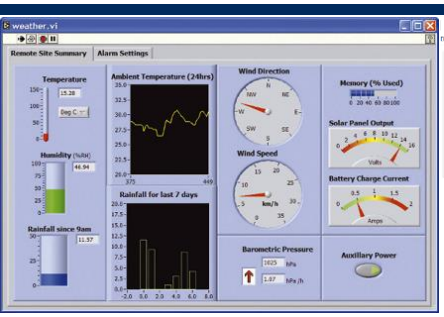
dataTaker is one of the world's leading brands of specialized data loggers and data recording equipment. Our data loggers are designed to be compatible with almost all types of sensors, with a strong focus on communications to make your data easily accessible. dataTaker loggers are designed to provide logging capability for environmental monitoring systems. The loggers support a wide range of weather sensors, air quality sensors, soil sensors, and other sensors within environmental area from various manufacturers.

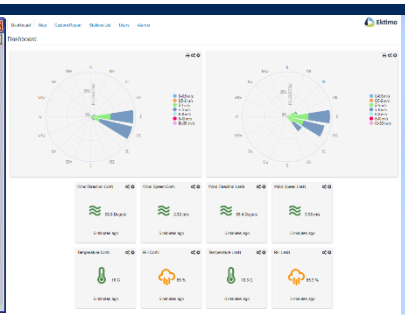
- Inputs for analogue, temperature sensors, digital, pulse and frequency, Modbus, serial and more signals
- Alarm channels and digital outputs to raise alarms
- Internal memory holds 10 million readings
- DT80M includes an integrated modem
- Internal T/RH sensor and add-on wind sensor

Ektimo's Cloud server and mobile App

Our cloud based server allows users to collect, monitor, analyze, store, and share information that improves connectivity and data acquisition of process instruments and industrial systems. Measurement results from DT80 logger are transferred to live cloud platform for users to view dashboard and trends, wind-rose and pollution-rose, and to download CSV or graphical reports. Dashboard is fully configurable based on user preferences.

Ektimo has a free iPhone app available on Apple store to access live platform and view current and history data.





Anscillary products

- Weather sensor: We offer a range of weather sensors for monitoring of wind speed, wind direction, temperature, relative humidity, barometric pressure, rainfall, solar radiation and mode.
- Power: PM monitoring systems and weather stations are designed with mains power, solar power or battery operated.
- Mechanical: Ektimo offers a range of masts and tripod for installation of ambient dust monitors and weather station. This includes heavy duty masts and 5m or 10m folding or pump-up masts.
- Data validation and reporting

APPENDIX 5. CAMM'S PARTICULATE MODELLING REPORT

Consulting
Air pollution
Modelling &
Meteorology

YARRA VALLEY QUARRY, WOORI YALLOCK
WA375 WORK PLAN VARIATION

LEVEL 2:
AIR QUALITY IMPACT ASSESSMENT

Report to:

DandyPremix Quarries Pty Ltd

Consulting Air pollution Modelling & Meteorology (CAMM)

CAMM Report No. 6/23
June 2024

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Project Title	Yarra Valley Quarry, Woori Yallock – WA375 Work Plan Variation – Level 2: Air Quality Impact Assessment			
Client	DandyPremix Pty Ltd			
Project No.	6/23	**Project Manager**		Graeme Ross
		QA/QC		Graeme Ross
Report Authors	Graeme Ross			
Report	Internal ×	Restricted ✓	Open ×	Research ×
Rel. No.	**Date of Issue**	**Checked by**	**Approved by**	**Reason for Update**
00	5 April 2023	GR	GR	Draft report
01	14 September 2023	GR	GR	Revised draft- inclusion of PM2.5 & blasting/drilling emissions.
02	23 October 2023	GR	GR	Draft report – revisions and inclusion of results for additional scenarios.
03	14 June 2024	GR	GR	Review revisions
04	27 June 2024	GR	GR	Final report

DISCLAIMER

This report was prepared by Consulting Air pollution Modelling & Meteorology (CAMM) on behalf of DandyPremix Pty Ltd. The material within reflects CAMM's best judgement at the time of preparation. Any use that any party makes of this report is the responsibility of such party. CAMM accepts no responsibility whatsoever for damages, if any, which are suffered by any party, in reliance on information contained in this report.

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CONTENTS

1. INTRODUCTION

1.1 Background

- Dandy Premix Quarries Pty Ltd (T/a Yarra Valley Quarries - YVQ) has existing extractive industries Work Authority 375 (WA375) issued by the Department of Energy, Environment and Climate Action (DEECA), Earth Resources Regulation (ERR) on 9 November 2010 for the WA375 (YVQ) site at 130 McMahons Road, Launching Place.

- Quarry operations have been conducted on the WA375 (YVQ) site continuously since the early 1980's.

- Dandy Premix Quarries Pty Ltd (Dandy Premix) propose expanding their hard rock (Hornfels) extractive operations into a 40ha block of adjoining land owned by Dandy Premix and known as Lot 50C and will soon lodge a Work Plan Variation (WPV) application with DEECA-ERR for endorsement as a first step in the approval process. The current crushing plant and other associated screening, conveying, and sales loading operations do not change under the proposed WPV application.

- The Work Plan Variation requires endorsement under the *Mineral Resources (Sustainable Development) Act 1990* as administered by DEECA-ERR, as a mandatory perquisite to applying to amend current Planning Permit number YR-2010/58 for the site, issued by the Yarra Ranges Shire Council on 9 September 2010 as the Responsible Authority under the *Planning and Environment Act 1987*.

- As part of the approval application process, Dandy Premix has engaged BCA Consulting, Earth Resources (BCA) as author of the WPV application process on the DEECA-ERR, Resources Rights Allocation Management (RRAM) online portal.

- As one of a suite of required environmental assessments, the WPV application includes a Dust risk assessment for statutory referral to relevant agencies, including the Environment Protection Authority of Victoria (EPA Victoria - EPAV).

- Dandy Premix has engaged Consulting Air pollution Modelling & Meteorology (CAMM) to undertake an air quality modelling impact assessment in support of the Dust risk assessment process, particularly regarding its referral to EPAV.

1.2 Risk Assessment Process – Air Quality

- The *Guideline for Assessing and Monitoring Pollution in Victoria (GAMAPV), EPA Publication 1961 (February 2022)*: provides a tiered approach to the assessment of risks for air pollution, with three levels of assessment in order of increasing complexity.

- Section 5.1.4 of GAMAPV includes the following table for determining the level of assessment required for mining and extractive industries.

Table 1 – Level of assessment for mining and extractive industries

	Large mine or quarry greater than 500,000 t/yr extraction	Medium mine or quarry between 150,000 t/yr and 500,000 t/yr extraction	Small mine or quarry between 50,000 t/yr and 150,000 t/yr extraction	Mine or quarry with yearly extraction below 50,000 t/yr extraction
Urban area	Level 3	Level 3	Level 2	Level 1
Rural area close to residences (less than 500 m from the limit of work described in the work plan)	Level 3	Level 2	Level 1	Level 1
Rural area (residences more than 500 m from the limit of work described in the work plan)	Level 2	Level 1	Level 1	Level 1
Extraction refers to: • quarries: the amount of soil and rock that is moved or extracted per year • above-ground mines: the amount of soil, rock and ore moved on the site • underground mines: the amount of soil rock and ore moved above ground and brought to the surface of the mine. Any emissions from ventilation shafts of the mine must also be taken into account in the estimates of emissions where the shaft is part of the premises				

- Application of the table for the proposed WA375 Work Plan Variation indicates that a Level 2 assessment is required on the basis that the site is a medium quarry in a rural area, with the closest sensitive receptor less than 500 m from the proposed extraction limit.

- As such, this report presents the results of an investigation of a Level 2 air assessment based on the use of dispersion modelling, with the predicted pollutant concentrations benchmarked against a set of pre-defined Air Pollution Assessment Criteria (APACs).

1.3 WA375 Work Plan Variation Overview

- Figure 1.1 illustrates the existing and proposed quarry areas

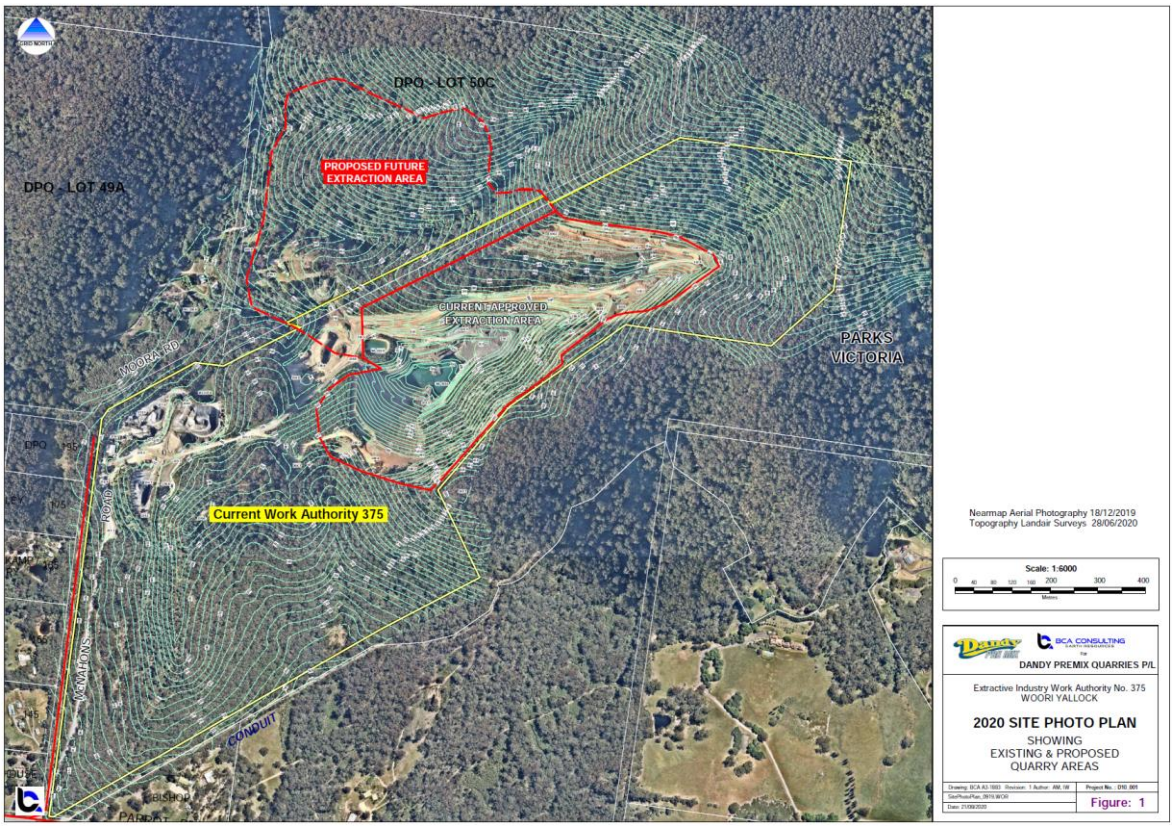


Figure 1.1: WA375 - Existing and Proposed Quarry Areas

- Figure 1.2 illustrates the proposed site layout plan, including the proposed development stages (Stages 1 – 4).

- Figure 1.3 illustrates the Stage 1 development with a proposed timeline of extraction and revegetation.

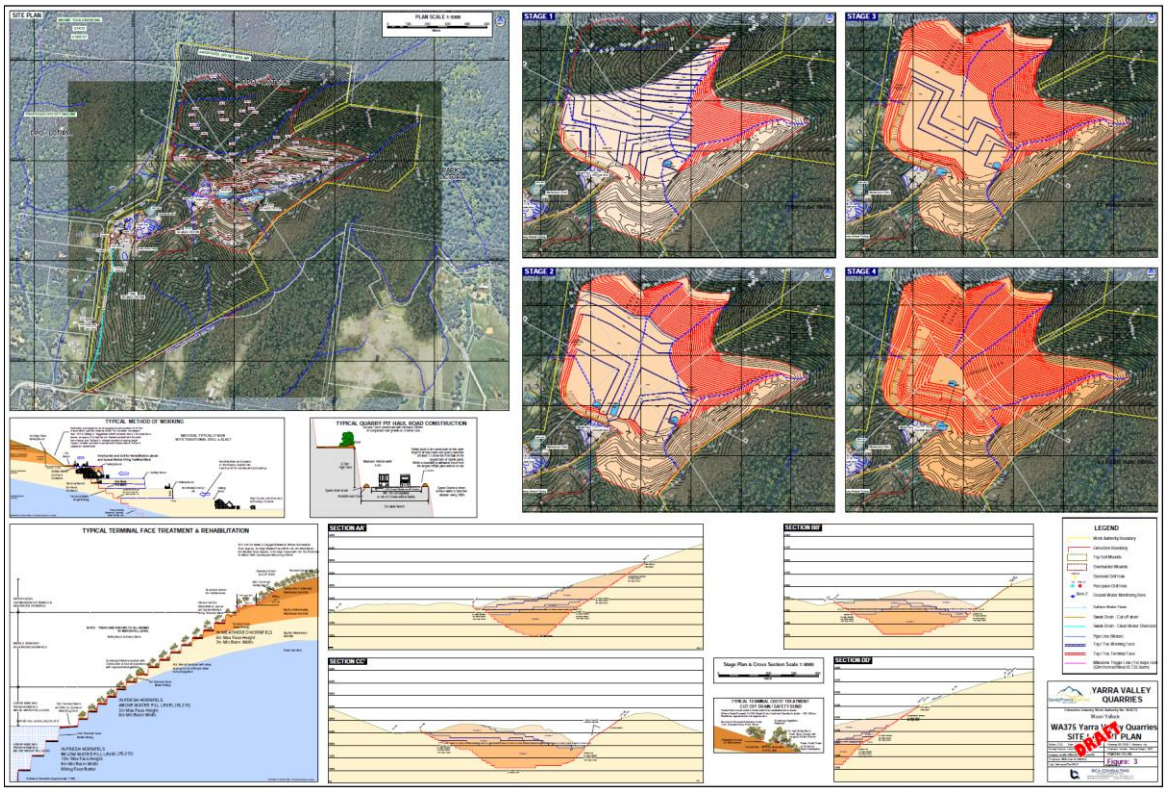


Figure 1.2: WA375 Work Plan Variation – Proposed Layout Plan

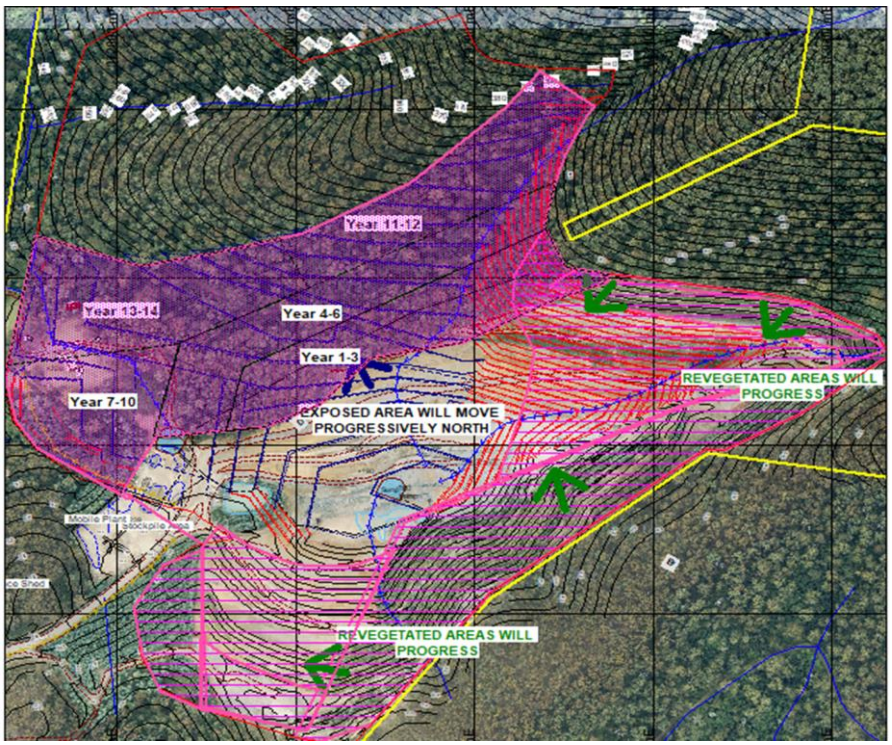
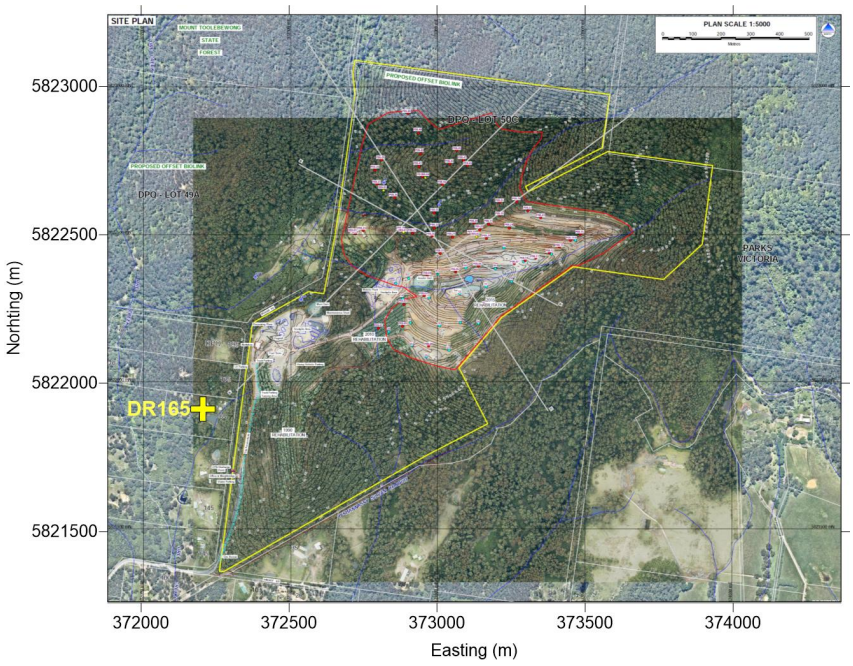


Figure 1.3: WA375 Work Plan Variation – Stage 1 - Proposed Time Line

1.4 Report Overview

- This report presents PM_{10} and $PM_{2.5}$ impact assessment results[1] for the cases:
  - **Existing Scenario** – a 'base' case representative of existing conditions.
  - **Year 1-3 Scenario** – a future case representative of Year 1-3 conditions during the proposed Stage 1 extension.
  - **Year 7-10 Scenario** – a future case representative of Year 7-10 conditions during the proposed Stage 1 extension.
- The **Year 7-10** scenario has been selected as representative of potential worst-case impacts during **Stage 1** at a discrete receptor (DR165) located at the allotment (#165) closest to the YVQ facility (see figure below and Figure 3.3 (c)).
- The impacts at DR165 resulting from the following years in Stage 1, and the subsequent Stages 2 – 4, can be regarded as further reduced as extraction activities move further north.
- The assessment follows the Level 2 modelling procedure under the GAMAPV, with a focus on an assessment of 24-hour average PM_{10} and $PM_{2.5}$ impacts at discrete receptor DR165.



- Note that:
  - A key requirement for a Level 2 modelling assessment is the availability of suitable 'site-specific' meteorological data, together with concurrent and 'site-specific' data containing background concentrations of the key indicators.
  - Acquisition of such 'site-specific' data is underway.
  - The current modelling assessment is based on 'best available' meteorological and background concentration data, and will be revised/replaced as adequate monitoring data become available.

[1] The report also examines RCS impacts based on the $PM_{2.5}$ results.

2. SOURCE AND NATURE OF EMISSIONS

2.1 General

Dust (particulate matter) is a key discharge to air from sources associated with the WA375 Work Plan Variation project activities.

Particles capable of being inhaled into the lungs are those with an aerodynamic diameter of less than 10 μm. The fraction of airborne particles in this category is referred to as PM_{10}. Particles with a diameter of less than 2.5 μm ($PM_{2.5}$) can potentially penetrate further into the lung and can enter the alveoli.

Particles that have a larger aerodynamic diameter than 10 μm tend not to penetrate the respiratory tract.

2.2 Indicators

The Level 2 dust impact assessment modelling has been performed following the requirements of GAMAPV, EPA Publication 1961 (February 2022): *Section 5.3.1 – Air Pollution Modelling, and Section 6.3 – Application of APACs to Modelling Outputs*, for emissions of the following health indicators:

- **Particulates as PM_{10}**
- **Particulates as $PM_{2.5}$**
- **Respirable Crystalline Silica (RCS)**

2.3 Air Pollution Assessment Criteria (APACs)

The predicted modelled impacts have been benchmarked against the following APACs[2]:

- **PM_{10}**
  50 μg/m^3 (24-hour average), no exceedances
  20 μg/m^3 (annual average)
- **$PM_{2.5}$**
  25 μg/m^3 (24-hour average), no exceedances
  8 μg/m^3 (annual average)
- **RCS**
  3 μg/m^3 (annual average)

[2] Note that PM_{10} and $PM_{2.5}$ are criteria pollutants with APACs as specified in the Environment Reference Standard (ERS).

3. MODELLING APPROACH

3.1 Introduction

This section details the dispersion model selected, the model configuration adopted, and key inputs.

3.2 AERMOD Model

The currently approved EPAV regulatory air dispersion model, AERMOD, has been used to assess the impact of the PM_{10} and $PM_{2.5}$ emissions.

