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**SUBJECT: Air quality assessment proposed Eagleton Quarry**

# 1 Introduction

Pacific Environment (PE) completed an air quality assessment (AQA) in January 2017 (**Pacific Environment, 2017**) as a Technical Appendix to the Environmental Assessment (EA) for the proposed Eagleton Quarry off Italia Road, Balickera (the Project) on behalf of Eagleton Rock Syndicate Pty Ltd (the Proponent).

The dispersion modelling completed assessed one worst-case operational scenario based on maximum annual production at 600 kilotonnes per annum (ktpa) with the assumption that the processing plant will operate on diesel power for the entire quarry life. The results of the modelling indicated that the predicted incremental TSP, $PM_{10}$, $PM_{2.5}$ and dust deposition at the closest residential receptors are below the impact assessment criteria. The cumulative assessment indicated that the Project is unlikely to result in any additional exceedances of relevant impact assessment criteria at the neighbouring receivers.

Following the exhibition of the EIS, comments have been received from the NSW Environment Protection Authority (NSW EPA), NSW Department of Planning and the Environment (DPE), Boral quarry and the local community. The comments are addressed in the following sections and remodelling has been undertaken based on the update to the quarry plan provided by the Proponent.

# 2 Responses to comments

## 2.1 Updated dispersion modelling

The dispersion modelling completed for the AQA has been updated to assess the modifications to the quarry plan. Full details are presented in **Section 2.6**.

## 2.2 Air emission calculations

**Comment**

The EPA noted that emission calculations are based on annual production spread over the year rather than impacts from peak daily production/activity. Provide further demonstration that the peak production has been appropriately assessed.



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**Response**

Due to the modification to the quarry layout, updated modelling has been completed, including maximum day activities, see **Section 3.5**.

## 2.3 Respite centre and Kings Hill proposal

**Comment:**

The DPE requests an assessment of potential air quality impacts on the nearby respite centre, and that the proposed development at Kings Hill is taken into account.

**Response**

As shown in **Table 3-5** to **Table 3-7**, the predicted concentrations and deposition levels at the respite centre (Receptor ID 6) are all below the relevant assessment criteria. Similarly receptor ID 4A, 4B and 4C are indicative of the closest housing proposed within the Kings Hill development, these are also shown to be below the assessment criteria.

## 2.4 Dust deposition and mitigation

**Comment**

The DPE and local community request a response concerning mitigation or remediation of impacts associated with dust covering homes and solar panels and dust collecting in water tanks.

**Response:**

As shown in **Table 3-5** , the maximum predicted increment in annual dust deposition levels at private receptors due to the Project only is 0.41 g/m$^2$/month at receptor ID 23 (Managers House – Gardenland), compared with the impact assessment criterion of 2 g/m$^2$/month. The maximum cumulative level at private receptors is 2.2 g/m$^2$/month at receptor ID 23 compared with the impact assessment criterion of 4 g/m$^2$/month.

Other private receptors on Six Mile Road such as the Respite Centre (ID 6) and adjoining properties (ID 7 and ID 8) to the south show predicted incremental increases from the project of 0.02, 0.02 and 0.03 g/m$^2$/month, against a criterion of 2 g/m$^2$/month.

Given the minor predicted increase in dust dispersion levels from the Project, it is considered that there will be no impact on the operation of solar panels or the need for any additional remediation for water tanks. Regardless of the proposed quarry activity, it is noted that it is good practice for all rainwater tank used for drinking water to be fitted with a first flush system.

# 2.5 Control factors and emissions

**Comments**

- Clarify emission control factors for plant
- Clarify control measures for plant
- Quantify diesel combustion for particulate emissions
- Revise modelling if diesel emissions are high

**Response:**

The moisture content data used to develop the controlled emission factors for crushing and screening activities ranged from 0.21 to 2.88 per cent (**US EPA, 2004**). As the moisture content of the material being processed is 2%, it is considered that the application of them in this assessment is justified.

In the absence of specific guidance in NSW that details best practice measures for quarrying operations, comparison has been made based on recommendations contained in the *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (**Donnelly *et al.*, 2011**) (the Best Practice Report), as presented in **Table 2-1**.

It is noted that some dust control measures (for example, restricting speed limits) are not directly quantified in the emission calculations and hence it is considered the predicted contribution from the Project presented in **Section 2.6** are conservative.

Should the Project be approved, an Air Quality Management Plan would be developed for the site, in consultation with the relevant stakeholders and would include relevant management measures.

As discussed in Section 7.2 of the AQA, the US EPA AP-42 emission factors used in the particulate emissions inventories include particulate matter emissions from both the mechanical processes (i.e. crustal material) and the diesel exhaust (combustion). These emission factors do not distinguish between these two sources, since the sampling method used to derive the original emission factors captured both mechanical and combustion particulate matter sources. However, in order to present a conservative assessment, $PM_{2.5}$ emission from the use of diesel emissions have been calculated and whilst they represent only 5% of the total, have been included in the updated $PM_{2.5}$ inventory and dispersion modelling presented in **Section 3.5**.

*Table 2-1: Summary of Best Practice Measures*

| OEH best practice Section | OEH best practice Table | Mining Activity | Best Practice Control Method | | % control from application per Best Practice document | Applied at site (Y/N/Not applicable) | Level of control applied in modelling | Comments For example: -Is there any site-specific information on effectiveness? -Are controls applied consistently (e.g. are some roads treated and not others)? |
|---|---|---|---|---|---|---|---|---|
| 9.2 | 66 | Hauling on Unsealed Roads (Note: reductions achieved by use of larger vehicles, conveyors and lower grader speeds calculated from emission factors) | Vehicle restrictions | Speed reduction from 75 km/h to 50 km/h | 40-75% | Y | Not quantifiable | |
| | | | | Speed reduction from 65 km/h to 30 km/h | 50-85% | Y | Not quantifiable | |
| | | | | Grader speed reduction from 16 km/h to 8 km/h | 75% | Y | Not quantifiable | |
| | | | Surface improvements | Pave the surface | >90% | N | | |
| | | | | Low silt aggregate | 30% | Y | Not quantifiable | Sealed road emission equation contains parameter for silt content of road. Value of 5% used. |
| | | | | Oil and double chip surface | 80% | N | | |
| | | | Surface treatments | Watering (standard procedure) | 10-74% | N | | |
| | | | | Watering Level 1 (2 L/m$^2$/h) | 50% | N | | |
| | | | | Watering Level 2 (>2 L/m$^2$/h) | 75% | Y | 75% | |
| | | | | Watering grader routes | 50% | Y | | |
| | | | | Watering twice a day for industrial unpaved road | 55% | N | | |
| | | | | Dust suppressants (please specify) | 84% | N | | |
| | | | Other | Use of larger vehicles | 90t to 220t:40% | N/A | | |
| | | | | | 140 to 220t:20% | N/A | | |
| | | | | | 140t to 360t:45% | N/A | | |
| | | | | Conveyors in place of haul roads | >95% | N/A | | |
| 9.3 | 71 | Wind Erosion on Exposed Areas & Overburden Emplacements | Avoidance | Minimise pre-strip | 100% per m2 of pre-strip avoided | Y | Not quantifiable | |
| | | | Surface stabilisation | Watering | 50% | Y | 50% | |
| | | | | Chemical suppressants | 70-84% | N | | |
| | | | | Paving and cleaning | >95% | N | | |
| | | | | Application of gravel to stabilise disturbed open areas | 84% | Y | 0% | As air quality modelling did not assess a specific stage of quarrying, conservatively assumed no control. |

| OEH best practice | | Mining Activity | Best Practice Control Method | | % control from application per Best Practice document | Applied at site (Y/N/Not applicable) | Level of control applied in modelling | Comments<br>For example:<br>-Is there any site-specific information on effectiveness?<br>-Are controls applied consistently (e.g. are some roads treated and not others)? |
|---|---|---|---|---|---|---|---|---|
| Section | Table | | | | | | | |
| | | | | Rehabilitation goals | 99% | Y | Not quantifiable | |
| | | | Wind speed reduction | Fencing, bunding, shelterbelts or in-pit dump | 30-80% | Y | Not quantifiable | |
| | | | | Vegetative ground cover | 70% | Y | 0% | As air quality modelling did not assess a specific stage of quarrying, conservatively assumed no control. |
| 9.3 | 72 | Wind Erosion and Maintenance - Coal Stockpiles | Avoidance | Bypassing stockpiles | 100% | N | | |
| | | | Surface stabilisation | Water sprays | 50% | Y | 50% | |
| | | | | Chemical wetting agents | 80-99% | N | | |
| | | | | Surface crusting agent | 95% | N | | |
| | | | | Carry over wetting from load in | 80% | N | | |
| | | | Enclosure | Silo with bag house | 95-100% | N | | |
| | | | | Cover storage pile with a tarp during high winds | 99% | N | | |
| | | | Wind speed reduction | Vegetative windbreaks | 30% | N | | Operations are designed to move progressively south advancing against vegetated batters. |
| | | | | Reduced pile height | 30% | Y | Not quantifiable | |
| | | | | Wind screens/fences | 75->80% | N | | Design of processing area has enabled retention of large bund around the southern side of plant. |
| | | | | Pile shaping/orientation | <60% | Y | Not quantifiable | As above |
| | | | | Erect 3-sided enclosure around storage piles | 75% | N | | |
| 9.4 | 76 | Bulldozers on OB | Minimise travel speeds and distance | | Not quantified | | | |
| | | | Travel routes and material kept moist | | 50% | Y | Not quantifiable | |
| 9.5 | 81 | Blasting and drilling | Blasting | Delay shot to avoid unfavourable weather conditions | Not quantified | Y | Not quantifiable | Will be followed within Noise and Vibration Management Plan. |
| | | | | Minimise area blasted | Not quantified | Y | Not quantifiable | |
| | 82 | | Drilling | Fabric filters | 99% | N | | |
| | | | | Cyclone | 80-90% | Y | 85% | |
| | | | | Water injection while drilling | 3-96% | N | | |
| 9.6 | 85 | Draglines | Minimise drop height | Reduce from 30m to 5m | 70% | N/A | | |