3.3 Selection of Model Configuration and Options

The following configuration and options have been selected for modelling atmospheric dispersion of emissions:

(i) Ground level concentrations (glc's) have been predicted on a 2 km x 2 km Cartesian receptor grid with Map Grid of Australia 2020 (MGA2020) coordinates and a resolution of 20 metres. Figure 3.1 illustrates the modelling domain selected, together with the location of the discrete receptor DR165, chosen as representative of nearest residential 'sensitive' location surrounding the project site.

(ii) In the absence of EPAV Publication – *Guide to air pollution modelling. Publication 1957*, the AERMOD model has been configured following the requirements of the guideline: *"Guidance notes for using the Regulatory Air Model AERMOD in Victoria – Publication No. 1551".*

(iii) Terrain at the site and surrounds within the modelling domain has been based on a topographical data file developed using data obtained from Geosciences (Australia) and local-scale data provided by BCA.

The full AERMOD model configuration, meteorological, and output files are available on request.

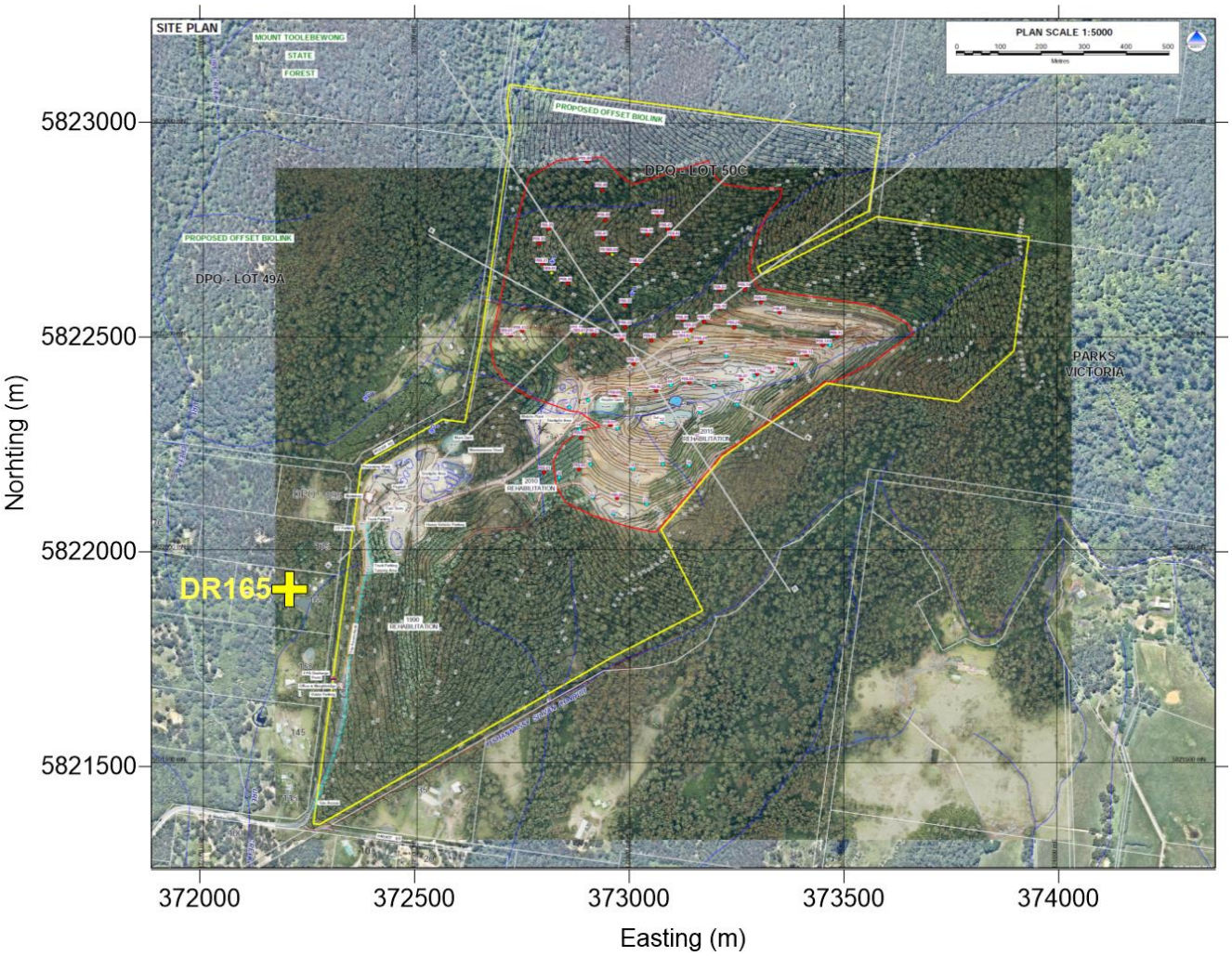


Figure 3.1: Modelling Domain
(The proposed site development plan is included as an insert for reference, with the nearest sensitive receptor (DR165) shown as labelled yellow cross).
(The coordinates on the axes are in MGA2020 coordinates (metres).

3.4 Meteorology

- Surface and upper air meteorological files spanning a full year, and containing hourly values of relevant meteorological variables, are needed for the prediction of the concentration averages required for comparison with the relevant air quality criteria.

- Air impact assessments using AERMOD in Victoria typically needs to be based on 5 years of meteorological data.

- Meteorological data files for Years 2017 – 2021, inclusive, have been complied for CAMM by pDs Consulting specifically for this assessment. In the absence of on-site meteorological data, and no nearby representative meteorological stations, the files have been based on site-representative datasets generated by the CSIRO prognostic model TAPM, and have been complied in accordance with EPAV draft guidelines: *"Construction of input meteorological files for EPA Victoria's regulatory air pollution model (AERMOD)': Publication No. 1550".*

- Full details of the data source, compilation process, and meteorological file characteristics are described in the pDs Consultancy report (available on request).

- The annual wind roses are provided below in Figure 3.2.

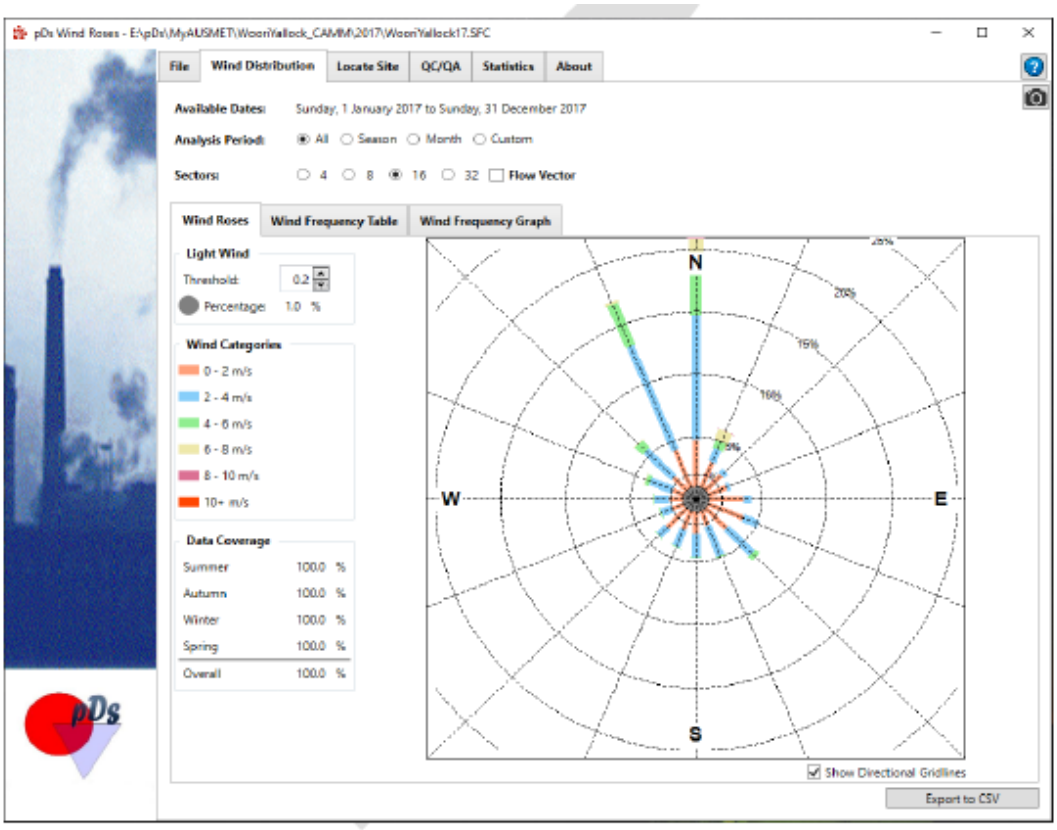


Figure 3.2 (a): Annual Wind Rose – Year 2017

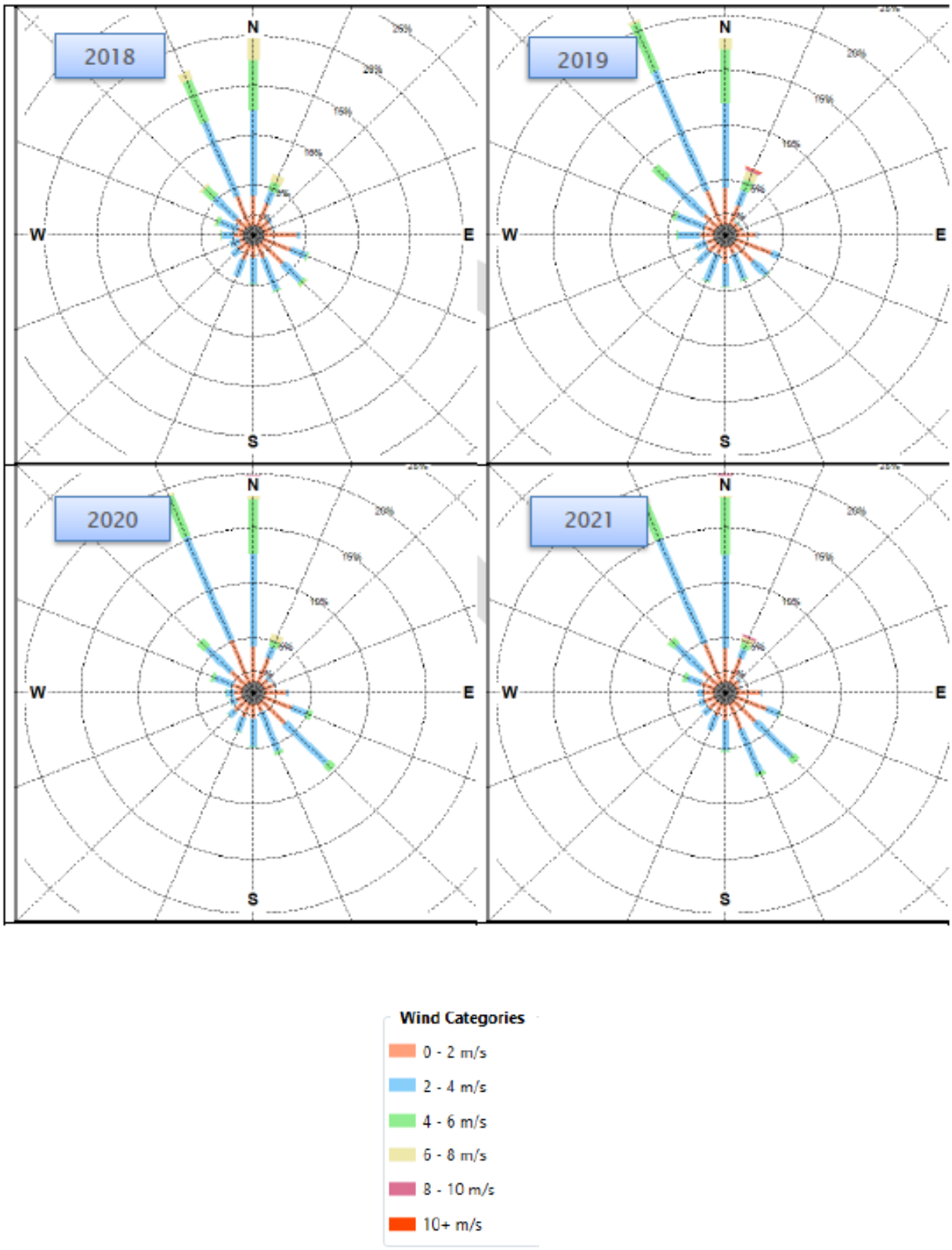


Figure 3.2 (b): Annual Wind Roses – Years 2018 – 2021

3.5 Emission Scenarios

- The Level 2 impact assessment modelling has been based on the following scenarios:
  - **Existing Scenario** – a 'base' case representative of existing (2023) conditions.
  - **Year 1-3 Scenario** – a future case representative of Year 1-3 conditions during the proposed Stage 1 extension.
  - **Year 7-10 Scenario** – a future case representative of Year 7-10 conditions during the proposed Stage 1 extension.

- The annual volumes of material moved and processed are contained in the following table below[3]:

Total Material Moved	**500,000 tonnes/annum**
Overburden/Soil Moved	**147,000 tonnes/annum**
Rock Moved/Processed	**353,000 tonnes/annum**
Estimated Annual Sales	**353,000 tonnes/annum**

- Figure 3.3 provides an outline of each scenario and the key sources selected as representative of emissions arising from activities during each case[4].

- Each scenario is based on the following assumptions:
  - Topsoil/Overburden is removed (**147,000 tonnes/annum**) in the **green area** and transported via the **green haul road** to the white hatched area for stockpiling and rehabilitation.
  - Rock is extracted (**353,000 tonnes per annum**) in the **blue area** with (**338,990 tonnes/annum**) transported by trucks along the **blue haul road** to the main processing area (blue hatched) and (**14,010 tonnes/annum**) to the mobile processing area (**pink hatched**)[5].
  - Processed material is transferred off-site on **black haul road.**
- Further details of the activities/sources are as follows:
  - **O/B extraction bench** – **green area** – extraction/loading, on-bench transfer.
  - **Rock extraction bench** – **blue area** – drilling, blasting, extraction/loading, on-bench transfer.

[3] Provided by BCA and adopted for each scenario.
[4] Note that no changes are proposed to the existing crushing or screening plant.
[5] Main to Mobile processing ratio provided by Dandy Premix.

- **Mobile Processing** – **pink hatched area** – unloading to stockpiles, stockpile to hopper by FEL, crushing/screening – transfer & loading (to main processing area/off-site).
- **Main Processing area** – **blue hatched area** – unloading to stockpiles and hopper, crushing/screening, transfer to stockpiles, loading and transfer of final products from stockpiles to trucks by FEL.
- **Rehab area** – **white hatched area -** unloading of o/b, stockpiling, on-area transfer & transport, rehab formation using bulldozer.

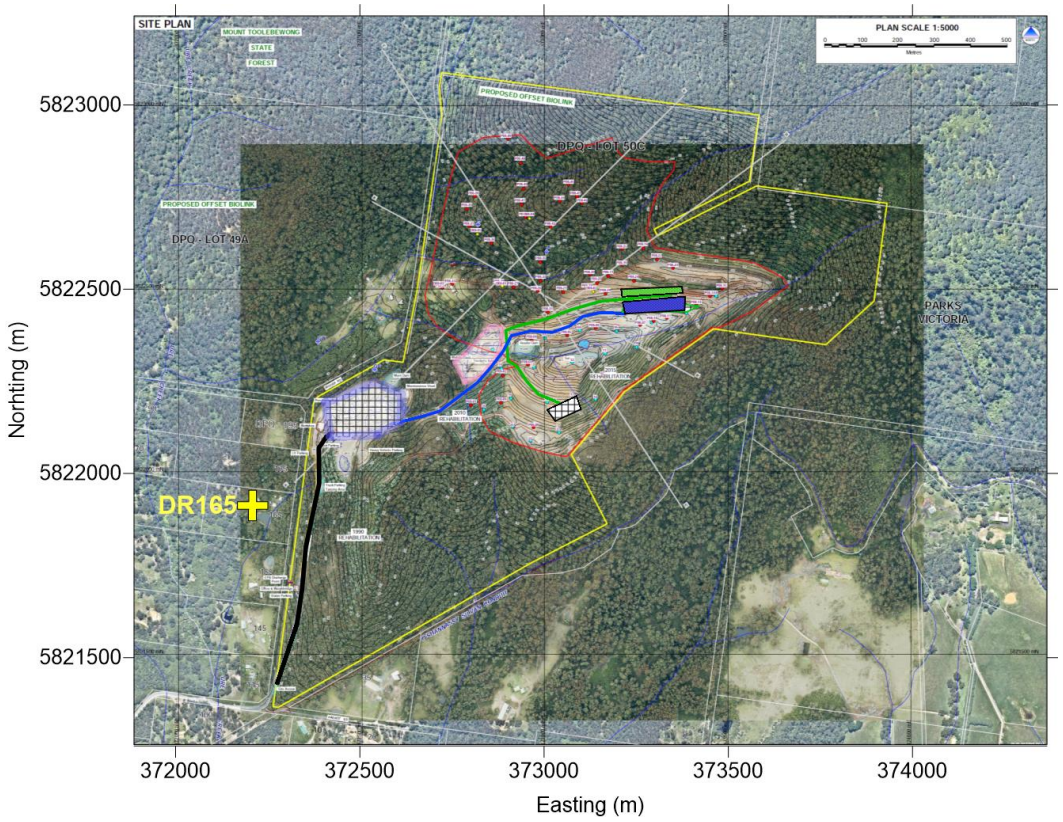


Figure 3.3 (a): Existing Scenario – Typical Existing Extraction

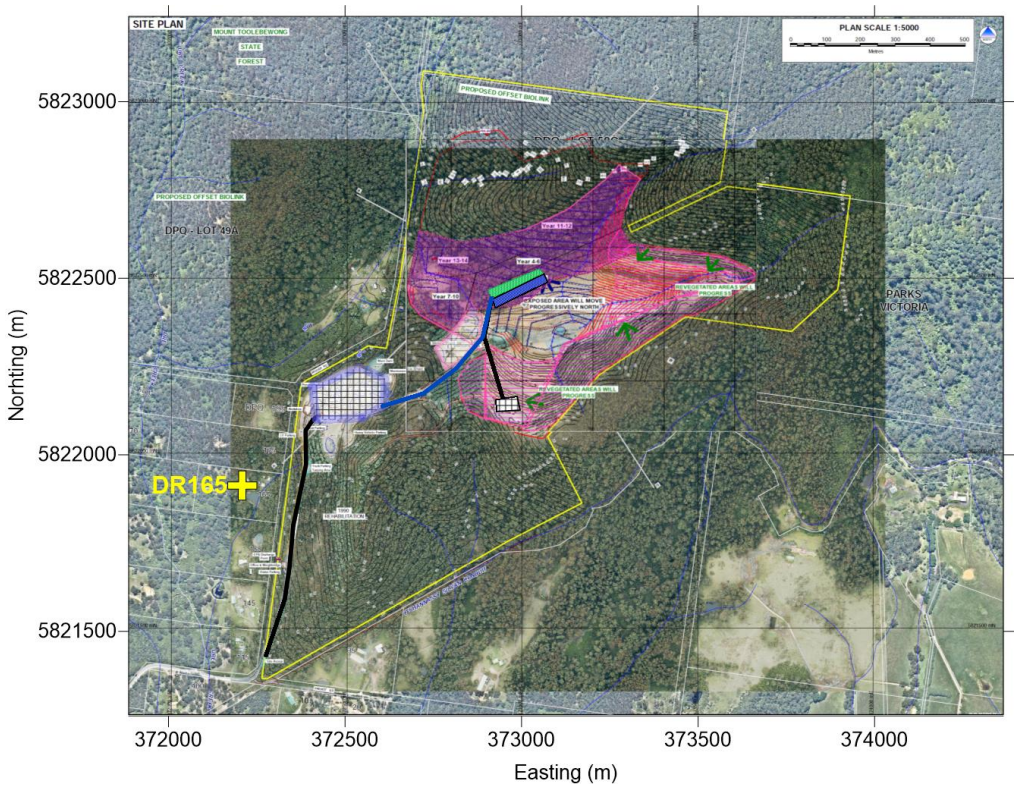


Figure 3.3 (b): Year 1-3 Scenario – Typical Extraction Activities

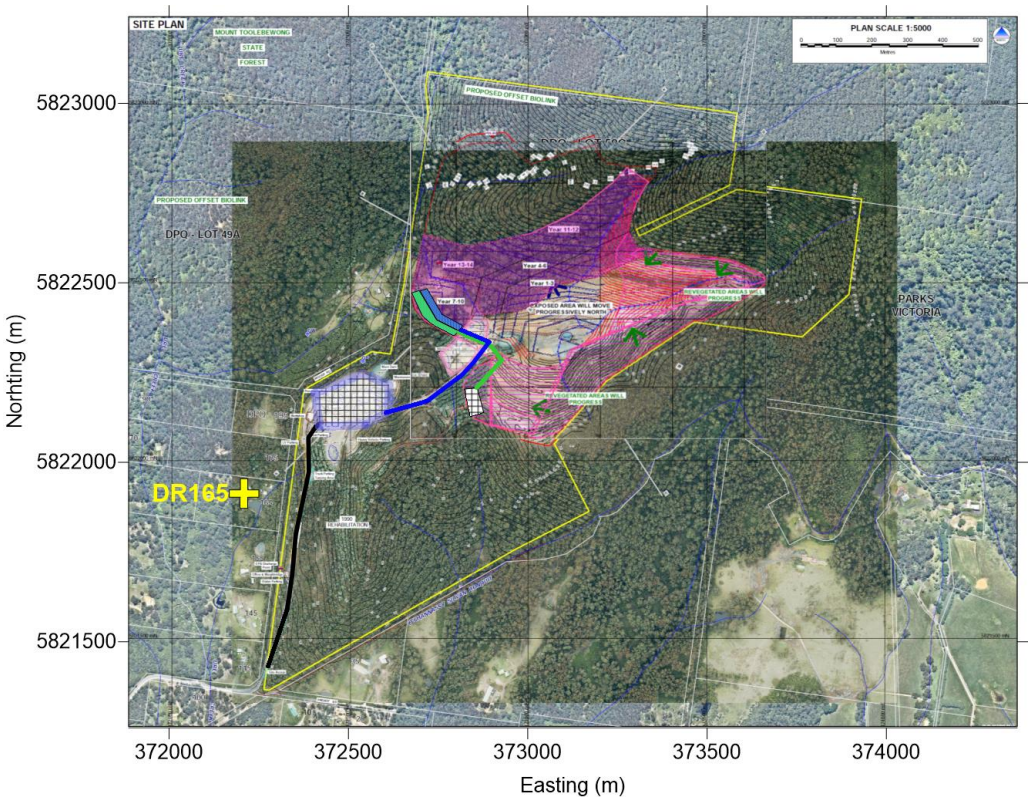


Figure 3.3 (c): Year 7-10 Scenario – Typical Extraction Activities

Emission Inventories

- The modelling scenario is representative of a typical year of activities with the emission inventories for the various **'mechanically-induced'** dust generating activities based on:
    - The following information provided by Dandy Premix and BCA:

      - the annual volumes of material for the o/b and rock extraction areas.
      - the operating hours
      - the percentage of the annual rock volume going to the mobile versus main processing area.
      - the volume of product going directly off-site versus stockpiling.
      - the typical capacities of the haul road trucks and FELs.

    - Published emission factors (e.g. USEPA AP-42 and National Pollutant Inventory (NPI) factors).
- It is important to highlight the following assumptions regarding specific activities:
    - Main Processing area – adoption of **controlled** emission factors for crushing/screening and transfer.
    - Mobile Processing area – adoption of **uncontrolled** emission factors for crushing/screening and transfer.
    - Drilling/blasting – conservative assumption of:
        - **1 blast/day**, 100 drill holes /blast and a blast area of 1000m^2
        - blasting spread over a 2-hour period commencing at midday with drilling emissions over the 5-hour period prior to the blast.
        - Drilling emissions **mitigated** using water sprays.
    - Haul Roads - Level 2 watering on primary roads, with Level 1 watering for on-bench roads.
- Appendix1 1 contains further details on the basis of the emissions inventory, including the emission factors, source representation and associated assumptions.

- The emissions and characteristics of the ***'wind-erosion'*** sources have been based on the following assumption:
    - ***General exposed areas:***
      Uncontrolled emission factor of 0.2 kg/hour/ha for PM_{10}[6], with emission rates based on wind speed categories.
- The modelling assessment has not included vehicle exhaust emissions or incorporated dust generating activities that are intermittent and of a relatively short duration.

[6] $PM_{2.5}$ consisting of 47.6% PM_{10}.

4. RESULTS – Existing Scenario – YVQ INCREMENT (excluding background)

4.1 Particulates as PM_{10}

4.1.1 24-Hour Average

- Table 4.1 contains the 1st highest predicted 24-hour average PM_{10} concentration at the closest sensitive receptor DR165 arising from the quarry emission generating activities based on each of the 5 years of meteorology, together with the percentage of the ERS APAC criterion.

Meteorological Year	Highest predicted 24-hour average GLC ug/m^3	Percentage of ERS APAC 50 ug/m^3
Year 2017	9.8	19.6
Year 2018	5.8	11.6
Year 2019	6.3	12.6
Year 2020	5.8	11.6
Year 2021	8.8	17.6

Table 4.1

- The highest predicted maximum level is based on **Year 2017** meteorology. As such, the results that follow focus on predictions for this year of meteorology, albeit that corresponding predictions based on the other 4 years are also provided as appropriate.
- Figure 4.1 illustrates a time series of the predicted 24-hour average concentrations at DR165 based on Year 2017 meteorology, with Figure 4.2 illustrating a contour plot.

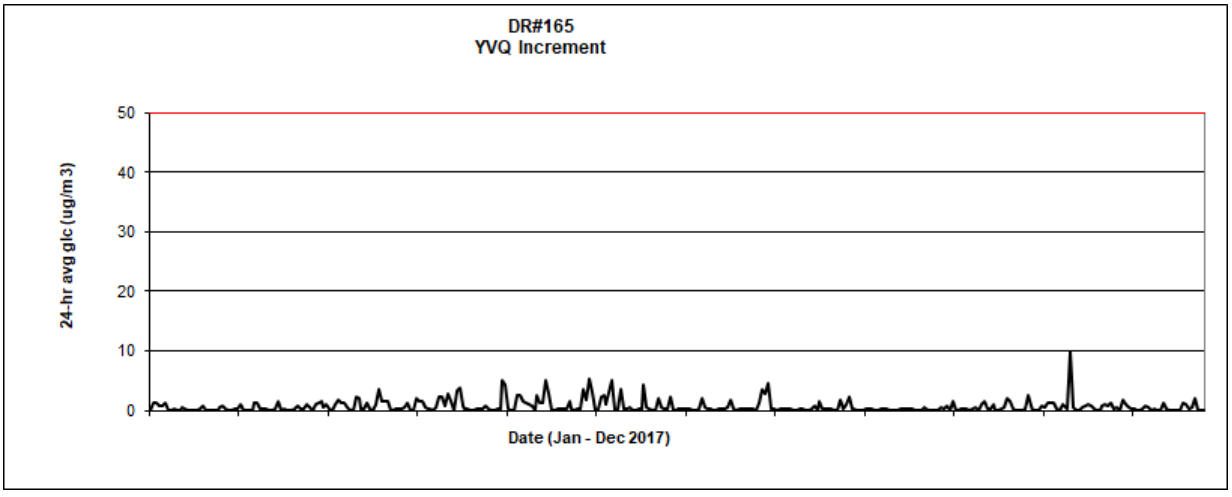


Figure 4.1

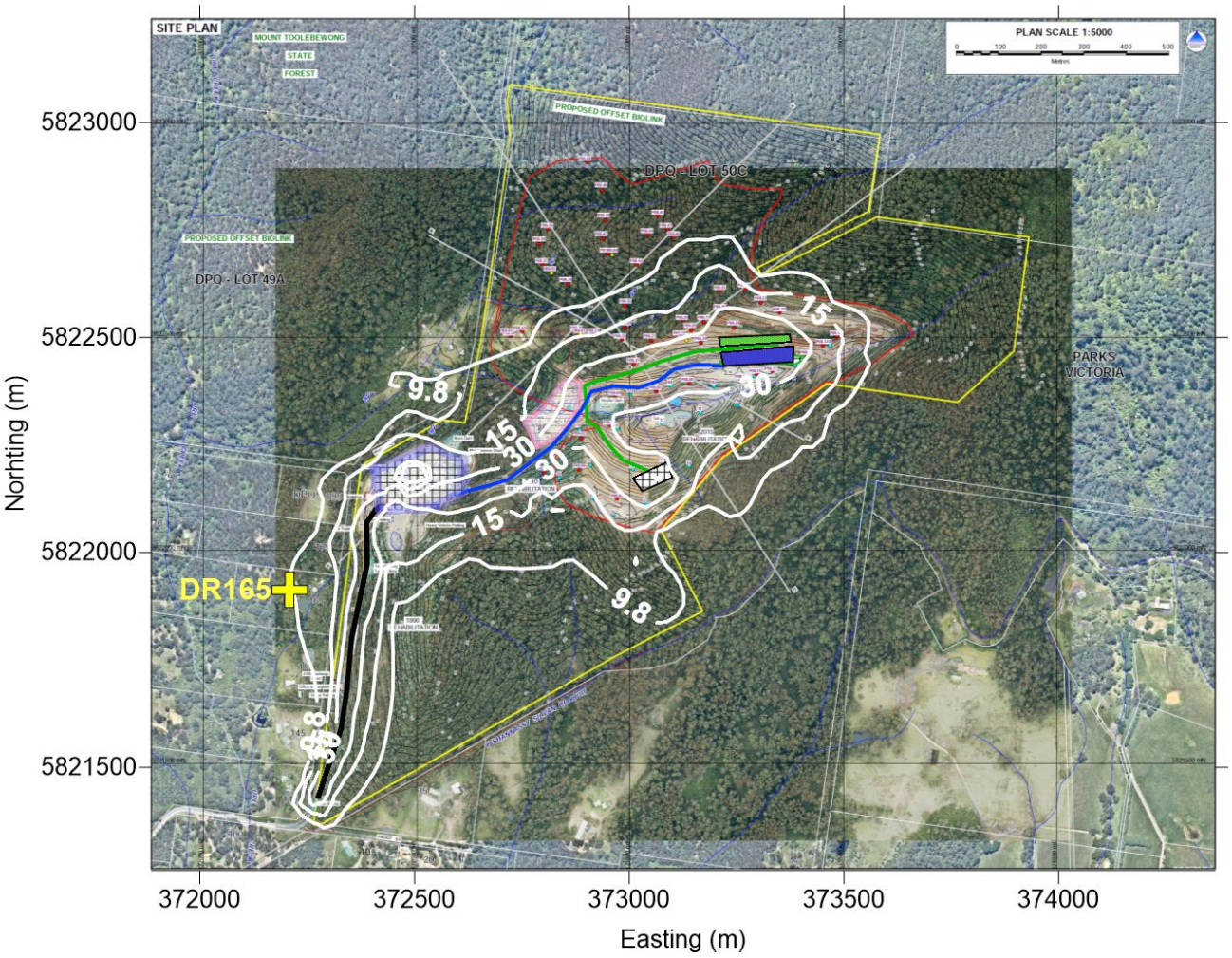


Figure 4.2: Contours of 1st highest predicted, 24-hour average, ground level concentration of PM_{10} – Year 2017 meteorology - YVQ Increment (excluding background).
(Contour levels are 9.8, 15 and 30 µg/m3).

Figure 4.3 illustrates time series of the predicted 24-hour average level at DR165 based on the other years of meteorology (Years 2018 -2021).

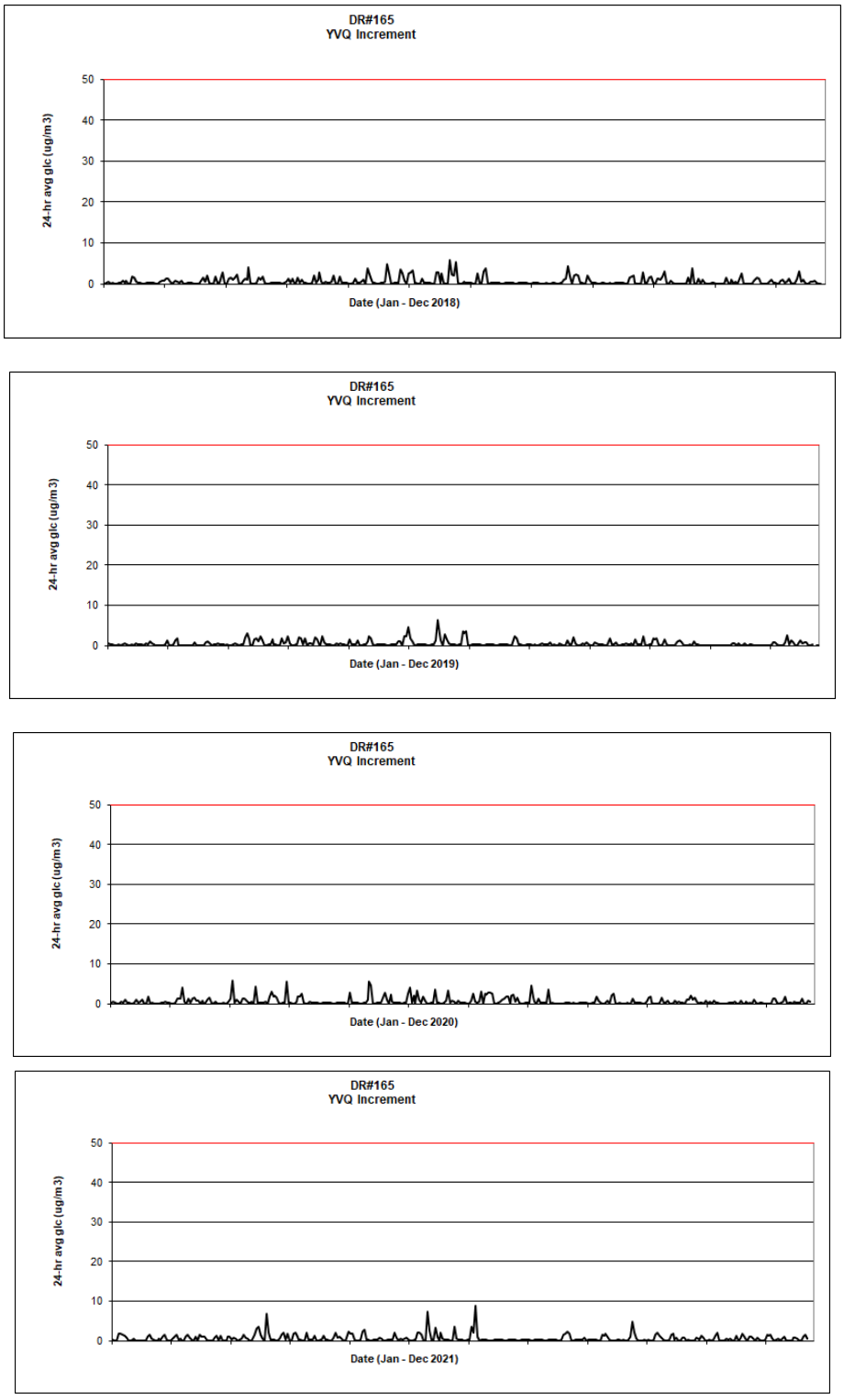


Figure 4.3: Time series plots at sensitive receptor DR165 - Predicted 24-hour ground level concentration of PM_{10} – Years 2018 - 2021 - YVQ increment (excluding background).

4.1.2 Annual Average

- Table 4.2 contains the predicted annual average PM_{10} concentration at sensitive receptor DR165 arising from the YVQ emission generating activities based on each of the 5 years of meteorology, together with the percentage of the ERS APAC criterion.

- The predicted impact due to the quarry is well below the **20 ug/m^3** APAC criterion, albeit no background contribution is included.

Meteorological Year	Annual average GLC ug/m^3	Percentage of ERS APAC 20 ug/m3
Year 2017	0.67	3.35
Year 2018	0.64	3.20
Year 2019	0.48	2.40
Year 2020	0.62	3.10
Year 2021	0.62	3.10

Table 4.2

- Figure 4.4 illustrates contours of predicted annual average based on Year 2017 meteorology.

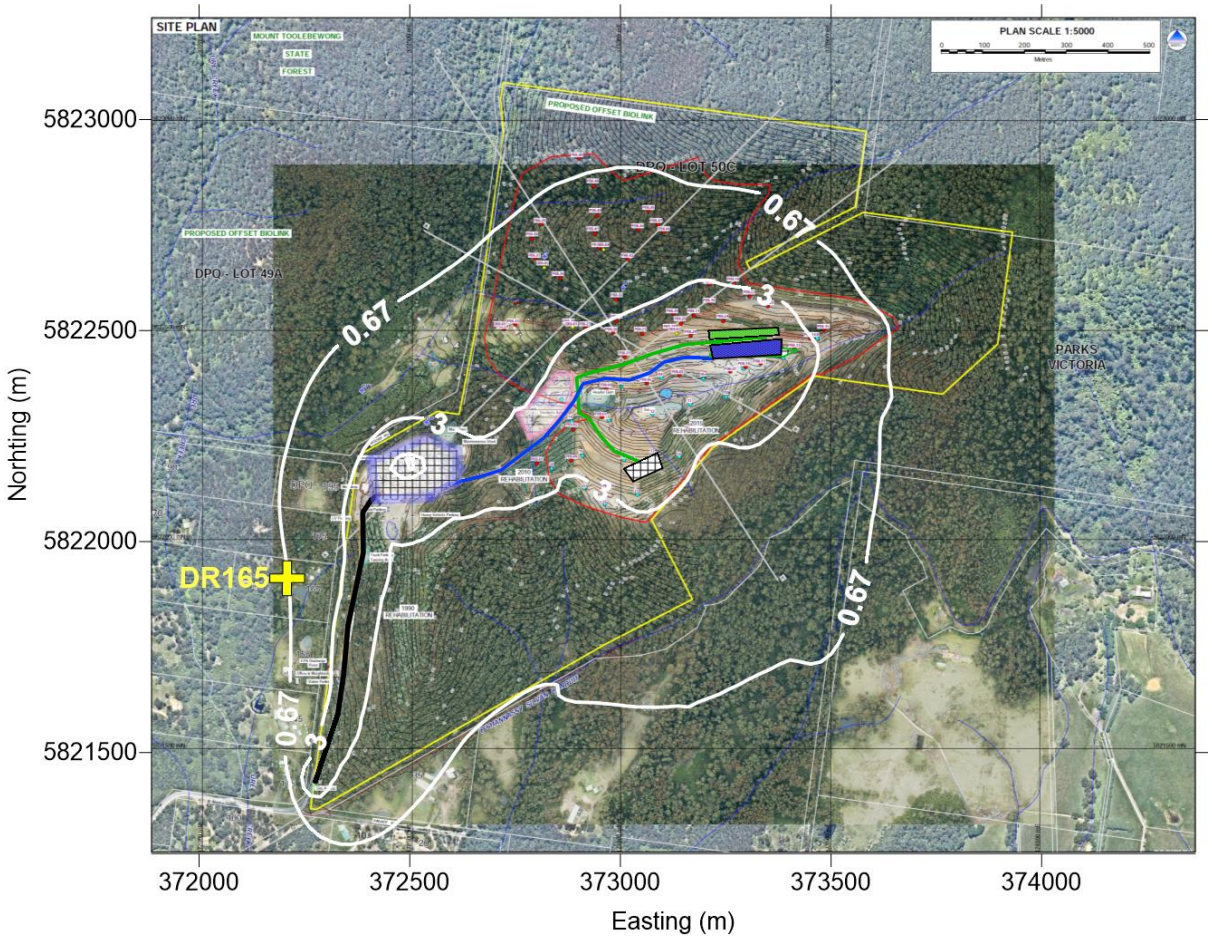


Figure 4.4: Contours of predicted, annual average, ground level concentration of PM_{10} – Year 2017 meteorology- YVQ Increment (excluding background). (Contour levels are 0.67 and 3 µg/m3).

4.2 Particulates as $PM_{2.5}$

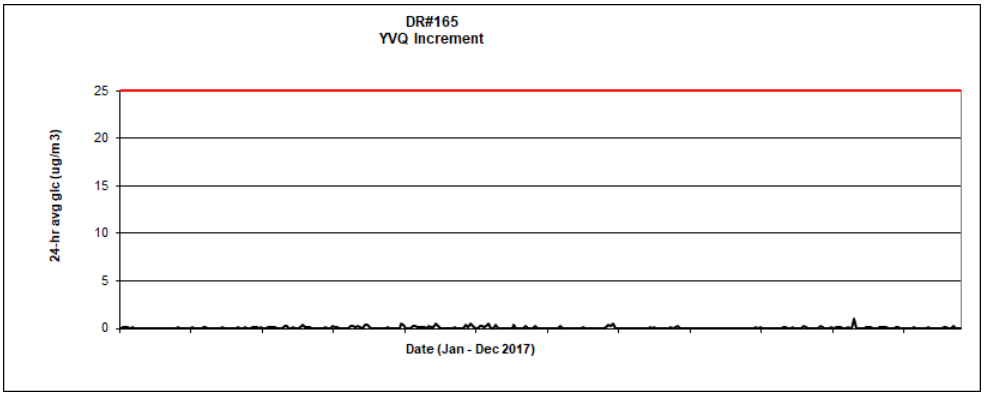
4.2.1 24-Hour Average

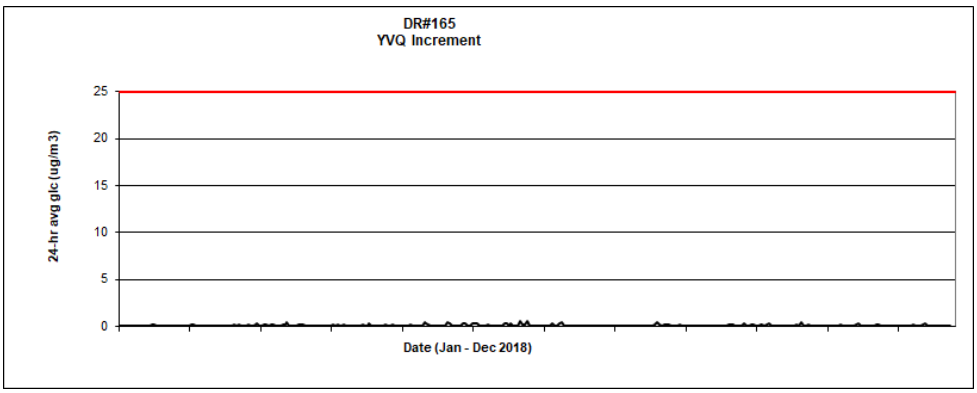
- Table 4.3 contains the 1st highest predicted 24-hour average $PM_{2.5}$ concentration at sensitive receptor DR165 arising from the YVQ emission generating activities based on each of the 5 years of meteorology, together with the percentage of the ERS APAC criterion.

Meteorological Year	Highest predicted 24-hour average GLC ug/m^3	Percentage of ERS APAC 25 ug/m3
Year 2017	0.98	3.92
Year 2018	0.57	2.28
Year 2019	0.63	2.52
Year 2020	0.57	2.28
Year 2021	0.87	3.48

Table 4.3

Figure 4.5 illustrates time series of the predicted 24-hour average concentrations at DR165 for each of the 5 years of meteorology, and Figure 4.6 illustrates a contour plot for Year 2017 meteorology.