| OEH best practice | | Mining Activity | Best Practice Control Method | | % control from application per Best Practice document | Applied at site (Y/N/Not applicable) | Level of control applied in modelling | Comments<br>For example:<br>-Is there any site-specific information on effectiveness?<br>-Are controls applied consistently (e.g. are some roads treated and not others)? |
|---|---|---|---|---|---|---|---|---|
| Section | Table | | | | | | | |
| | | (Note: Reduction due to reduced drop height and water have been inferred from the dragline emission factor) | Minimising drop height | Reduce from 10m to 5m | 40% | N/A | | |
| | | | Modify activities in windy conditions | | Unquantified | N/A | | |
| | | | Water sprays | | 50% | N/A | | |
| | | | Minimise side casting | | Unquantified | N/A | | |
| 9.7 | 90 | Loading and dumping overburden (Note: Reduction due to reduced drop height and water have been inferred from the dragline emission factor and rounded down to nearest 10%) | Excavator | Minimise drop height (3m to 1.5m) | 30% | Y | Not quantifiable | |
| | | | Truck dumping | Minimise drop height (3m to 1.5m) | 30% | Y | Not quantifiable | |
| | | | | Water application | 50% | N | | |
| | | | | Modify activities in windy conditions | Unquantified | Y | Not quantifiable | |
| 9.8 | 95 | Loading and dumping ROM coal | Avoidance | Bypass ROM stockpiles - dumping | 50% | N | | |
| | | | | Bypass ROM stockpiles - forming stockpiles (e.g. dozer push) | 100% | N | | |
| | | | Truck or loader dumping coal | Minimise drop height (10m to 3m) | 30% | Y | Not quantifiable | |
| | | | | Water sprays on ROM pad | 50% | Y | 50% | |
| | | | Truck or loader dumping to ROM bin | Water sprays on ROM bin or ROM pad | 50% | Y | 50% | |
| | | | | Three sided and roofed enclosure of ROM bin | 70% | Y | 0% | Conservatively assumed just water sprays |
| | | | | Three sided and roofed enclosure of ROM bin + water sprays | 85% | Y | 0% | Conservatively assumed just water sprays |
| | | | | Enclosure with control device | 90-98% | NA | | |

# 2.6 Crystalline silica

**Comment**

The public submissions raised concerns with respect to silicosis.

**Response:**

Silica ($SiO_2$) is a naturally occurring mineral composed of silicon and oxygen. It exists in crystalline and amorphous forms depending on the structural arrangement of the oxygen and silicon atoms. Only the crystalline forms are known to be fibrogenic (causes the formation of fibres) and only the respirable particles (those which are capable of reaching the gas exchange region of the lungs) are considered in determining health effects of crystalline silica. The three most common types of crystalline silica are quartz, tridymite and cristobalite.

Human exposure to crystalline silica occurs most often during occupational activities that involve the working of materials containing crystalline silica products (e.g. masonry, concrete, sandstone) or use or manufacture of crystalline silica-containing products. Activities that involve cutting, grinding or breaking of these materials can result in the liberation of particles in multiple size ranges.

Crystalline silica dust is found everywhere in the environment (i.e. not only in an occupational context) due to natural, industrial and agricultural activities as it comprise 12% of the earth's crust (**EPG Resources 2014**).

Whilst the long term inhalation of silica dust may lead to the formation of scar tissue in the lungs, which can result in silicosis, a serious lung disease, silicosis is regarded exclusively as a work place exposure issue that is associated with long-term exposure to high levels of respirable crystalline silica (RCS).

The World Health Organization's Concise International Chemical Assessment Document on Crystalline Silica, Quartz (**CICAD, 2000**) states that "*there are no known adverse health effects associated with the non-occupational exposure to quartz*".

In addition, an **Australian Government Senate Committee (2005)** report identified that there are no reports in the international literature of individuals developing silicosis as a result of exposure to non-occupational levels (i.e. levels outside the work place) of silica dust, and an expert appearing before the committee confirmed the potential for such an occurrence as being very remote.

A literature review on the potential impacts to health from exposure to crustal material in Port Hedland, WA, states "*exposure to airborne quartz carries the risk of silicosis, but only with prolonged exposure to concentrations greater than 200* $\mu g/m^3$" (**Department of Health, 2007**).

In Australia, the occupational exposure standards for respirable crystalline silica are defined by the Safe Work Australia. The national exposure standard for respirable crystalline silica is

100$\mu$g/m$^3$ (Time Weighted Average (TWA))[1]. Although the occupational standard is not applicable to the assessment of the ambient air quality, the risk of silicosis among people living in areas surrounding activities such as quarrying would therefore be considered minimal provided the concentration of respirable particles at the source was acceptable in terms of occupational safety.