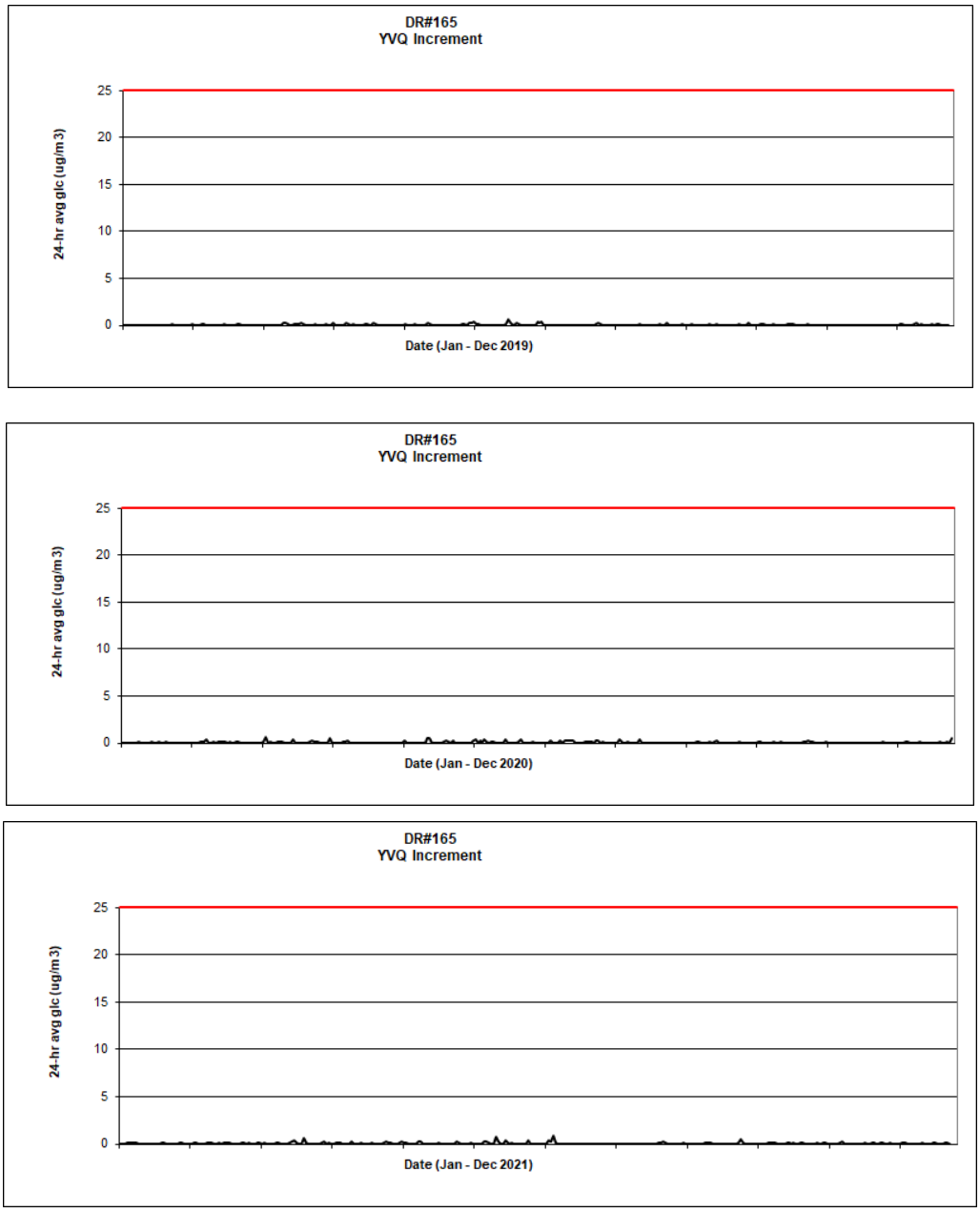


Figure 4.5: Time series plots at sensitive receptor DR165 - Predicted 24-hour ground level concentration of $PM_{2.5}$ – Years 2017 - 2021 - YVQ increment (excluding background).

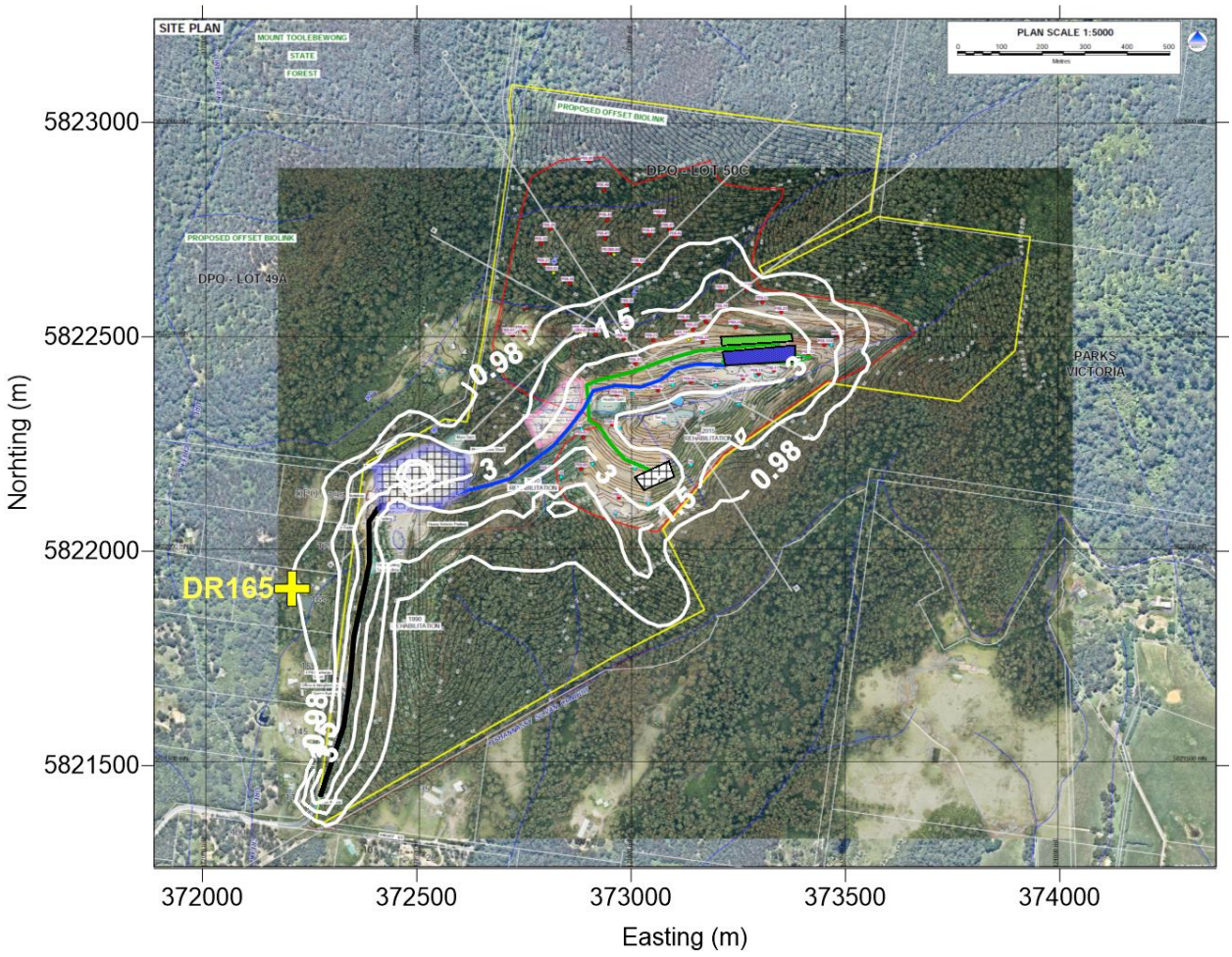


Figure 4.6: Contours of 1st highest predicted, 24-hour average, ground level concentration of $PM_{2.5}$ – Year 2017 meteorology - YVQ Increment (excluding background). (Contour levels are 0.98, 1.5 and 3 µg/m3).

4.2.2 Annual Average

- Table 4.4 contains the predicted annual average $PM_{2.5}$ concentration at sensitive receptor DR165 arising from the YVQ emission generating activities based on each of the 5 years of meteorology, together with the percentage of the ERS APAC criterion.

- The predicted impact due to the quarry is less than **1%** of the **8 ug/m^3** APAC criterion, albeit no background contribution is included

Meteorological Year	Annual average GLC ug/m^3	Percentage of ERS APAC 8 ug/m3
Year 2017	0.066	0.825
Year 2018	0.063	0.788
Year 2019	0.047	0.588
Year 2020	0.062	0.775
Year 2021	0.061	0.763

Table 4.4

- Figure 4.7 illustrates contours of predicted annual average based on Year 2017 meteorology.

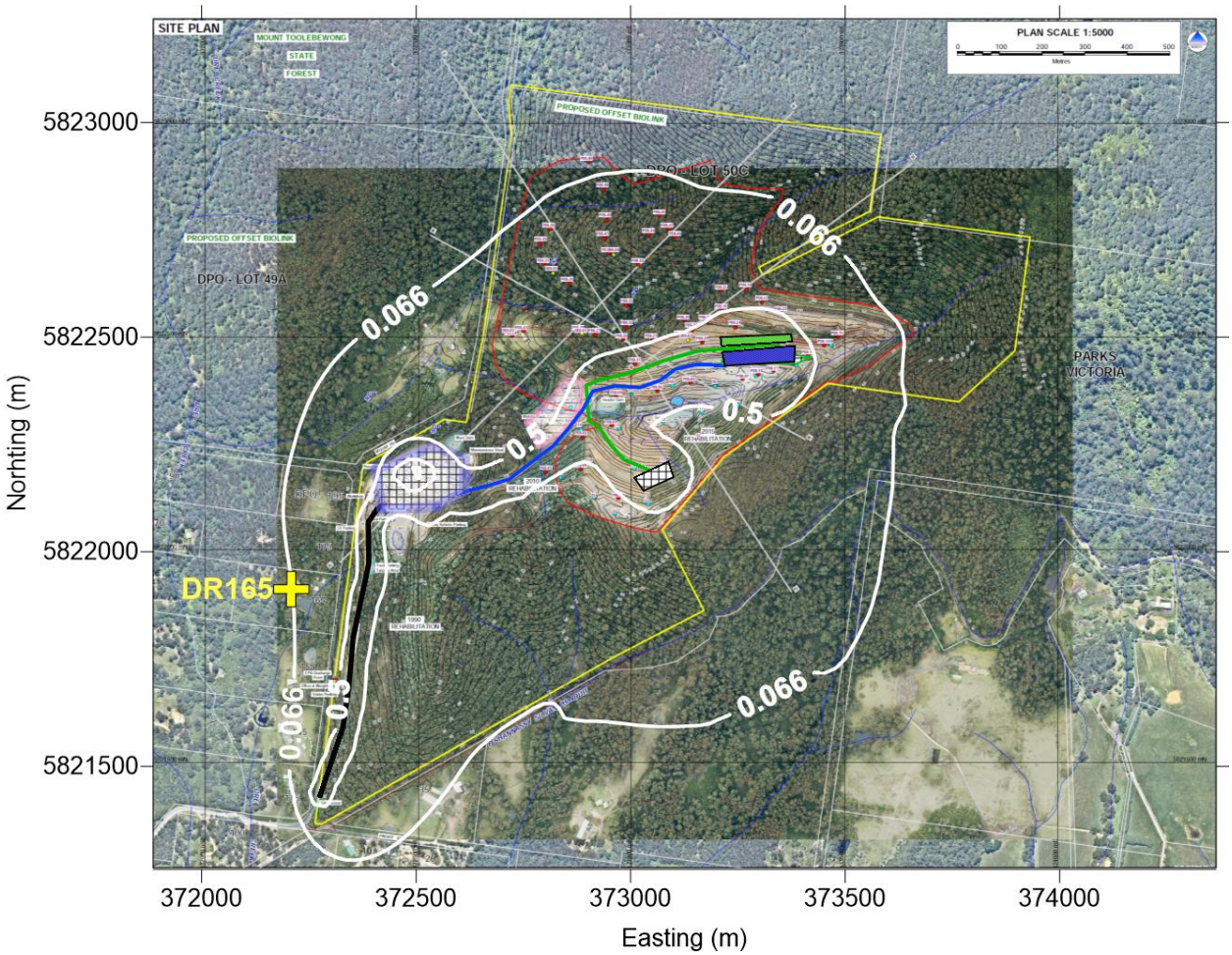


Figure 4.7: Contours of predicted annual average, ground level concentration of $PM_{2.5}$ – Year 2017 meteorology - YVQ Increment (excluding background).
(Contour levels are 0.066 and 0.5 µg/m3).

5. RESULTS – Existing Scenario - CUMULATIVE IMPACT

5.1 Introduction

- Evaluating cumulative impacts requires inclusion of the existing or background concentrations of the indicators of interest.

- In the absence of complete and verified representative 'on-site' monitored information, EPAV air monitoring data is one option for providing a benchmark for the background concentrations.

- The background concentrations adopted for this assessment are based on data from the Traralgon air monitoring station (AMS), albeit that the resulting background is expected to be overly conservative.

Background Level – Traralgon AMS Data

24-Hour Average

- EPAV recommends that background concentrations for 24-hour average assessments should be based on a time series of the observed 1-hour average values (henceforth referred to as the 'EPAV recommended approach'). The previous option to include a constant background concentration based on the 70th percentile of one year's observed hourly concentrations being no longer acceptable.

- The cumulative assessment results in Sections 5.2 and 5.3 are presented using background concentrations based on the 'EPAV recommended approach', with results based on the previous constant 70th percentile option also included for comparison and reference.

- Figures 5.1 and 5.2 provide time series of the 24-hour average PM_{10} and $PM_{2.5}$ concentrations at the Traralgon AMS for each of Years 2017-2021.

- Note that:
    - The 24-hour values have been calculated from the raw 1-hour values provided by EPAV.
    - Gaps represent periods when 24-hour values cannot be determined due to gaps in the 1-hour data.
    - The 24-hour average data includes the following exceedances (and identified causes[7]) of the ambient criterion:

PM_{10}

- Year 2017 – 0 exceedance days.
- Year 2018 – 1 exceedance day, due to land burns.
- Year 2019 – 5 exceedance days, 1 due to a bushfire, 1 due to local wind-blown dust and 3 due to wind-blown dust/bushfire.
- Year 2020 – 9 exceedance days, due to major regional bushfires that impacted the south east coast of Australia.
- Year 2021 – 0 exceedance days.

$PM_{2.5}$

- Year 2017 – 5 exceedance days, 4 due to planned burns and 1 due to domestic wood heaters.
- Year 2018 – 2 exceedance day, 1 due to wood heaters/land burns and 1 due to urban (wood heaters).
- Year 2019 – 7 exceedance days, 6 due to bush fires and 1 due to land burns.
- Year 2020 – 5 exceedance days, due to land burns and major regional bushfires that impacted the south east coast of Australia.
- Year 2021 – 2 exceedance days, 1 due to planned land burns and 1 due to wood smoke from domestic solid fuel heaters.

[7] EPA Victoria Publication Nos: 1703, 1749, 1875, 1958, 2052.

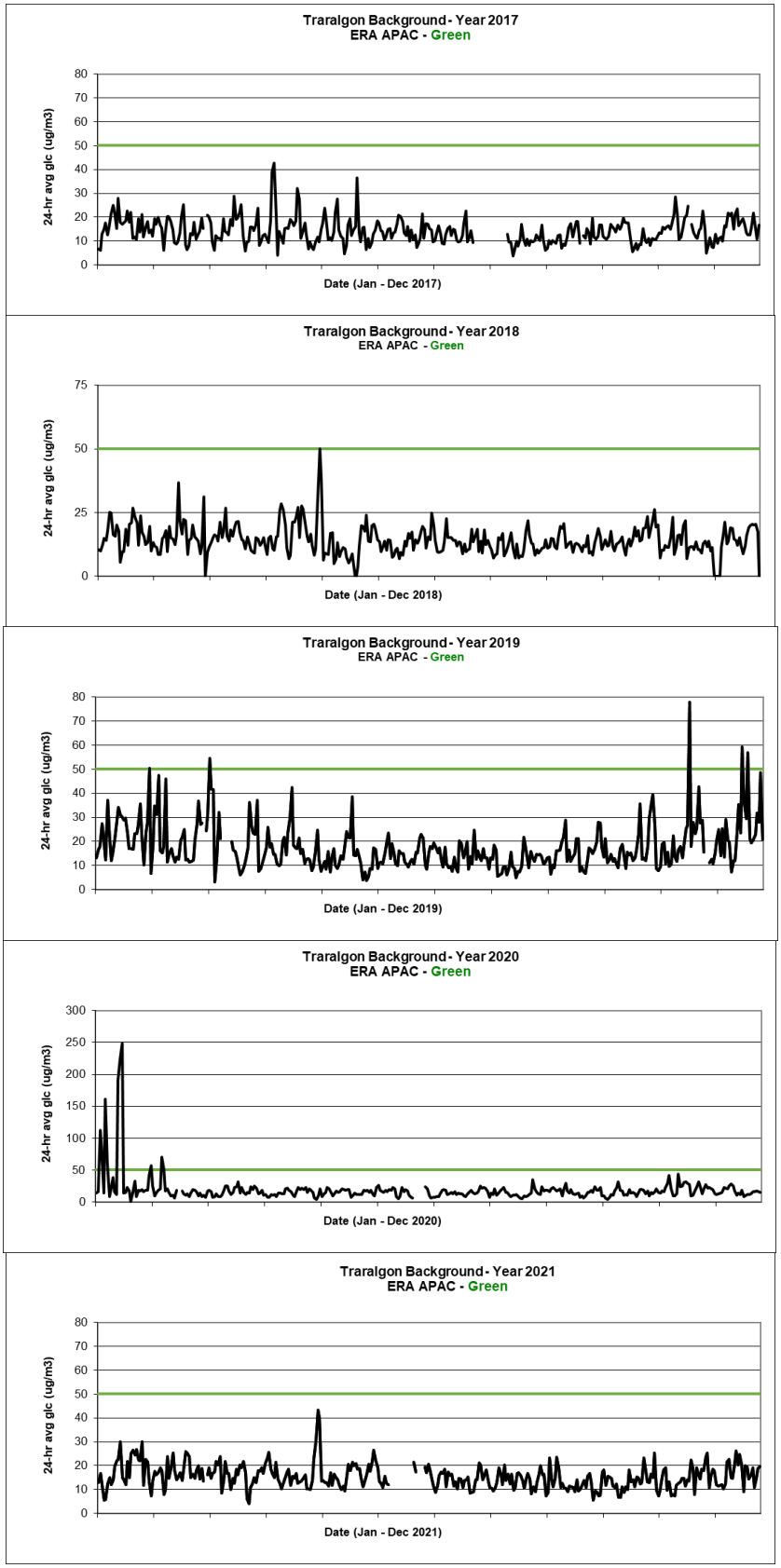


Figure 5.1: Time series of 24-hour averages – Traralgon AMS, Years 2017 - 2021 – PM_{10}

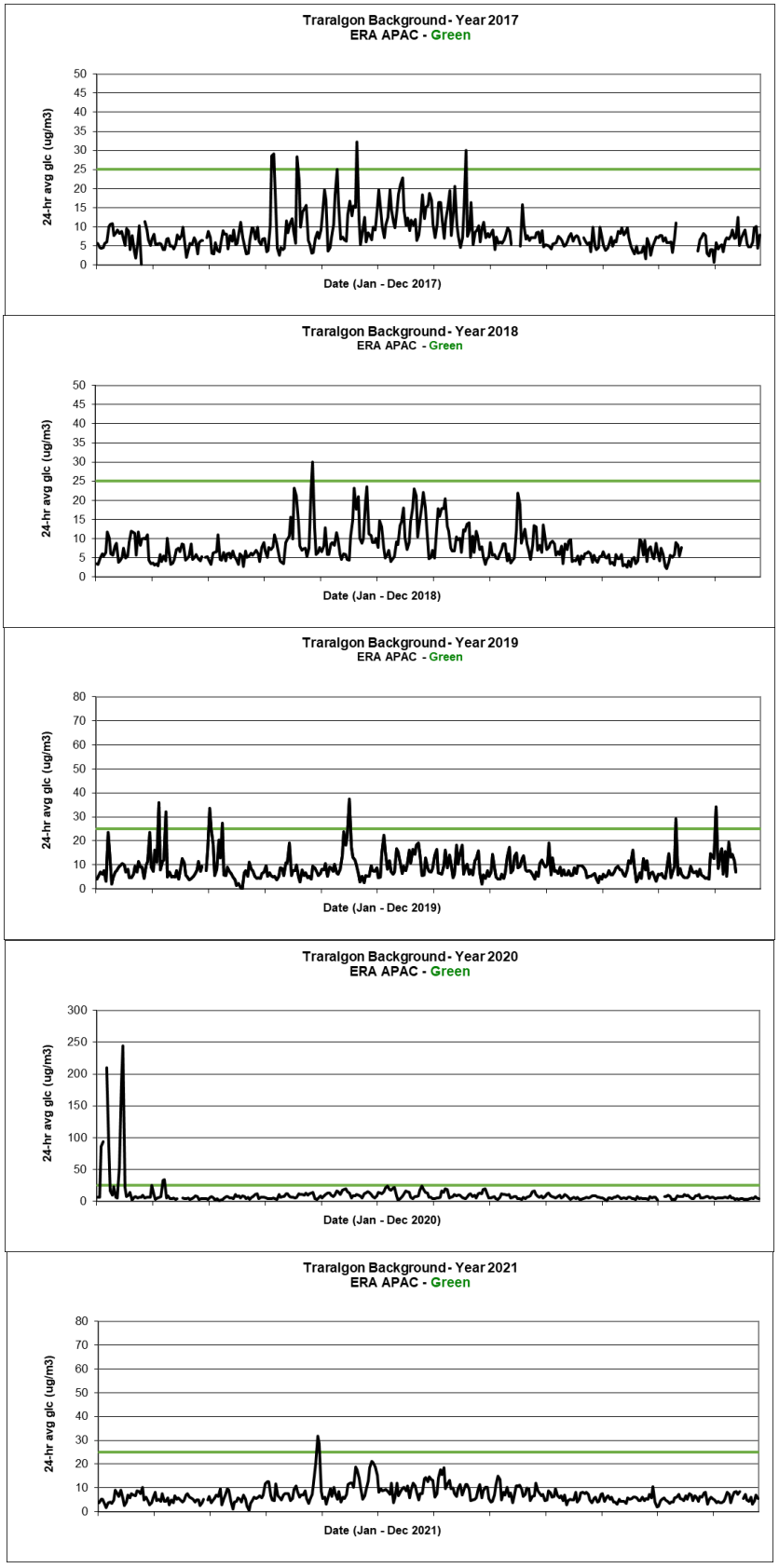


Figure 5.2: Time series of 24-hour averages – Traralgon AMS, Years 2017 - 2021 – $PM_{2.5}$

Annual Average

Table 5.1 contains the annual average PM_{10} and $PM_{2.5}$ concentrations at the Traralgon AMS for each of Years 2017-2021.