NSW Environment Protection Authority (EPA) has not set any impact assessment criteria for crystalline silica. The Victorian EPA has adopted an ambient assessment criterion for mining and extractive industries of 3 $\mu$g/m$^3$ (annual average as $PM_{2.5}$[2]) (**VEPA, 2007**). This has been derived from the Reference Exposure Level (REL)[3] set by the California EPA Office of Environmental Health Hazard Assessment of 3 $\mu$g/m$^3$ (annual average as $PM_4$[4]) (**OEHHA, 2005**), at or below which "no adverse effects are expected for indefinite exposure".

An extensive ambient crystalline silica sampling program completed in the United States (**EPG Resources 2014**) collected data between October 2012 and October 2013 inside the fencelines of four active sand quarrying facilities. The report concluded that the long-term (fifteen-month) average ambient $PM_4$ crystalline silica concentrations both upwind and downwind of the facilities were less than 6% of the 3 $\mu$g/m$^3$ REL, the measured 24-hour average concentrations were almost entirely below 1.5 $\mu$g/m$^3$ both upwind and downwind and were due in part to the regional background levels of $PM_4$ crystalline silica that are present in the ambient air throughout the US, and the differences between upwind and downwind measurements were usually too low to be detected (further supporting the fact that the sand quarrying operations were not having a detrimental impact on local air quality). This is understood to be the most extensive ambient monitoring of $PM_4$ crystalline silica in the vicinity of sand quarrying operations to have ever been undertaken and clearly demonstrates that sand quarrying operations do not result in ambient levels of $PM_4$ crystalline silica that are considered to be detrimental to the general population. Sampling completed in the vicinity of coal mining operations in the Hunter Valley, NSW between February and October 2010 (**Morrison and Nelson, 2011)** crystalline silica concentrations were in the range 0.5 – 1.8 µg/m$^3$ ($PM_4$). These values are significantly below the threshold value of 3 µg/m$^3$ at or below which "no adverse effects are expected for indefinite exposure".

As presented in the updated air quality assessment below, the maximum annual average $PM_{10}$ concentration due to the Project at the most affected residence is predicted to be 1.3 $\mu$g/m$^3$ (see receptor 41 in **Table 3-5** below). Given that crystalline silica would be a small fraction of $PM_{10}$

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[1] TWA - the average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day working week.
[2] $PM_{2.5}$ - particles with an equivalent aerodynamic diameter of less than approximately 2.5$\mu$m
[3] RELs are used by the California Environmental Protection Agency as indicators of potential adverse health effects. A REL is a concentration level (g/m3) or dose (mg/kg/day) at (or below) which no adverse health effects are anticipated for a specified time period. RELs are generally based on the most sensitive adverse health effect reported in the medical and toxicological literature. RELs are designed to protect the most sensitive individuals in the population by the inclusion of margins of safety.
[4] $PM_4$ - particles with an equivalent aerodynamic diameter of less than approximately 4$\mu$m

concentrations, any $PM_4$ crystalline silica levels would be significantly below levels that may be of concern.

## 2.7 NSW Department of Planning and Environment Voluntary Land Acquisition and Mitigation Policy (VLAMP)

**Comment**

The supplementary AQA should include some discussion regarding the predicted exceedances in the context of the Voluntary Land Acquisition and Mitigation Policy (VLAMP). In particular, the assessment should address impacts on worker health at the paintball facility.

**Response:**

The Department of Planning and Environment (DPE) voluntary mitigation and acquisition criteria are summarised in **Table 2-2** and **Table 2-3**, respectively. The Project has now been assessed against these criteria, in addition to the NSW EPA impact assessment criteria.

*Table 2-2. DPE particulate matter mitigation criteria*

| Pollutant | Criterion | Averaging period | Application |
|---|---|---|---|
| TSP* | 90 µg/m$^3$ | Annual-mean | Total impact |
| $PM_{10}$ | 50 µg/m$^3$<br>30 µg/m$^3$ | 24-hour average<br>Annual-mean | Incremental impact[(a)]<br>Total impact |
| Deposited dust* | 2 g/m$^2$/month<br>4 g/m$^2$/month | Annual-mean<br>Annual-mean | Incremental impact[(a)]<br>Total impact |

*TSP and deposited dust are not included in this assessment.
[(a)] Zero allowable exceedances of the criterion over the life of the development.

*Table 2-3. DPE particulate matter acquisition criteria*

| Pollutant | Criterion | Averaging period | Application[(a)] |
|---|---|---|---|
| TSP* | 90 µg/m$^3$ | Annual-mean | Total impact |
| $PM_{10}$ | 50 µg/m$^3$<br>30 µg/m$^3$ | 24-hour average<br>Annual-mean | Incremental impact[(b)]<br>Total impact |
| Deposited dust* | 2 g/m$^2$/month<br>4 g/m$^2$/month | Annual-mean<br>Annual-mean | Incremental impact[(b)]<br>Total impact |

Total impact includes the impact of the Project and all other sources, whilst incremental impact refers to the impact of the Project considered in isolation. The incremental impact for the DPE mitigation criteria also applies to areas where more than 25% of the land has been predicted to exceed.