Meteorology	Annual average – Traralgon AMS ug/m^3	
	PM_{10}	$PM_{2.5}$
Year 2017	15.3	8.5
Year 2018	14.4	8.1
Year 2019	17.61	8.89
Year 2020	20.87	8.99
Year 2021	16.57	7.24
5-Year Average	**16.95**	**8.34**

Table 5.1 Annual averages

- **Note that for PM_{10}**:
  - The annual standard of 25 ug/m^3 for the National Environment Protection (Ambient Air Quality) Measure is met for each year, but the more stringent Victoria ERS APAC of 20 ug/m^3 is exceeded/marginal in Year 2020.
  - The annual averages are based on the raw 1-hour average data, and as such, include:
    - Exceptional events such as bushfires, hazard reduction burns, and continental scale dust storms; and
    - Local influences specific to the Traralgon area which may not be reflective of the Yarra Valley Quarry area.
  - In order to remove the influence of the exceptional events, the annual average cumulative results that follow are based on a '**representative'[8] annual average background concentration for PM_{10} of 14.15 ug/m^3.**
- **Note that for $PM_{2.5}$**:
  - The annual ERS APAC of 8 ug/m^3 is exceeded at the Traralgon AMS in all years apart from Year 2021.
  - The annual averages are based on the raw 1-hour average data, and as such, include:
    - Exceptional events such as bushfires and land burns; and
    - Local urban influences specific to the Traralgon area which may not be reflective of the Yarra Valley Quarry area.
  - However, starting in 2018, EPAV began reporting a population weighted annual average concentration of **7.1 ug/m^3** for Victoria[9].
  - As such, the annual average cumulative assessment results that follow are based on a '**representative' annual average background concentration for $PM_{2.5}$ of 7.1 ug/m^3.**

[8] Based on excluding days when the 24-hour average is greater than two standard deviations from the mean taken over the full 5 years (2017-2021) – the approach adopted in EPAV Publication No. 1709 when analysing $PM_{2.5}$ events and trends. Note that the resulting 'representative' level is also similar to a 'population weighted level' calculated by factoring the 5-year average value for PM_{10} in Table 5.1 in proportion to the corresponding adjustment to the 5-year average for $PM_{2.5}$ in Table 5.1.

[9] Based on the application of a modelling approach, in combination with population data (e.g., EPAV Publication Nos. 1749, 1875 & 11958).

5.2 PM_{10} Results – Cumulative Impact

5.2.1 24-Hour Average

EPAV recommended approach - background

Figure 5.3 provides the cumulative impact results at sensitive receptor DR165 based on meteorology for Year 2017. The time series illustrate predicted concentrations corresponding to the TOTAL (shown in red) of the quarry increment plus the background. The background level (shown in black) is included for reference.

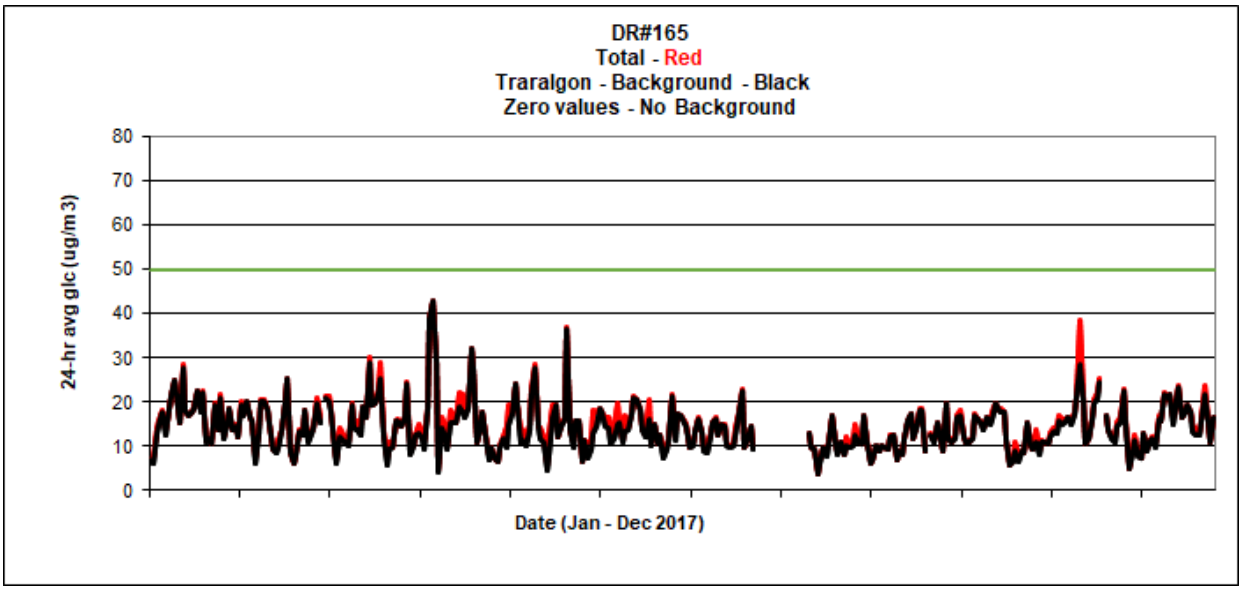


Figure 5.3 – DR165

The results indicate:

1. *No exceedances of the **ERS APAC of 50 ug/m^3**.*

2. *When the contribution from YVQ is highest, the total prediction is 38.4 ug/m^3 (with a background of 28.6 and a YVQ contribution of 9.8).*

Figure 5.4 provides the equivalent cumulative impact results based on the remaining four years of meteorology. The results indicate that any exceedances of the ERS APAC are as a result of the background, with no increase in the number of exceedances as a result of including the quarry increment[10].

[10] Albeit that there are some marginal cases when the background is just below the criterion.

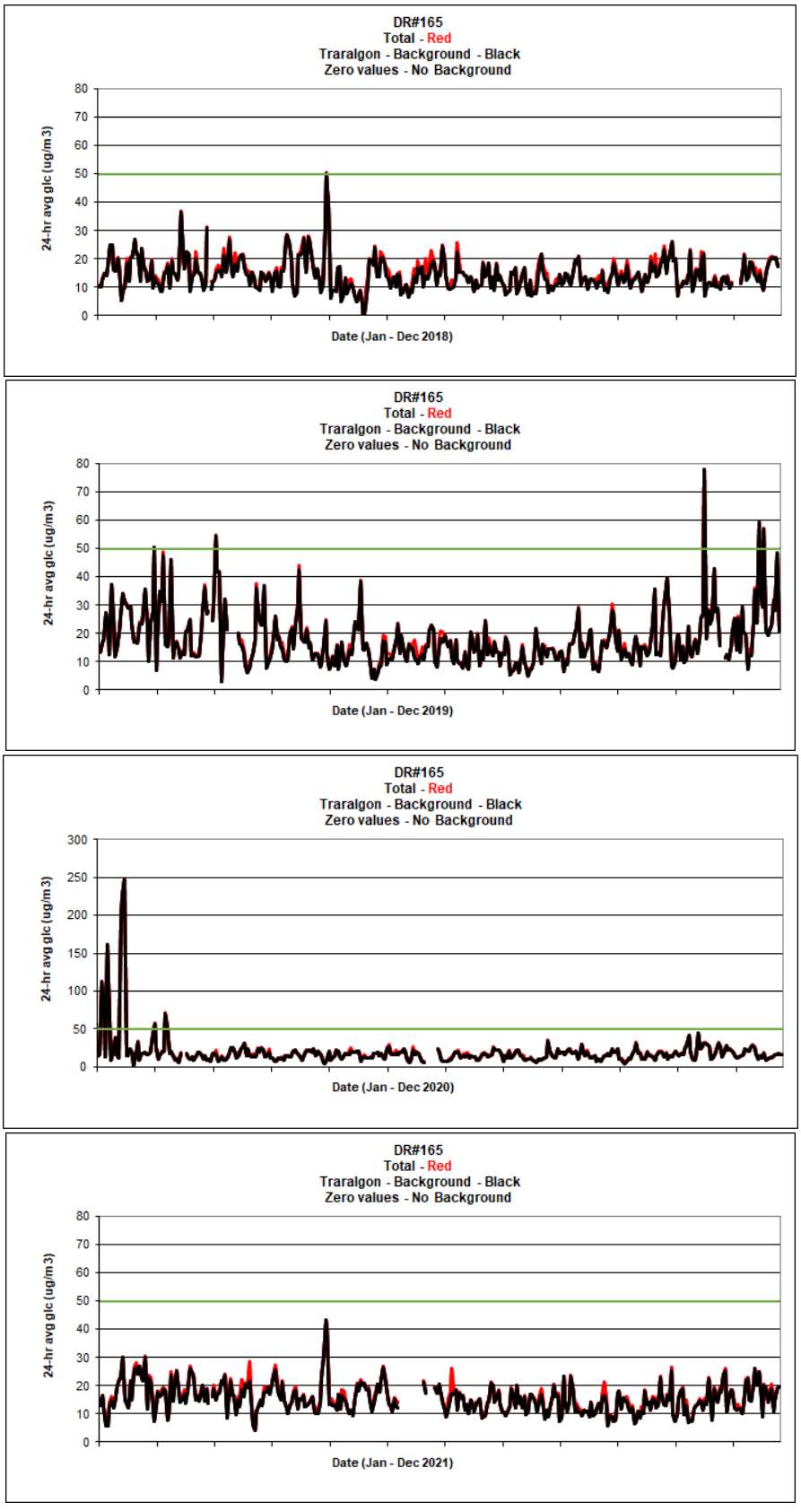


Figure 5.4: Time series plots at DR165 – Cumulative Impact – Years 2018 - 2021.

Constant 70th percentile – background

The following table contains the results based on adopting this representation of background for the 24-hour average predictions of PM_{10} at the sensitive receptor DR165 for Year 2017.

Sensitive Receptor	Quarry Increment (ug/m^3)	Background 70th percentile (ug/m^3)	TOTAL (ug/m^3)	Compliance (% of APAC)
DR165	9.8	16.7	26.5	Yes (53.0%))

5.2.2 Annual Average

The table below illustrates the cumulative impact prediction at the sensitive receptor DR165 based on including the 'representative' annual average concentration.

PM_{10}, ANNUAL AVERAGE			
Sensitive Receptor	**Quarry increment (ug/m^3)**	**Background (ug/m^3)**	**Total (ug/m^3)**
DR165	0.67	14.15	**14.82**

5.3 $PM_{2.5}$ Results – Cumulative Impact

5.3.1 24-Hour Average

EPAV recommended approach - background

Figure 5.5 provides the cumulative impact results at sensitive receptor DR165. The time series illustrate predicted concentrations corresponding to the TOTAL (shown in red) of the quarry increment plus the background. The background level (shown in black) is included for reference.

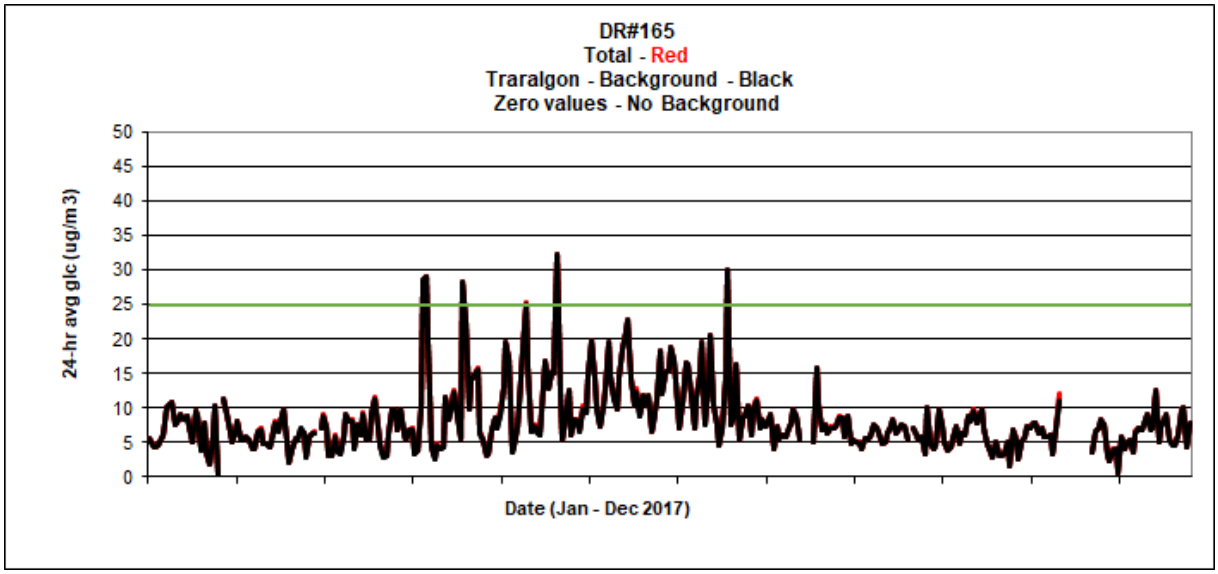


Figure 5.5 – DR165

The results indicate that:

1. *The five (5) exceedances of the **ERS APAC of 25 ug/m³** are as a result of the adopted background (4 due to planned burns and 1 due to domestic wood heaters), with no (0) additional exceedances as a result of including the quarry increment.*
2. *When the contribution from YVQ is highest, the total prediction is 12.1 ug/m³ (with a background of 11.1 and a YVQ contribution of 0.98).*

Figure 5.6 provides the equivalent cumulative impact results based on the remaining four years of meteorology. The results indicate that any exceedances of the ERS APAC are as a result of the background, with no increase in the number of exceedances as a result of including the quarry increment[11].

[11] Albeit that there are some marginal cases when the background is just below the criterion.

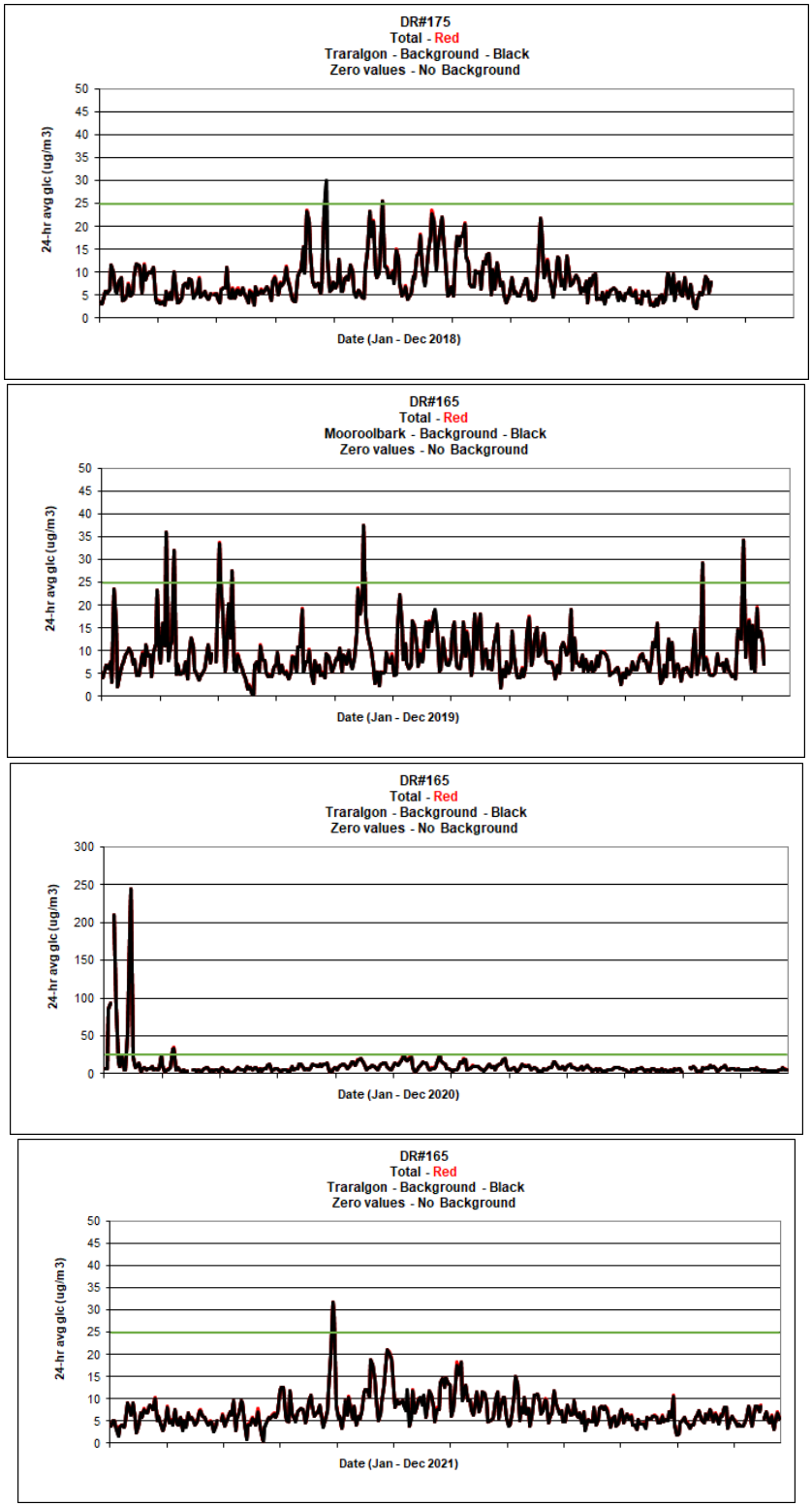


Figure 5.6: Time series plots at DR165 – Cumulative Impact – Years 2018 - 2021.

Constant 70th percentile – background

The following table contains the results based on adopting this representation of background for the 24-hour average predictions of $PM_{2.5}$ at sensitive receptor DR165 for Year 2017.

Sensitive Receptor	Quarry Increment (ug/m^3)	Background 70th percentile (ug/m^3)	TOTAL (ug/m^3)	Compliance (% of APAC)
DR165	0.98	9.6	10.58	Yes (42.32%))

5.3.2 Annual Average

The table below illustrates the cumulative impact prediction at sensitive receptors DR165 based on including the 'representative' annual average concentration.

PM_{10}, ANNUAL AVERAGE			
Sensitive Receptor	**Quarry increment (ug/m^3)**	**Background (ug/m^3)**	**Total (ug/m^3)**
DR165	0.066	7.1	**7.166**

6. RESULTS – Proposed Extension - Stage 1

6.1 Introduction

- This section provides key results that allow a comparison of the impacts of the following proposed future scenarios during Stage 1 with those of the current existing scenario:
    - **Stage 1 - Year 1-3 Scenario**
    - **Stage 1 - Year 7-10 Scenario**
- The results focus on the outcomes of the impacts at DR165 based on Year 2017 meteorology and background data.

6.2 Particulates as PM_{10}

6.2.1 24-Hour Average

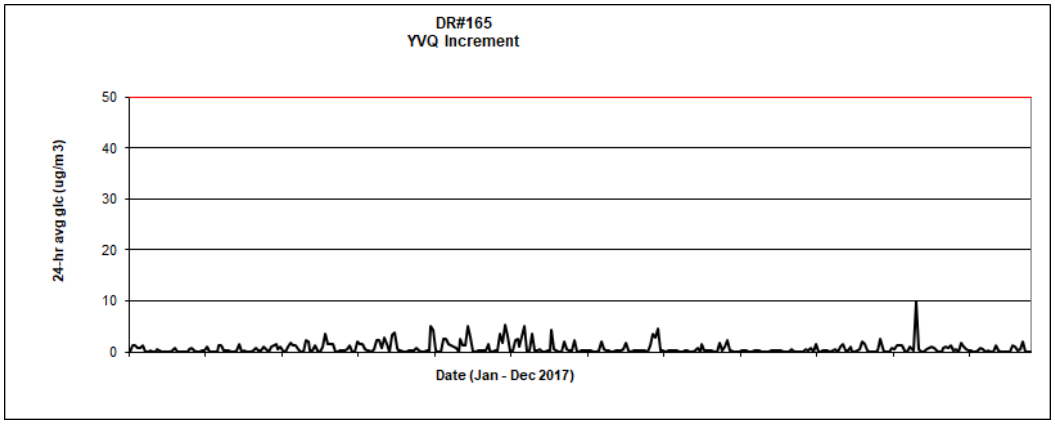
(i) YVQ Increment (excluding background)

- Table 6.1 contains a comparison of the 1st highest predicted 24-hour average PM_{10} concentration at the closest sensitive receptor DR165 arising from the quarry emission generating activities for each of the scenarios for Year 2017, together with the percentage of the ERS APAC criterion.