At Clause 12AB(4), the mining SEPP also sets a non-discretionary development standard of cumulative annual average $PM_{10}$ concentration for private dwellings of 30 µg/$m^3$.

The comparison with these criteria can be found in **Section 3.7.4**.

# 3 Updated air quality assessment

## 3.1 Introduction

Whilst the original AQA did not predict any exceedances of the relevant impact assessment criteria, this section presents an updated AQA following modification of the quarry plan by the Proponent to further mitigate against any potential air quality impacts. The additional mitigation measures include:

- Flipping of the plant layout such that the jaw crusher moves to the northwest towards the Boral quarry approximately 290 m
- Retention of 12.5-25m high bund along the southern extent of the processing area
- Movement of the haul road to the northern boundary
- Erection of the roof structure over the secondary and tertiary crusher

In addition, the updated AQA assess both annual and maximum-day activities.

The updated emission inventories for TSP, $PM_{10}$ and $PM_{2.5}$ for the quarry are provided in **Section 3.5**, together with updated source locations.

The modelling predictions for the Project are presented **Section 3.6** (annual averages) and **Section 3.7** (24-hour averages). The contour plots presented are indicative of the concentrations that could potentially be reached under the new conditions modelled. It is important to note that the isopleth figures are presented to provide a visual representation of the predicted impacts. To produce the isopleths, it is necessary to make interpolations between predicted concentrations, and as a result the isopleths will not always match exactly with predicted impacts at any specific location.

In the case of maximum 24-hour average concentrations, it is also important to note that individual contour plots do not represent one moment in time, but rather the maximum 24-hour average that could potentially occur at each location over the period of a year.

## 3.2 Modelling system and meteorological data

As per the previous AQA, the CALMET/CALPUFF modelling system was used and the same meteorological data applied.

In response to a submission from Boral regarding provision of CALMET-generated meteorological parameters (erroneously referred to as AERMET-generated in the submission) the following information is provided.

Stability can be described across a spectrum ranging from highly unstable through neutral to highly stable. A highly unstable boundary layer is characterised by strong surface heating and relatively light winds, leading to intense convective turbulence and enhanced plume diffusion. At the other extreme, very stable conditions are often associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Under these conditions plumes can remain relatively undiluted for considerable distances downwind. Neutral conditions are linked to windy and/or cloudy weather, and short periods around sunset and sunrise, when surface rates of heating or cooling are very low.

The stability of the atmosphere plays a large role in determining the dispersion of a plume and it is important to have it correctly represented in dispersion models. Current air quality dispersion models (such as AERMOD and CALPUFF) use the Monin-Obukhov Similarity Theory (MOST) to characterise turbulence and other processes in the PBL. One of the measures of the PBL is the Monin-Obukhov length (L), which approximates the height at which turbulence is generated equally by thermal and mechanical effects (**Seinfeld and Pandis 2006**). It is a measure of the relative importance of mechanical and thermal forcing on atmospheric turbulence.

Because values of L diverge to + and - infinity as stability approaches neutral from the stable and unstable sides, respectively, it is often more convenient to use the inverse of L (i.e., 1/L) when describing stability.

**Figure 3-1** shows the hourly averaged 1/L for the Project site computed from all data in the CALMET surface file. Based on **Table 3-1** this plot indicates that the PBL is stable overnight and becomes unstable as radiation from the sun heats the surface layer of the atmosphere and drives convection. The changes from positive to negative occur at the shifts between day and night. This indicates that the diurnal patterns of stability are realistic.

*Table 3-1: Inverse of the Monin-Obukhov length L with respect to Atmospheric stability*

| 1/L | Atmospheric Stability |
|---|---|
| Negative | Unstable |
| Zero | Neutral |
| Positive | Stable |

**Figure 3-2** shows the variations in stability over the year by hour of the day, with reference to the widely known Pasquill-Gifford classes of stability. The relationship between L and stability classes is based on values derived by **Golder (1972)** set out in **NSW EPA (2016).** Note that the reference to stability categories here is only for convenience in describing stability. The model uses calculated values of L across a continuum.

**Figure 3-2** shows that stable and very stable conditions occur for about 50% of the time, which is typical for inland locations that regularly experience temperature inversions at night. Atmospheric instability increases during the day and reaches a peak around noon as solar-driven convective energy peaks. A stable atmosphere is prevalent during the night. These profiles indicate that pollutant dispersion is most effective during the daytime and least effective at night.