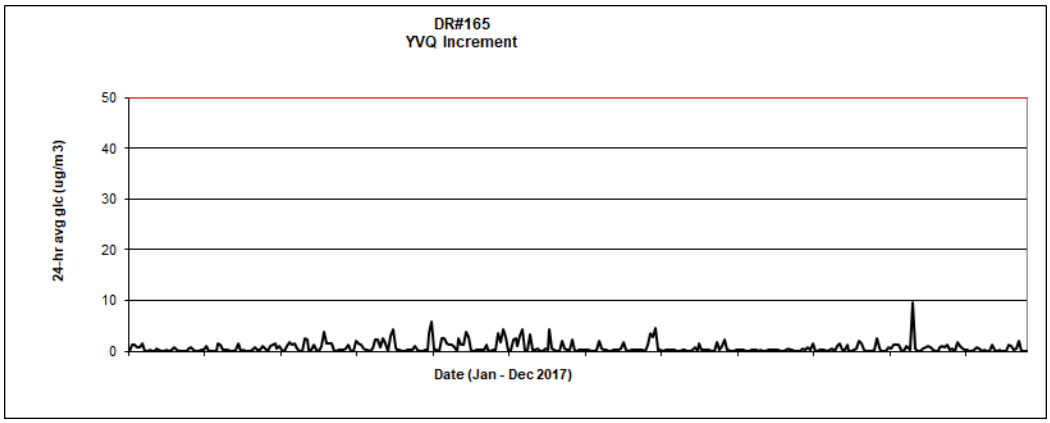
Sensitive Receptor ID: DR165	Highest predicted 24-hour average GLC, Year 2018 ug/m^3	Percentage of ERS APAC 50 ug/m^3
Existing Scenario	9.8	19.6
Years 1-3 Scenario	9.6	19.2
Years 7-10 Scenario	9.6	19.2

Table 6.1

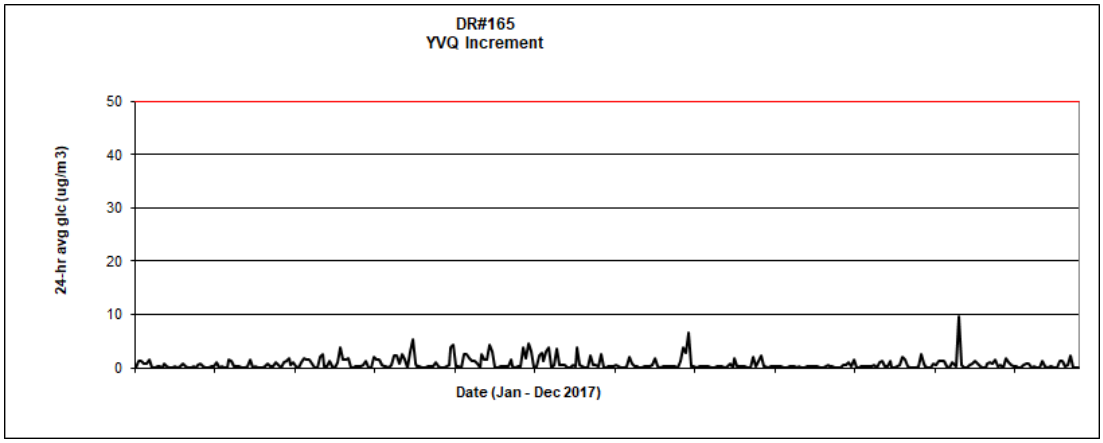
- Figure 6.1 provided a comparison of the time series of the predicted 24-hour average concentrations at DR165 based on Year 2017 meteorology for each scenario, with Figure 6.2 illustrating comparative contour plots.



(a) Existing Scenario

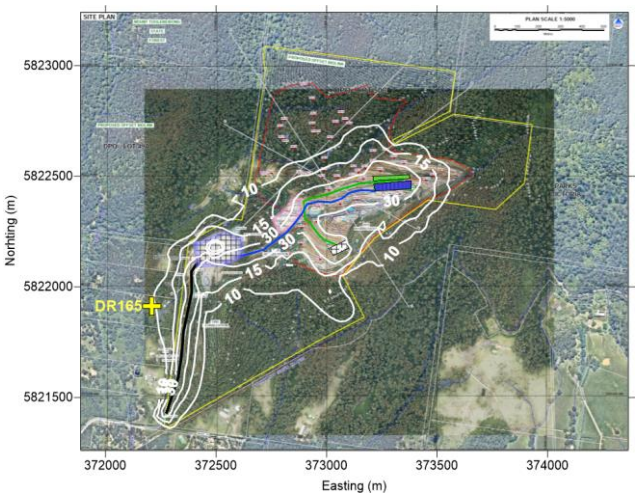


(b) Year 1-3 Scenario

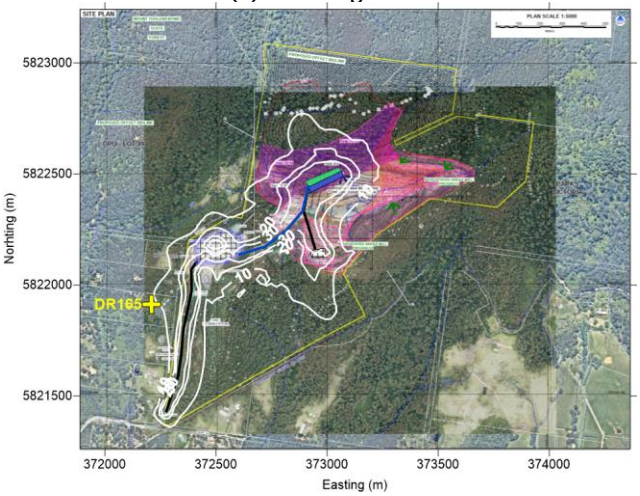


(c) Year 7-10 Scenario

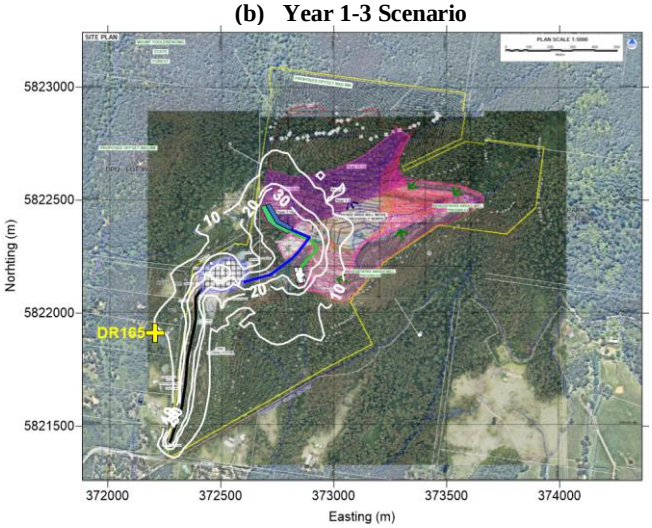
Figure 6.1



(a) Existing Scenario



(b) Year 1-3 Scenario

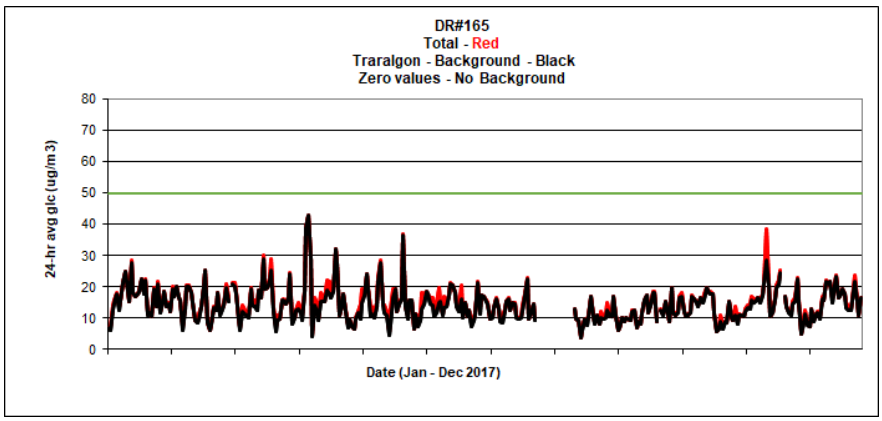


(c) Year 7-10 Scenario

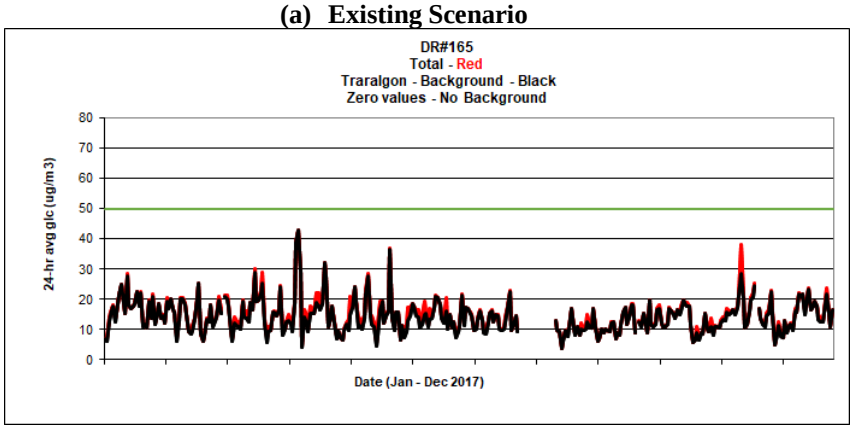
Figure 6.2: Contours of 1st highest predicted, 24-hour average, ground level concentration of PM_{10} – Year 2017 - YVQ Increment (excluding background).
(Contour levels are 10, 20 and 30 µg/m3).

(ii) Cumulative Impact

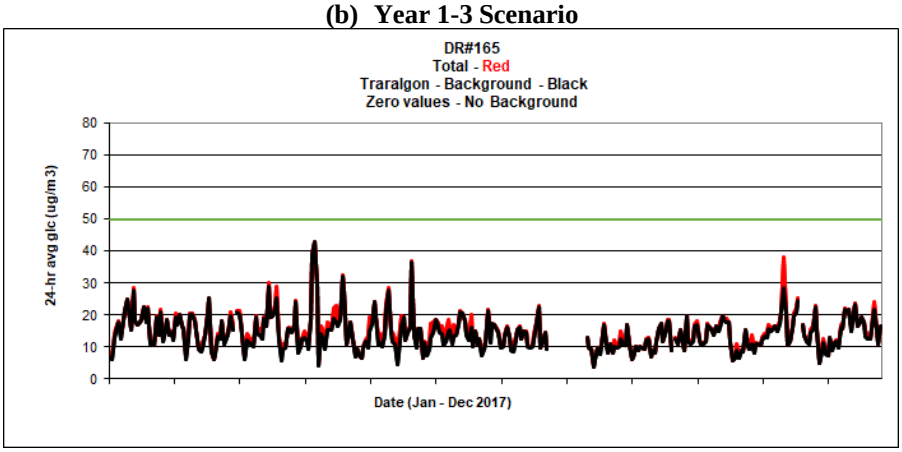
- Figure 6.3 provides the cumulative impact results at sensitive receptor DR165 for each of the scenarios based on Year 2017 meteorology. The time series illustrate predicted concentrations corresponding to the TOTAL (shown in red) of the YVQ increment plus the background. The background level (shown in black) is also included for reference.



(a) Existing Scenario



(b) Year 1-3 Scenario



(c) Year 7-10 Scenario

Figure 6.3

- The results indicate that for all three scenarios there is no increase in exceedances of the **ERS APAC of 50 ug/m3** resulting from the inclusion of the predicted quarry increment.

6.2.2 Annual Average

(i) YVQ Increment (excluding background)

- Table 6.2 contains the predicted annual average PM_{10} concentration at sensitive receptor DR165 arising from the YVQ emission generating activities for each of the scenarios based on Year 2017 meteorology, together with the percentage of the ERS APAC criterion.

Sensitive Receptor ID: DR165	Annual average GLC, Year 2018 ug/m^3	Percentage of ERS APAC 20 ug/m3
Existing Scenario	0.67	3.35
Years 1-3 Scenario	0.68	3.40
Years 7-10 Scenario	0.71	3.55

Table 6.2

- Figure 6.4 illustrates comparative contour plots of predicted annual average based on Year 2017 meteorology for each scenario.

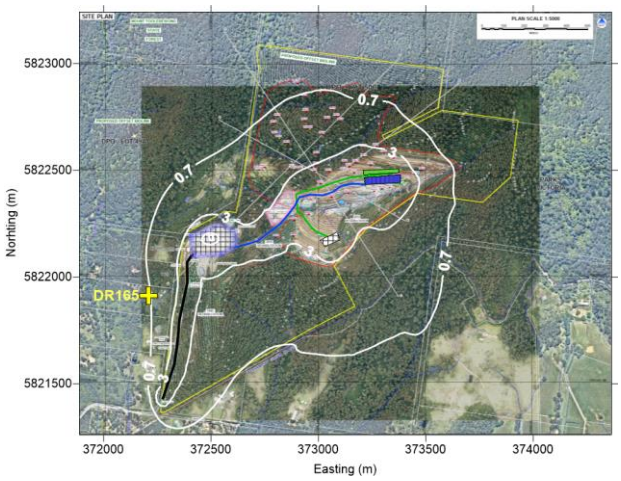
(ii) Cumulative Impact

- The table below illustrates the cumulative impact prediction at the impacted sensitive receptor DR165 for each scenario based on including the annual average of the observations at the Traralgon AMS during Year 2017.

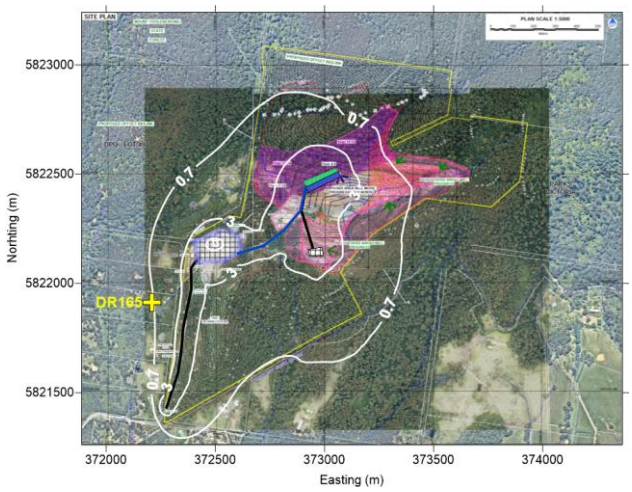
Sensitive Receptor	Quarry increment at DR165 (ug/m3)	Traralgon 2017 Background[12] (ug/m3)	Total (ug/m3)
Existing Scenario	0.67	15.3	**15.97**
Year 1-3 Scenario	0.68	15.3	**15.98**
Year 7-10 Scenario	0.71	15.3	**16.01**

- The results indicate that cumulative total satisfies the ERS APAC of 20 ug/m^3 for all three scenarios.

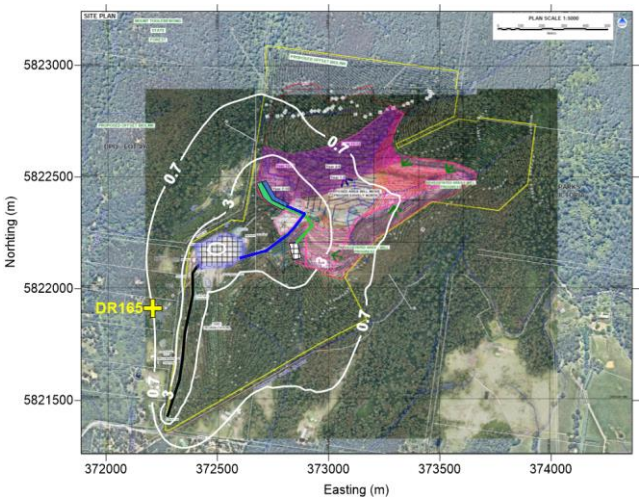
[12] EPAV Publication No. 1703 – Air monitoring report 2017.



(a) Existing Scenario



(b) Year 1-3 Scenario



(c) Year 7-10 Scenario

Figure 6.4: Contours of predicted, annual average, ground level concentration of PM_{10} – Year 2017 - YVQ Increment (excluding background).
(Contour levels are 0.7 and 3 µg/m3).

6.3 Particulates as $PM_{2.5}$

6.3.1 24-Hour Average

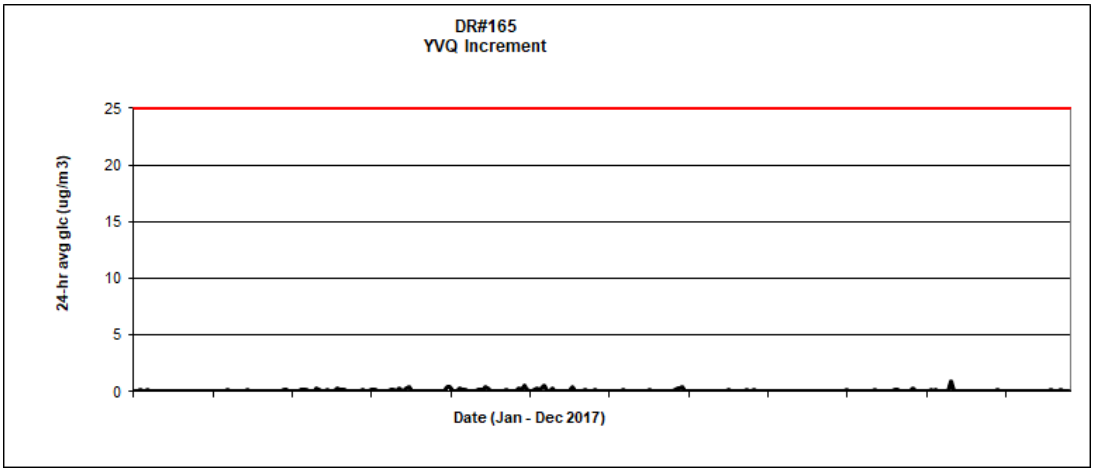
(i) YVQ Increment (excluding background)

- Table 6.3 contains a comparison of the 1st highest predicted 24-hour average $PM_{2.5}$ concentration at the closest sensitive receptor DR165 arising from the quarry emission generating activities for each of the scenarios based on Year 2017 meteorology, together with the percentage of the ERS APAC criterion.

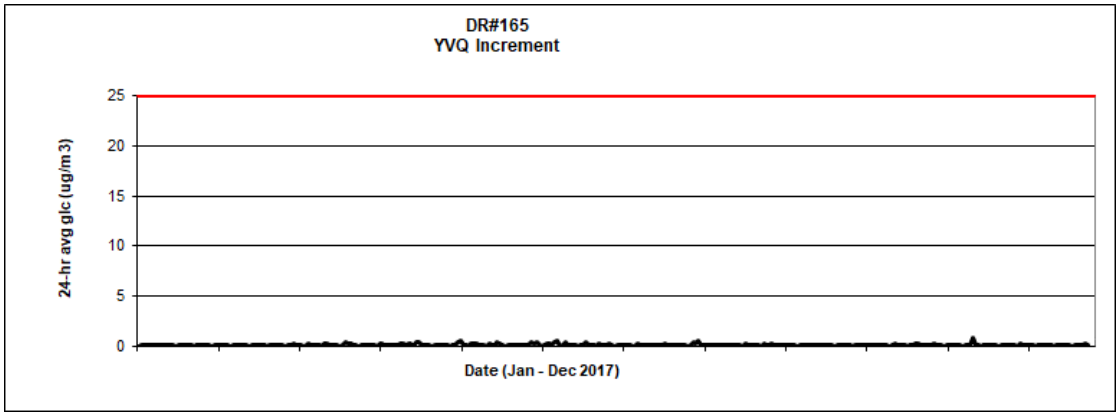
Sensitive Receptor ID: DR165	Highest predicted 24-hour average GLC, Year 2017 ug/m^3	Percentage of ERS APAC 25 ug/m^3
Existing Scenario	0.98	3.92
Years 1-3 Scenario	0.87	3.48
Years 7-10 Scenario	1.05	4.20

Table 6.3

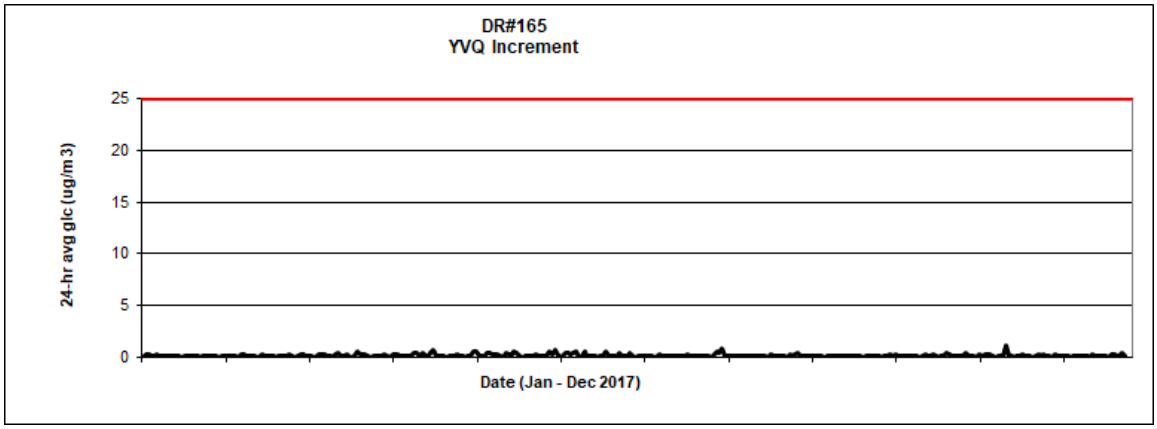
- Figure 6.5 provided a comparison of the time series of the predicted 24-hour average concentrations at DR165 based on Year 2017 meteorology for each scenario, with Figure 6.6 illustrating comparative contour plots.