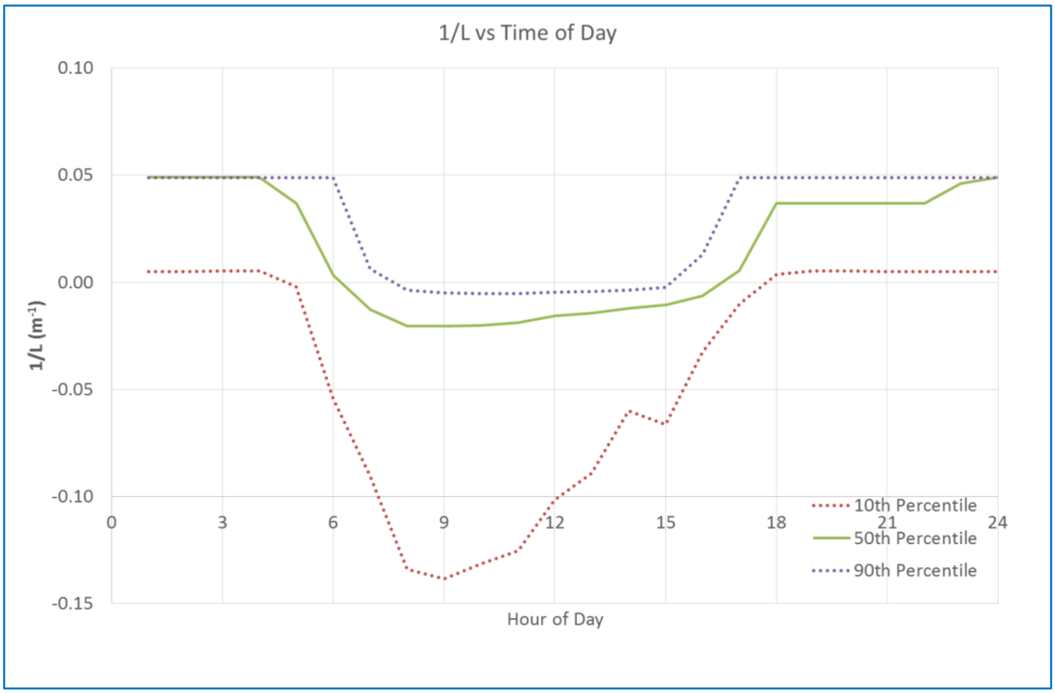



*Figure 3-1: Annual statistics of 1/L by hour of the day for each modelling year*

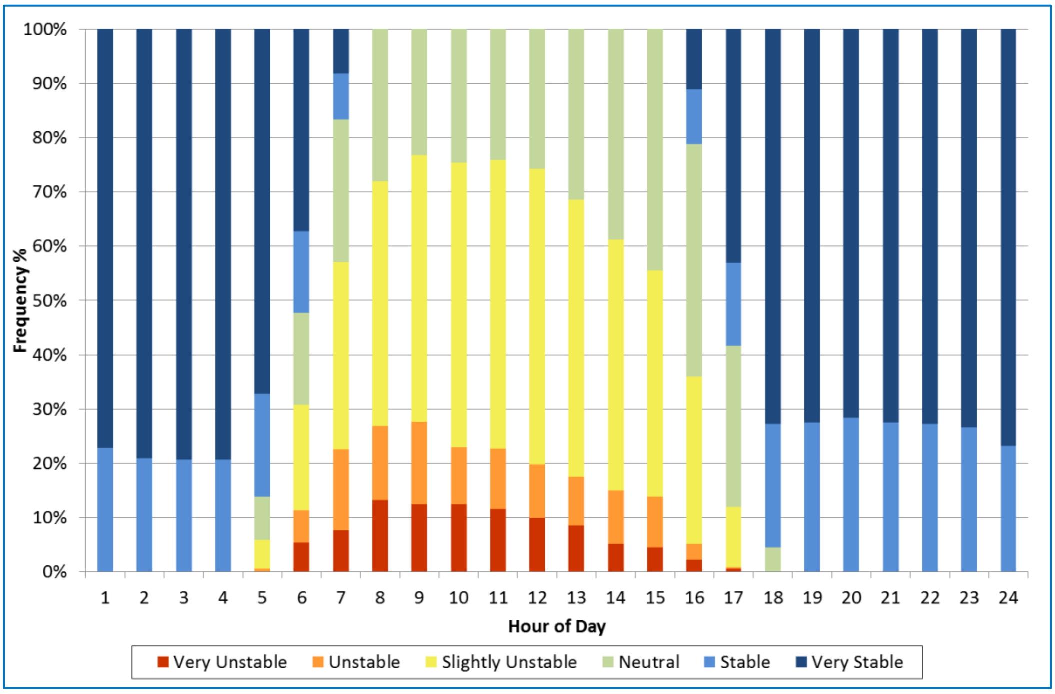



*Figure 3-2: Annual distribution of stability type by hour of the day for each modelling year*

## 3.3 Receptor locations

The discrete receptor locations have been updated and some additional (including the respite centre ID 6) have been included.

The location of the receptors are presented in **Figure 3-3** and the details of each presented in **Table 3-2**.

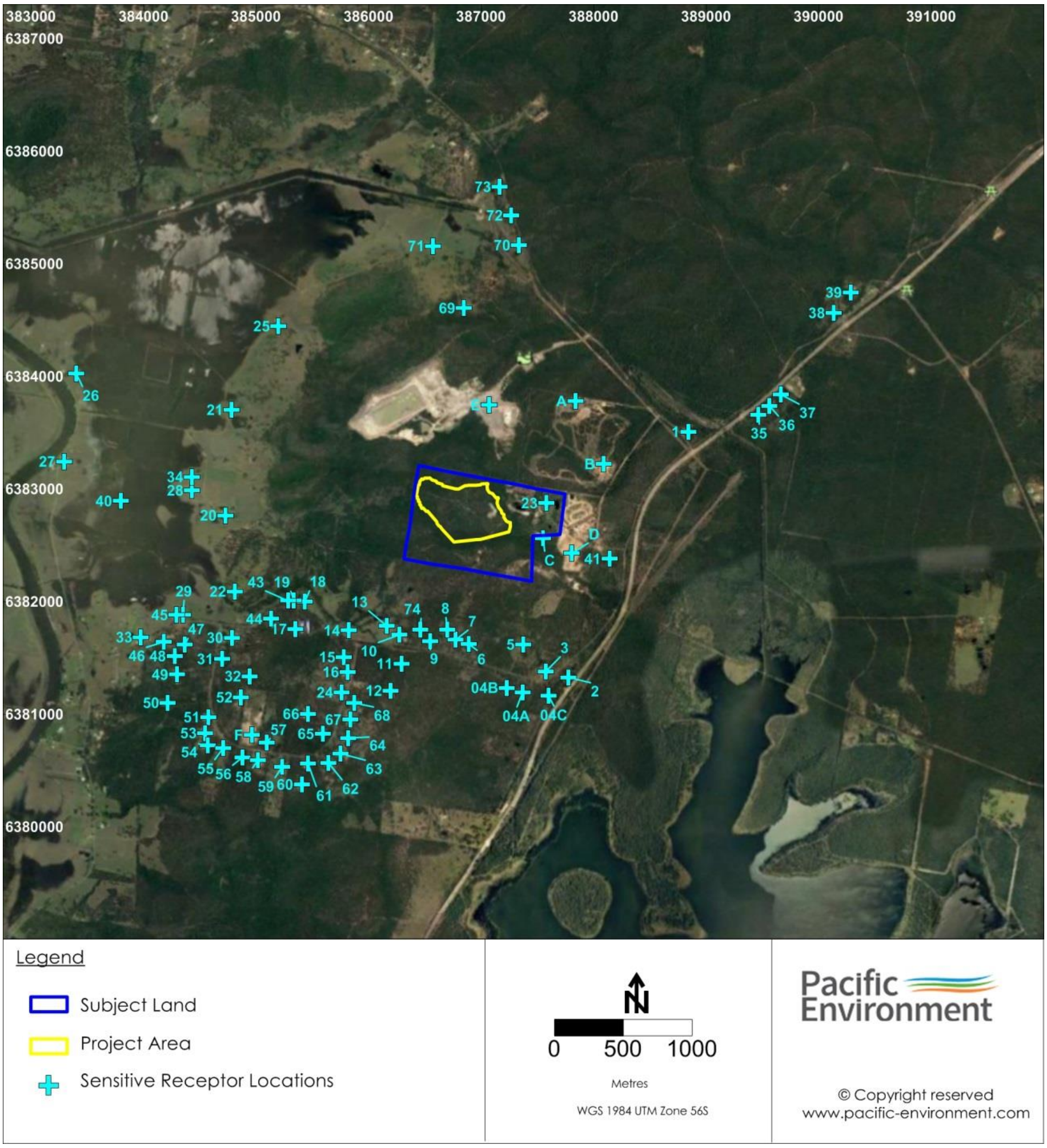



*Figure 3-3: Receptor locations*

*Table 3-2: Receptor locations and details*

| Receptor ID | Receptor Description | MGA coordinates Zone 56 | |
|---|---|---|---|
| | | Easting (m) | Northing (m) |
| 1 | | 388837 | 6383510 |
| 2 | | 387773 | 6381328 |
| 3 | | 387571 | 6381380 |
| 04A | Proposed Kingshill residential area | 387366 | 6381196 |
| 04B | Proposed Kingshill residential area | 387227 | 6381235 |
| 04C | Proposed Kingshill residential area | 387596 | 6381167 |
| 5 | | 387371 | 6381621 |
| 6 | Eagleton Ridge Respite Centre and Private Residence | 386887 | 6381625 |
| 7 | | 386771 | 6381662 |
| 8 | | 386697 | 6381750 |
| 9 | | 386546 | 6381649 |
| 10 | | 386272 | 6381707 |
| 11 | | 386289 | 6381449 |
| 12 | | 386193 | 6381210 |
| 13 | | 386158 | 6381787 |
| 14 | | 385820 | 6381745 |
| 15 | | 385779 | 6381509 |
| 16 | | 385810 | 6381375 |
| 17 | | 385349 | 6381758 |
| 18 | | 385431 | 6382002 |
| 19 | | 385333 | 6382013 |
| 20 | | 384723 | 6382767 |
| 21 | | 384781 | 6383704 |
| 22 | | 384807 | 6382091 |
| 23 | Gardenland Managers House | 387576 | 6382876 |
| 24 | | 385759 | 6381194 |
| 25 | | 385196 | 6384448 |
| 26 | | 383400 | 6384026 |
| 27 | | 383290 | 6383246 |
| 28 | | 384428 | 6382989 |
| 29 | | 384347 | 6381886 |
| 30 | | 384782 | 6381681 |
| 31 | | 384695 | 6381492 |
| 32 | | 384941 | 6381338 |
| 33 | | 383974 | 6381685 |
| 34 | | 384427 | 6383108 |
| 35 | | 389462 | 6383661 |
| 36 | | 389559 | 6383740 |
| 37 | | 389661 | 6383840 |
| 38 | | 390130 | 6384565 |
| 39 | | 390281 | 6384748 |
| 40 | | 383794 | 6382895 |
| 41 | | 388138 | 6382381 |
| 43 | | 385281 | 6382009 |
| 44 | | 385131 | 6381848 |
| 45 | | 384290 | 6381883 |
| 46 | | 384176 | 6381642 |
| 47 | | 384363 | 6381618 |
| 48 | | 384273 | 6381517 |
| 49 | | 384294 | 6381353 |
| 50 | | 384213 | 6381103 |
| 51 | | 384575 | 6380975 |
| 52 | | 384864 | 6381152 |
| 53 | | 384547 | 6380834 |
| 54 | | 384568 | 6380723 |
| 55 | | 384706 | 6380702 |
| 56 | | 384879 | 6380619 |

| Receptor ID | Receptor Description | MGA coordinates Zone 56 | |
|---|---|---|---|
| | | Easting (m) | Northing (m) |
| 57 | | 385090 | 6380749 |
| 58 | | 385012 | 6380591 |
| 59 | | 385231 | 6380535 |
| 60 | | 385404 | 6380377 |
| 61 | | 385460 | 6380562 |
| 62 | | 385641 | 6380570 |
| 63 | | 385750 | 6380651 |
| 64 | | 385817 | 6380790 |
| 65 | | 385589 | 6380827 |
| 66 | | 385458 | 6381003 |
| 67 | | 385834 | 6380953 |
| 68 | | 385869 | 6381101 |
| 69 | | 386845 | 6384607 |
| 70 | | 387334 | 6385167 |