(a) Existing Scenario

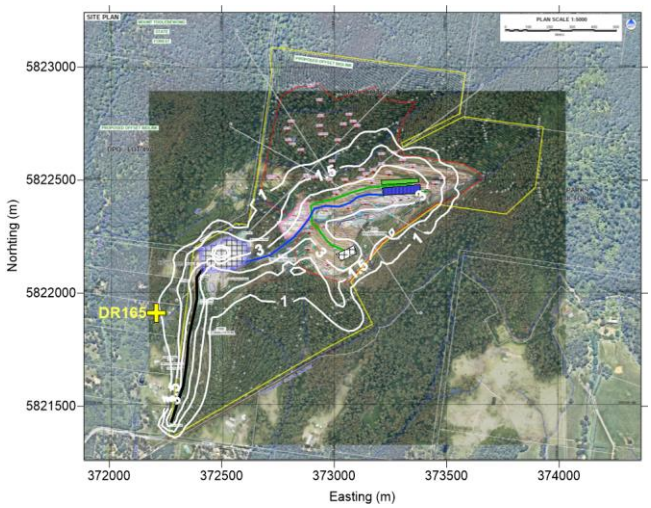


(b) Year 1-3 Scenario

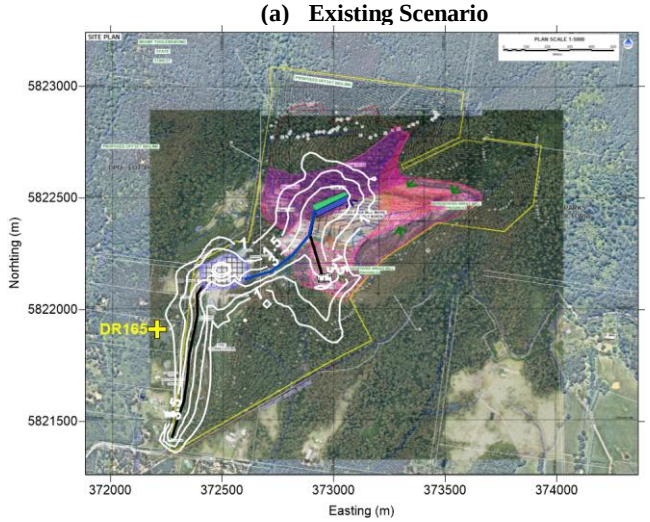


(c) Year 7-10 Scenario

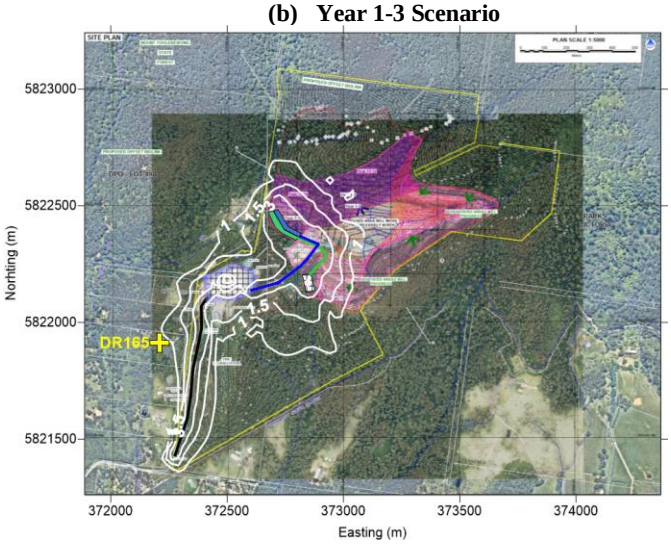
Figure 6.5



(a) Existing Scenario



(b) Year 1-3 Scenario

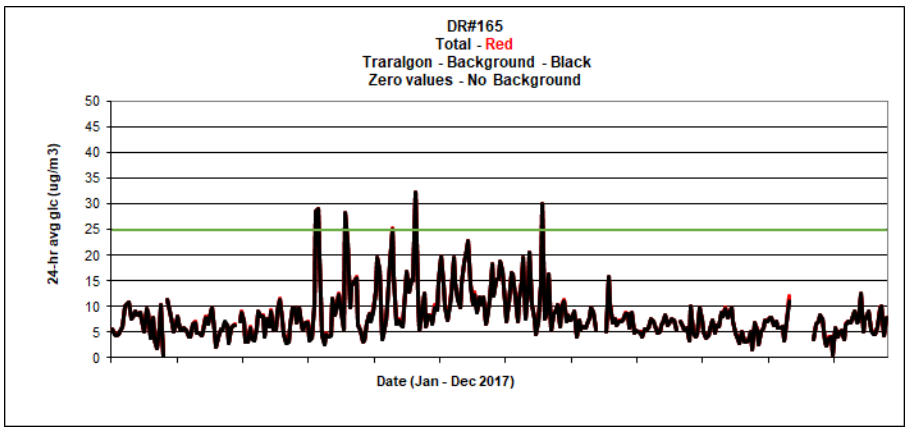


(c) Year 7-10 Scenario

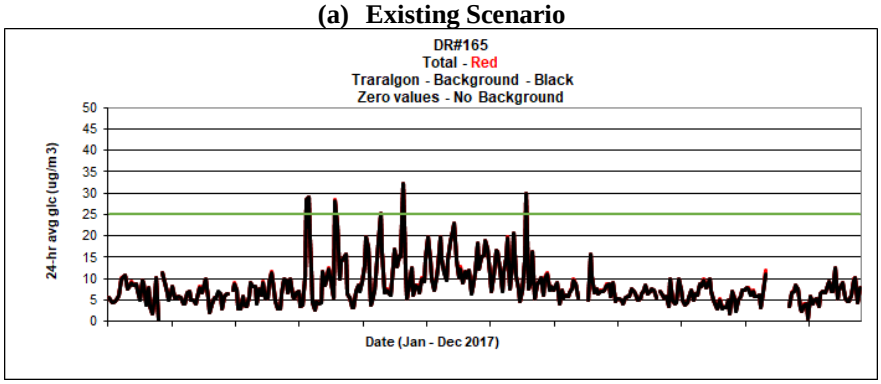
Figure 6.6: Contours of 1st highest predicted, 24-hour average, ground level concentration of $PM_{2.5}$ – Year 2017 - YVQ Increment (excluding background). (Contour levels are 1, 1.5 and 3 µg/m³).

(iii) Cumulative Impact

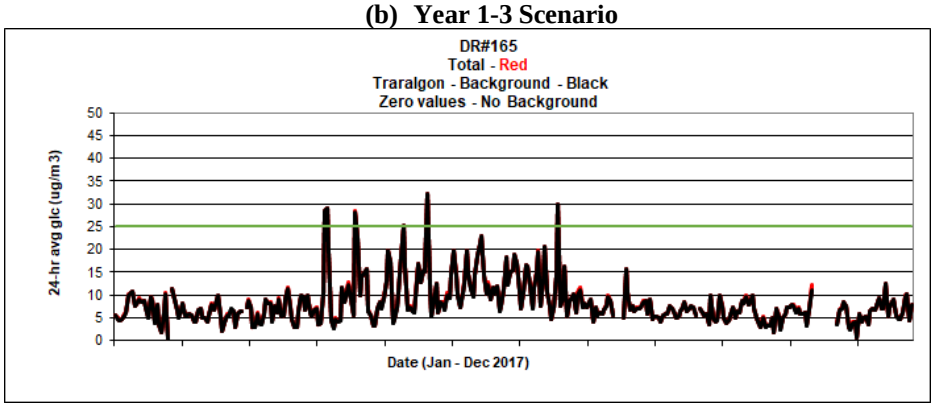
- Figure 6.7 provides the cumulative impact results at sensitive receptor DR165 for each of the scenarios based on Year 2017 meteorology. The time series illustrate predicted concentrations corresponding to the TOTAL (shown in red) of the YVQ increment plus the background. The background level (shown in black) is also included for reference.



(a) Existing Scenario



(b) Year 1-3 Scenario



(c) Year 7-10 Scenario

Figure 6.7

- The results indicate that for all three scenarios there is no increase in exceedances of the **ERS APAC of 25 ug/m3** resulting from the inclusion of the predicted quarry increment[13].

[13] Albeit that there is one marginal cases when the background is just below the criterion.

6.3.2 Annual Average

(i) YVQ Increment (excluding background)

- Table 6.4 contains the predicted annual average $PM_{2.5}$ concentration at sensitive receptor DR165 arising from the YVQ emission generating activities for each of the scenarios based on Year 2017 meteorology, together with the percentage of the ERS APAC criterion.

Sensitive Receptor ID: DR165	Annual average GLC, Year 2017 ug/m^3	Percentage of ERS APAC 8 ug/m3
Existing Scenario	0.066	0.825
Years 1-3 Scenario	0.065	0.813
Years 7-10 Scenario	0.097	1.21

Table 6.4

- Figure 6.8 illustrates comparative contour plots of predicted annual average based on Year 2017 meteorology for each scenario.

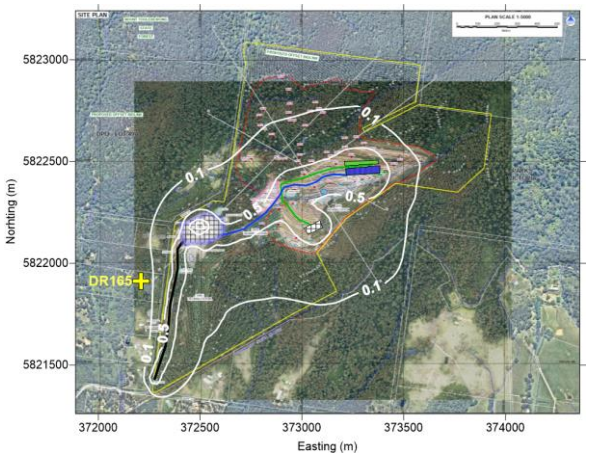
(iii) Cumulative Impact

- The table below illustrates the cumulative impact prediction at the impacted sensitive receptor DR165 for each scenario based on including the annual average of the observations at the Traralgon AMS during Year 2017.

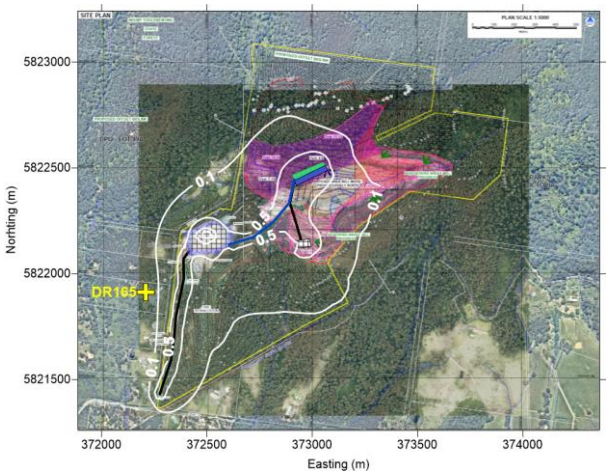
Sensitive Receptor	Quarry increment at DR165 (ug/m3)	Traralgon Background[14] (ug/m3)	Total (ug/m3)
Existing Scenario	0.066	7.1	**7.166**
Year 1-3 Scenario	0.065	7.1	**7.165**
Year 7-10 Scenario	0.097	7.1	**7.197**

- The results indicate that cumulative total satisfies the ERS APAC of 8 ug/m^3 for all three scenarios.

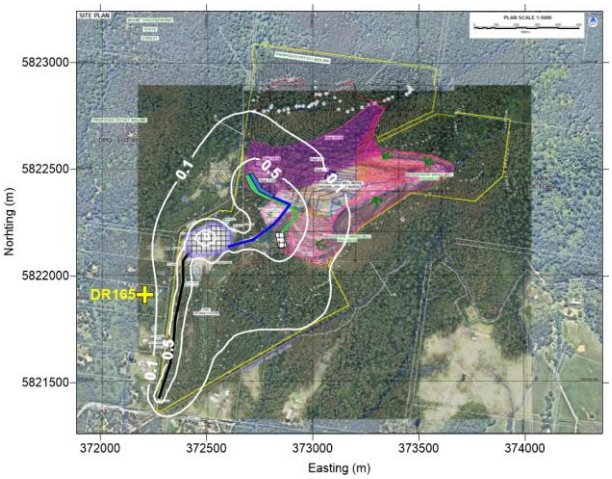
[14] Population weighted background - EPAV Publication No. 1749 – Air monitoring report 2020.



(a) Existing Scenario



(b) Year 1-3 Scenario



(c) Year 7-10 Scenario

Figure 6.8: Contours of predicted, annual average, ground level concentration of $PM_{2.5}$ – Year 2017 meteorology - YVQ Increment (excluding background). (Contour levels are 0.1 and 0.5 µg/m3).

7. RESPIRABLE CRYSTALLINE SILICA (RCS)

7.1 Background Concentration

- Ambient RCS concentrations are not routinely measured, and particularly for longer (annual) averaging periods that allow comparison against the **ERS APAC of 3 ug/m^3 (annual average).**

- A brief literature review of reported ambient concentrations indicates:

    - Reported ambient concentrations in the vicinity of coal mines in the Hunter Valley in the range 0.2 to 1.4 ug/m^3 (for the $PM_{2.5}$ size fraction), based on averaging periods of between one hour and five days.

    - A background concentration of 0.7 ug/m^3, apparently based on data collected in Victoria, as adopted by Toxikas in an assessment for a Material Recovery and Refuse Transfer Station[15].

    - A background concentration of 1.7 ug/m^3 (annual average) as suggested by EPAV in regard to the air quality assessment for the Murray Basin Mineral Sands Stage 2 Project[16]. Note that:
        - An air quality assessment report prepared by GHD[17] for a proposed new quarry at Chiltern, Victoria suggests that the EPAV value of 1.7 ug/m^3 was a 'non-detect' value for RCS, with the actual RCS value being somewhere between zero and 1.7 ug/m^3.
        - Recent advice from EPAV indicates that they do not have any background RCS data.

    - Recently reported annual average background concentrations from ambient monitoring campaigns associated with mineral sands projects:
        - 0.46 and 0.12 ug/m^3 [18]
        - 0.134 ug/m^3 [19]
        - 0.34 ug/m^3 [20]

- The results of the brief literature review suggest a value of around **0.3 ug/m^3** as a conservative background for rural locations with little anthropogenic activity.

[15] Not relevant as based on product sampling rather than 'in-air' sampling measurements.
[16] Section 9.1.5 - Inquiry Report – September 2008 – EES Murray Basin Mineral Sands Stage 2 Project, Work Approval Application WA63046.
[17] Air Quality Assessment – New Chiltern Quarry – GHD Report to Cemex Pty Ltd, November 2009.
[18] EES – Goschen Mineral Sands & Rare Earths Project (Loddon Mallee region).
[19] EES – Avonbank Mineral Sands Project (near Horsham)
[20] EES – Fingerboards Mineral Sands Project (north east of Bairnsdale)

7.2 Quarry Site Assessment

- *The table below provides the results of a conservative cumulative impact assessment (based on the adoption of a likely highly conservative background concentration of 1.7 ug/m^3, and an **implausible conservative assumption** that 100% of the predicted $PM_{2.5}$ annual average at the highest impacted residential receptor is as RCS) which demonstrates that the APAC of 3 ug/m^3 would be satisfied for all three scenarios.*

ANNUAL AVERAGE – RCS – APAC – 3 ug/m^3						
Sensitive Receptor DR165	**Quarry Increment $PM_{2.5}$ (ug/m^3)**	**Assumed Percentage RCS (%)**	**Quarry Increment RCS (ug/m^3)**	**Background (ug/m^3)**	**TOTAL RCS (ug/m^3)**	**Compliance (% of APAC)**
Existing Scenario	0.066	100	0.066	1.7	1.766	Yes (58.87%)
Year 1-3 Scenario	0.065	100	0.065	1.7	1.765	Yes (58.83%)
Year 7-10 Scenario	0.097	100	0.097	1.7	1.797	Yes (59.90%)

8. CONCLUDING REMARKS

8.1 General

The report presents the results of an investigation of the efficacy of a Level 2 air assessment of the proposed WA375 Work Plan Variation. The results have been based on the use of dispersion modelling, with the predicted pollutant concentrations benchmarked against a set of pre-defined Air Pollution Assessment Criteria (APACs).

The Level 2 dust impact assessment modelling has been performed following the requirements of GAMAPV, EPA Publication 1961 (February 2022): *Section 5.3.1 – Air Pollution Modelling, and Section 6.3 – Application of APACs to Modelling Outputs*, for emissions of the following health indicators:

- **Particulates as PM_{10}**
- **Particulates as $PM_{2.5}$**
- **Respirable Crystalline Silica (RCS)**

The modelling approach has been undertaken to predict impacts at a discrete receptor (DR165) located at the allotment (#165) closest to the YVQ facility. The impact assessment has been undertaken for the following cases:

- **Existing Scenario** – a 'base' case representative of existing (2023) conditions.
- **Year 1-3 Scenario** – a future case representative of Year 1-3 conditions during the proposed Stage 1 extension.
- **Year 7-10 Scenario** – a future case representative of Year 7-10 conditions during the proposed Stage 1 extension.

Note that:

- The **Year 7-10** scenario has been selected as representative of potential worst-case impacts on DR165 during **Stage 1** of the proposed extension, particularly on the basis of proximity to DR165.
- The impacts at DR165 resulting from the following years in Stage 1, and the subsequent Stages 2 – 4, can be regarded as further reduced as extraction activities move further north.

The primary impact assessment results presented have been based on Year 2017 meteorology and daily-varying background data, albeit that additional results are also presented that indicate that the key assessment results listed below are also valid for Years 2018 – 2021 meteorology.

The information presented in this report supports the following conclusions for the proposed WA375 Work Plan Variation:

General

- 'Natural' sources[21] can result in exceedances of the ERS APACs for PM_{10} and $PM_{2.5}$ throughout the region, and at the quarry facility.
- The incremental contribution from the quarry sources is predicted to:
    - Be small relative to the background chosen as representative of what can naturally occur in the local environment.
    - Not result in any significant additions to the 'naturally' occurring number of exceedances.

Specific

Particulates as PM_{10}

Quarry Increment

- *The predicted maximum increment from the quarry at the highest impacted sensitive receptor is less than 20% of the 24-hour average ERS APAC for PM_{10} of 50 ug/m^3.*

Cumulative Impact

- *The cumulative average, based on background data from the Traralgon AMS, includes exceedances of the ERS APAC of 50 ug/m^3, however, these are all due to the background, with no additional exceedances resulting from the inclusion of the quarry increment.*
- *The predicted cumulative annual average satisfies the ERS APAC of 20 µg/m^3 at the highest impacted sensitive receptor, with the maximum increment from the quarry less than 4% of the APAC.*

Particulates as $PM_{2.5}$

Quarry Increment

- *The predicted maximum increment from the quarry at the highest impacted sensitive receptor is less than 4% of the 24-hour average ERS APAC for $PM_{2.5}$ of 25 ug/m^3.*

Cumulative Impact

- *The cumulative average, based on background data from the Traralgon AMS, includes exceedances of the ERS APAC of 25 ug/m^3, however, these are all due to the background, with no additional exceedances resulting from the inclusion of the quarry increment.*
- *The predicted cumulative annual average at the highest impacted sensitive receptor is problematic when background based on Traralgon data are included, however:*
    - *The background based on the Traralgon annual average already exceeds the ERS APAC of 8 µg/m^3, but satisfies the APAC if cases when a population weighted adjustment is adopted.*
    - *The predicted cumulative annual average satisfies the APAC when the adjusted background is included.*

Respirable Crystalline Silica (RCS)

- *A cumulative impact assessment based on the adoption of a likely conservative background concentration of 1.7 ug/m^3, and **an implausible conservative assumption** that 100% of the predicted $PM_{2.5}$ annual average at the highest impacted residential receptor is as RCS, indicates that the APAC of 3 ug/m^3 would be satisfied.*

[21] As represented by the adopted background dataset which includes exceptional events such as bushfires, hazard reduction burning or continental-scale windblown dust that cannot be controlled through normal air quality management strategies.

8.2 Conclusion – Level 2 Assessment

- ***The assessment outcomes from the Level 2 modelling support a case for approval of the proposed WA375 Work Plan Variation, with a requirement to undertake continuing monitoring for model verification.***

- ***Note that:***

    - ***The outcomes are based on:***

        - ***Very conservative assumptions regarding emissions.***

        - ***Modelling results that do not include potential reductions in impact due to the influence of 'in-pit retention', intervening vegetation, and/or the adoption of further possible source emission controls.***

    - ***The results can also be regarded as 'comparative' modelling providing a framework where relative influences and changes to emission sources can be examined and compared.***

APPENDIX 1: Emissions Inventory – Emission Factors and Assumptions

1. General

- Particulate emissions for the scenarios have been based on relevant emission factors sourced from National Inventory (NPI) Emission Estimation Technique Manual for Mining version 3.1 and the USEPA AP-42 Emission Factor Handbook; in combination with material volumes, characteristics and operating conditions as provided by Dandy Premix and BCA.
- Table A-1 presents details of the emission factors and/or equations adopted, including the assumed emission controls.
- Table A-2 outlines the representation of the emission sources adopted in AERMOD, including the specific emission component types included.
- Sections 2 – 7 provide details of the resulting PM_{10} and $PM_{2.5}$ emission rates for each emission component type, together with the key input characteristic assumed.

Activity	Emission Factor &/or Equation	Units	Source	Variables/Notes	Controls Applied
Loading/unloading – excavator/shovel/FEL	**$EF = k \times 0.0016 \times (U/2.2)^{1.3}/(M/2)^{1.4}$**	**kg/t**	**NPI Mining v3.1, AP-42 13.2.4-3**	**k = 0.35 (PM_{10})** **k = 0.053 ($PM_{2.5}$)** **U = average wind speed (m/s)** **M = moisture content (%)**	**No controls**
Bulldozing	**$EF = k \times s^{1.2}/M^{1.3}$**	**kg/h**	**AP-42 11.9-2, NPI Mining v3.1**	**k = 2.6 x 0.75 = 1.95 (PM_{10})** **k = 2.6 x 0.105 = 0.273 ($PM_{2.5}$)** **s = silt content (%)** **M = moisture content (%)**	**No controls**
Unpaved haul roads – wheel dust	**$EF = (0.4536/1.6093) \times k \times (s/12)^{0.9} \times ((W \times 1.1023)/3)^{0.45}$**	**kg/VKT**	**NPI Mining v3.1, AP-42 13.2.2-4**	**k = 1.5 (PM_{10})** **k = 0.15 ($PM_{2.5}$)** **s = silt content (%)** **W = average vehicle weight (t)**	**No controls**
Wind erosion	**Annual average emissions:** **EF = 0.2 (PM_{10})** **Hourly varying (wind dependent) emissions:** **$EF = k \times U^3 \times (1 - U_t^2/U^2)$, $U > U_t$**	**kg/ha/h** **g/s/m^2**	**NPI Mining v3.1** **Shao et al (1996)**	**$PM_{2.5} = 0.1515 \times PM_{10}$ (AP-42, 11.19.2)** **k = site specific empirical constant** **U_t = wind speed threshold = 5.4 m/s**	**No controls**
Crusher: **Primary, Secondary & Tertiary crushing** **Fines crushing** **Screening** **Fines screening** **Conveyor transfer point** **Unloading** **Loading**	**0.0012 (PM_{10}); 0.000222 ($PM_{2.5}$)** **0.0075 (PM_{10}); 0.0004375 ($PM_{2.5}$)*** **0.0043 (PM_{10}); 0.00029 ($PM_{2.5}$)*** **0.036 (PM_{10}); 0.0024 ($PM_{2.5}$)*** **0.00055 (PM_{10}); 0.00016 ($PM_{2.5}$)*** **0.000008 (PM_{10})**** **0.000005 (PM_{10})****	**kg/t**	**AP-42 11.19.2.2, Table 11.19.2-1**	***$PM_{2.5}$ emission factors based on $PM_{2.5}/PM_{10}$ ratios for controlled factors contained in AP-42, 11.19.2, Table 11.19.2-1** **** Replaced by loading/unloading emission factors in AP-42 13.2.4-3 (Conservative assumption)**	**No controls**

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ID	Type	Characteristics	Description	Emission Components
EX	**Volume (x5)**	**sigyo=8.46m, sigzo=5m**	**Rock extraction bench**	• **Loading/unloading** • **On-bench roads – Level 1 watering** • **Bulldozing** • **Drilling & Blasting**
OB	**Volume (x5)**	**sigyo=8.46m, sigzo=5m**	**Overburden extraction bench**	• **Loading/unloading** • **On-bench roads- Level 1 watering** • **Bulldozing**
RH	**Volume (x2)**	**sigyo=11.28m, sigzo=5m**	**Rehabilitation area**	• **Loading/unloading** • **On-bench roads- Level 1 watering** • **Bulldozing**
EXHR1-13	**Line**	**width=10m, sigzo=5m**	**Haul road from extraction bench EX to MOB & MAIN stockpiles & processing crusher**	• **Unpaved haul road – Level 2 watering**
OBHR1-7	**Line**	**width=10m, sigzo=5m**	**Haul road from overburden bench OB to rehab. area RH**	• **Unpaved haul road – Level 2 watering**
OFHR1-4	**Line**	**width=10m, sigzo=5m**	**Haul road from MAIN stockpiles to off-site via weighbridge**	• **Unpaved haul road – Level 2 watering**
OFHR1-11	**Line**	**width=10m, sigzo=5m**	**Haul road from SE stockpile to off-site via weighbridge**	• **Unpaved haul road – Level 2 watering**
MOB	**Volume (x1)**	**(sigyo=21m, sigzo=5m) x4**	**Mobile processing area – crusher & stockpiles (pre & post)**	• **Unloading/loading – Trucks & FEL** • **FEL transfer roads – Level 1 watering** • **Crushing/screening**
MAIN	**Volume (x1)**	**sigyo=21m, sigzo=5m**	**Materials processing area – crusher & stockpiles (pre & post)**	• **Unloading/loading – Trucks & FEL** • **FEL transfer roads – Level 1 watering** • **Crushing/screening**
WE1-5	**Volume (x4)**	**(sigyo=46.6m, sigzo=0m)** **(sigyo=20.9m, sigzo=0m)** **(sigyo=25.8m, sigzo=0m)** **(sigyo=16.5m, sigzo=0m)**	**General area wind erosion**	• **Wind speed categories**

Table A-2: Source Representation - AERMOD

2. Loading/unloading – excavators/shovels/FELs

	PM-10								EXISTING SCENARIO-STD EMISSIONS			
											PROPORTION TO:	
	Loading/unloading	EX-BENCH	OB-BENCH							EX-MATERIAL (t)	MAIN	MOBILE
	M (%)	10	12						EX-BENCH	353000	0.960313	0.039687
	Wind speed (m/sec)	2.7	2.7						OB-BENCH	147000		
	k	0.35	0.35									
	EF (kg/t)	7.37171E-05	5.71103E-05									
Source type	Emission factor kg/t	Material volume t/anm	PM10 kg/anm	Hrs/anm	PM10 kg/hr	PM10 g/sec	Area m**2	PM10 g/m2/sec				
EX-BENCH												
Removal/Loading-EX	7.37171E-05	353000	26.022	3484	0.007	0.00207	4500	0.000000461				
OB-BENCH												
Removal/Loading-OB	5.71103E-05	147000	8.395	1876	0.004	0.00124	4500	0.000000276				
PROCESSING-STOCKPILES												
Unloading/loading-MAIN PROCESSING AREA-MAIN	7.37171E-05	338990.4318	24.989	3484	0.007	0.00199						
Unloading/unloading-MOBILE PROCESSING AREA- MOB	5.71103E-05	14010	0.800	3484	0.000	0.00006						
OB-REHAB&STOCKPILES												
Unloading/loading-REHAB SP -RE	5.71103E-05	147000	8.395	1876	0.004	0.00124	3200	0.000000388				

	PM-2.5								EXISTING SCENARIO-STD EMISSIONS			
											PROPORTION TO:	
	Loading/unloading	EX-BENCH	OB-BENCH							EX-MATERIAL (t)	MAIN	MOBILE
	M (%)	10	12						EX-BENCH	353000	0.960313	0.039676
	Wind speed (m/sec)	2.7	2.7						OB-BENCH	147000		
	k	0.053	0.053									
	EF (kg/t)	1.11629E-05	8.64813E-06									
Source type	Emission factor kg/t	Material volume t/anm	PM2.5 kg/anm	Hrs/anm	PM2.5 kg/hr	PM2.5 g/sec	Area m**2	PM2.5 g/m2/sec				
EX-BENCH												
Removal/Loading-EX	1.11629E-05	353000	3.940	3484	0.0011	0.00031	4500	0.000000070				
OB-BENCH												
Removal/Loading-OB	8.64813E-06	147000	1.271	1876	0.0007	0.00019	4500	0.000000042				
PROCESSING-STOCKPILES												
Unloading/loading-MAIN PROCESSING AREA-MAIN	1.11629E-05	338990.4318	3.784	3484	0.0011	0.00030						
Unloading/unloading-MOBILE PROCESSING AREA- MOB	8.64813E-06	14009.56819	0.121	3484	0.0000	0.000010						
OB-REHAB&STOCKPILES												
Unloading/loading-REHAB SP -RE	8.64813E-06	147000	1.271	1876	0.0007	0.00019	3200	0.000000059				

3. Bulldozing

	PM-10					EXISTING SCENARIO-STD EMISSIONS	
	Bulldozer	EX-BENCH	OB-BENCH				
	M (%)	10	12				
	s (%)	10	10				
	k	1.95	1.95				
	EF (kg/hr)	1.548940058	1.222078184				
Source type	Emission factor kg/hr	No of hrs hr/yr	PM10 kg/yr	PM10 g/sec	AREA m**2	PM10 g/m2.sec	
EX-BENCH							
Bulldozer-EX	1.548940058	780	1208.173245	0.107565	4500	2.39E-05	
OB-BENCH							
Bulldozer-OB	1.222078184	780	953.2209839	0.084867	4500	1.89E-05	
OB-REHAB&STOCKPILES							
Bulldozer-RH	1.222078184	780	953.2209839	0.084867	3200	2.65E-05	

	PM-2.5					EXISTING SCENARIO-STD EMISSIONS	
	Bulldozer	EX-BENCH	OB-BENCH				
	M (%)	10	12				
	s (%)	10	10				
	k	0.273	0.273				
	EF (kg/hr)	0.216851608	0.171090946				
Source type	Emission factor kg/hr	No of hrs hr/yr	PM2.5 kg/yr	PM2.5 g/sec	AREA m**2	PM2.5 g/m2.sec	
EX-BENCH							
Bulldozer-EX	0.216851608	780	169.1442543	0.015059	4500	3.35E-06	
OB-BENCH							
Bulldozer-OB	0.171090946	780	133.4509377	0.011881	4500	2.64E-06	
OB-REHAB&STOCKPILES							
Bulldozer-RH	0.171090946	780	133.4509377	0.011881	3200	3.71E-06	

4. Unpaved haul roads – Trucks

PM-10								EXISTING SCENARIO-STD EMISSIONS							
											PROPORTION TO:				
Truck Haul Rd Emissions- Unpaved			Customer Haul Rd Emissions- Unpaved						EX-MATERIAL (t)		MAIN	MOBILE			
W (t)	70			W (t)	45			EX-BENCH	353000		0.960313	0.039676			
s (%)	15			s (%)	8			OB-BENCH	147000						
k	1.5			k	1.5										
EF (kg/VKT)	2.228285181			EF (kg/VKT)	1.037340038										

Source type	Emission factor kg/VKT	Material volume t/anm	Travel distnce km	Km/Return trip	Truck capacity t	No of trips/loads	VKT/anm	PM10 kg/anm	hrs/anm	PM10 kg/hr	PM10 g/sec	AREA m**2	Level 1 Watering g/m2/sec	Level 2 Watering g/m2/sec
EX-BENCH														
On-Bench Haul Road - EX	2.228285181	353000	0.06708	0.13416	54.4	6488.970588	870.5603	1939.856603	3484	0.55679	0.154664	1677	0.000046	
Haul Road to MAIN-Stockpile - EXHR1-13	2.228285181	353000	0.7446	1.4892	54.4	6488.970588	9663.375	21532.75531	3484	6.180469	1.716797	7446		0.0000576
OB-BENCH														
On-Bench Haul Road - OB	2.228285181	147000	0.06708	0.13416	54.4	2702.205882	362.5279	807.8156391	1876	0.430605	0.119613	1677	0.000036	
Haul Road to REHAB - OBHR1-11	2.228285181	147000	0.7448	1.4896	54.4	2702.205882	4025.206	8969.306619	1876	4.78108	1.328078	7448		0.0000446
REHAB AREA														
On-Area-Haul Roads - RE	2.228285181	147000	0.05637	0.11274	54.4	2702.205882	304.6467	678.8397074	1876	0.361855	0.100515	1409.25	0.000036	
HAUL Rds - OFF-SITE														
OFHR1-7	1.037340038	353000	0.07554	0.15108	40	8825	1333.281	1383.065763	3484	0.396976	0.110271	755.4		0.0000365

PM-2.5								EXISTING SCENARIO-STD EMISSIONS							
											PROPORTION TO:				
Truck Haul Rd Emissions- Unpaved			Customer Haul Rd Emissions- Unpaved						EX-MATERIAL (t)		MAIN	MOBILE			
W (t)	70			W (t)	45			EX-BENCH	353000		0.960313	0.039676			
s (%)	15			s (%)	8			OB-BENCH	147000						
k	0.15			k	0.15										
EF (kg/VKT)	0.222828518			EF (kg/VKT)	0.103734004										

Source type	Emission factor kg/VKT	Material volume t/anm	Travel distnce km	Km/Return trip	Truck capacity t	No of trips/loads	VKT/anm	PM2.5 kg/anm	hrs/anm	PM2.5 kg/hr	PM2.5 g/sec	AREA m**2	Level 1 Watering g/m2/sec	Level 2 Watering g/m2/sec
EX-BENCH														
On-Bench Haul Road - EX	0.222828518	353000	0.06708	0.13416	54.4	6488.970588	870.5603	193.9856603	3484	0.055679	0.015466	1677	0.000005	
Haul Road to MAIN-Stockpile - EXHR1-13	0.222828518	353000	0.7446	1.4892	54.4	6488.970588	9663.375	2153.275531	3484	0.618047	0.17168	7446		0.0000058
OB-BENCH														
On-Bench Haul Road - OB	0.222828518	147000	0.06708	0.13416	54.4	2702.205882	362.5279	80.78156391	1876	0.043061	0.011961	1677	0.000004	
Haul Road to REHAB - OBHR1-11	0.222828518	147000	0.7448	1.4896	54.4	2702.205882	4025.206	896.9306619	1876	0.478108	0.132808	7448		0.0000045
REHAB AREA														
On-Area-Haul Roads - RE	0.222828518	147000	0.05637	0.11274	54.4	2702.205882	304.6467	67.88397074	1876	0.036185	0.010052	1409.25	0.000004	
HAUL Rds - OFF-SITE														
OFHR1-7	0.103734004	353000	0.07554	0.15108	40	8825	1333.281	138.3065763	3484	0.039698	0.011027	755.4		0.0000036

5. Unpaved haul roads – FELs

PM-10						EXISTING SCENARIO-STD EMISSIONS								
										PROPORTION TO:				
FEL-Haul Rd -Unpaved	MAIN PROC-STOCKPILES			MOBILE PROC-STOCKPILES					EX-MATERIAL MAIN		MOBILE			
W (t)	40			W (t)	40				EX-BENCH	353000	0.960312838	0.039676		
s (%)	15			s (%)	15				OB-BENCH	147000				
k	1.5			k	1.5									
EF (kg/VKT)	1.732222399			EF (kg/VKT)	1.732222399									

Source type	Emission factor kg/VKT	Material volume t/anm	Travel distnce km	Km/Return trip	FEL capacity t	No of trips/loads	VKT/anm	PM10 kg/anm	hrs/anm	PM10 kg/hr	PM10 g/sec	AREA m**2	Level 1 Watering g/sec	Level 2 Watering g/sec
MAIN PROC-STOCKPILES														
Haul Roads -MAIN-PROC- MAIN	1.732222399	338990.4318	0.0116	0.0232	10	33899.04318	786.4578	1362.32	3484	0.391021762	0.108617		0.054309	
MOBILE PROC-STOCKPILES														
Haul Roads - MOBILE PROC -MOB	1.732222399	14006	0.005	0.01	10	1400.5652	14.00565	24.2609	3484	0.00696352	0.001934		0.000967	

PM-2.5						EXISTING SCENARIO-STD EMISSIONS								
										PROPORTION TO:				
FEL-Haul Rd -Unpaved	MAIN PROC-STOCKPILES			MOBILE PROC-STOCKPILES					EX-MATERIAL MAIN		MOBILE			
W (t)	40			W (t)	40				EX-BENCH	353000	0.960312838	0.039676		
s (%)	15			s (%)	15				OB-BENCH	147000				
k	0.15			k	0.15									
EF (kg/VKT)	0.17322224			EF (kg/VKT)	0.17322224									

Source type	Emission factor kg/VKT	Material volume t/anm	Travel distnce km	Km/Return trip	FEL capacity t	No of trips/loads	VKT/anm	PM2.5 kg/anm	hrs/anm	PM2.5 kg/hr	PM10 g/sec	AREA m**2	Level 1 Watering g/sec	Level 2 Watering g/sec
MAIN PROC-STOCKPILES														
Haul Roads -MAIN-PROC- MAIN	0.17322224	338990.4318	0.0116	0.0232	10	33899.04318	786.4578	136.232	3484	0.039102176	0.010862		0.005431	
MOBILE PROC-STOCKPILES														
Haul Roads - MOBILE PROC -MOB	0.17322224	14005.652	0.005	0.01	10	1400.5652	14.00565	2.42609	3484	0.000696352	0.000193		0.000097	

6. Crusher

	PM-10	EXISTING SCENARIO-STD EMISSIONS																	
MAIN PROC (t)									MOBILE PROC (t)										
338990.4318									14005.652										
Source type	Emission factor kg/t	Material volume t/anm	PM10 kg/anm	Hrs/anm	PM10 kg/hr	PM10 g/sec			Source type	Emission factor kg/t	Material volume t/anm	PM10 kg/anm	Hrs/anm	PM10 kg/hr	PM10 g/sec				
PROC-CRUSHING									PROC-CRUSHING										
Primary crushing	0.00027	338990.4318	91.527	3484	0.026	0.00730			Primary crushing	0.0012	14005.652	16.807	3484	0.005	0.00134				
Secondary crushing	0.00027	338990.4318	91.527	3484	0.026	0.00730			Secondary crushing	0.0012	14005.652	16.807	3484	0.005	0.00134				
Tertiary crushing	0.00027	338990.4318	91.527	3484	0.026	0.00730			Tertiary crushing	0.0012	14005.652	16.807	3484	0.005	0.00134				
Fines crushing	0.0075	25000	187.500	3484	0.054	0.01495			Fines crushing	0.0075	0	0.000	3484	0.000	0.00000				
Screening	0.00037	338990.4318	125.426	3484	0.036	0.01000			Screening	0.0043	14005.652	60.224	3484	0.017	0.00480				
Fines screening	0.036	25000	900.000	3484	0.258	0.07176	TOTAL g/s		Fines screening	0.036	0	0.000	3484	0.000	0.00000	TOTAL g/s			
Conveyor Transfer Point	0.0000023	338990.4318	0.780	3484	0.000	0.00006	0.11866		Conveyor Transfer Point	0.00055	14005.652	7.703	3484	0.002	0.00061	0.00944			
Truck unloading	8.21127E-05	338990.4318	27.835	3484	0.008	0.00222			Truck unloading	8.21127E-05	14005.652	1.150	3484	0.000	0.00009				
Truck loading	8.21127E-05	338990.4318	27.835	3484	0.008	0.00222			Truck loading	8.21127E-05	14005.652	1.150	3484	0.000	0.00009				
	PM-2.5	EXISTING SCENARIO-STD EMISSIONS								PM-2.5	EXISTING SCENARIO-STD EMISSIONS								
MAIN PROC (t)									MOBILE PROC (t)										
338990.4318									14005.652										
Source type	Emission factor kg/t	Material volume t/anm	PM2.5 kg/anm	Hrs/anm	PM2.5 kg/hr	PM2.5 g/sec			Source type	Emission factor kg/t	Material volume t/anm	PM2.5 kg/anm	Hrs/anm	PM2.5 kg/hr	PM2.5 g/sec				
PROC-CRUSHING									PROC-CRUSHING										
Primary crushing	0.00005	338990.4318	16.950	3484	0.005	0.00135			Primary crushing	0.000222	14005.652	3.109	3484	0.001	0.00025				
Secondary crushing	0.00005	338990.4318	16.950	3484	0.005	0.00135			Secondary crushing	0.000222	14005.652	3.109	3484	0.001	0.00025				
Tertiary crushing	0.00005	338990.4318	16.950	3484	0.005	0.00135			Tertiary crushing	0.000222	14005.652	3.109	3484	0.001	0.00025				
Fines crushing	0.0004375	25000	10.938	3484	0.003	0.00087			Fines crushing	0.0004375	0	0.000	3484	0.000	0.00000				
Screening	0.000025	338990.4318	8.475	3484	0.002	0.00068			Screening	0.00029	14005.652	4.062	3484	0.001	0.00032				
Fines screening	0.0024	25000	60.000	3484	0.017	0.00478	TOTAL g/s		Fines screening	0.0024	0	0.000	3484	0.000	0.00000	TOTAL g/s			
Conveyor Transfer Point	0.0000065	338990.4318	2.203	3484	0.001	0.00018	0.01056		Conveyor Transfer Point	0.00016	14005.652	2.241	3484	0.001	0.00018	0.00125			
Truck unloading	1.24342E-05	338990.4318	4.215	3484	0.001	0.00034			Truck unloading	1.24342E-05	14005.652	0.174	3484	0.000	0.00001				
Truck loading	1.24342E-05	338990.4318	4.215	3484	0.001	0.00034			Truck loading	1.24342E-05	14005.652	0.174	3484	0.000	0.00001				

7. Notes

a. Moisture content – Raw material: based on low end of range provided by Dandy Premix.
b. Silt content: based on NPI/AP-42 values.
c. Wind speed information extracted from TAPM-generated meteorology.
d. Emissions from processing area (MOB & MAIN): based on highly conservative case with multiple unloading/loading and FEL transfer between crusher, truck and stockpiles.