| 71 | | 386571 | 6385159 |
| 72 | | 387266 | 6385431 |
| 73 | | 387164 | 6385685 |
| 74 | | 386456 | 6381754 |
| A | MG Car club hill climb track | 387836 | 6383782 |
| B | Motorplex | 388087 | 6383223 |
| C | Hunter Valley Paintball | 387550 | 6382562 |
| D | Motor Cross Track | 387804 | 6382431 |
| E | Boral Seaham Quarry | 387069 | 6383747 |
| F | Quarry | 384959 | 6380817 |

# 3.4 Background concentrations

The 2017 Pacific Environment report sets out the existing air quality sourced from Beresfield OEH site and for dust deposition from an operating quarry similar in size to the Project. In summary, for the purposes of assessing potential air quality impacts, the following existing air quality levels are assumed:

- Annual average $PM_{10}$ concentrations of 20 µg/m$^3$
- 24-hour $PM_{10}$ concentrations – daily varying
- Annual average $PM_{2.5}$ concentration of 7 µg/m$^3$
- 24-hour $PM_{2.5}$ concentrations – daily varying
- Annual average TSP concentration of 50 µg/m$^3$
- Annual average dust deposition of 1.8 g/m$^2$/month

Due to the surrounding residential and industrial sites near the Beresfield monitoring site, it is considered that the assumed background concentrations present a conservative estimate of current ambient concentrations at the project site.

The annual average dust deposition of 1.8 g/m$^2$/month taken from average background dust deposition levels around Lynwood quarry, was chosen based on the following reasons:

- Background values for dust deposition near the project were not available. An extensive search of information in the public domain was unsuccessful in locating any information.

- Lynwood quarry is similar in size to the Project and therefore dust deposition levels around the site would be considered representative.
- Lynwood quarry and the Project are both based in rural locations and dust sources would be expected to be similar.
- Annual average dust deposition levels of 2 g/m$^2$/month have been used for large mining projects in the Hunter Valley (**Pacific Environment, 2014**). Dust deposition levels are likely to be higher in the Hunter Valley due to the influence of large mining operations but the value chosen for this assessment is similar (1.8 g/m$^2$/month compared with 2 g/m$^2$/month). On that basis, this value may even be relatively conservative.

# 3.5 Emission inventories

**Table 3-3** presents a summary of the annual and maximum day activities. From this information, emission inventories were developed for TSP, $PM_{10}$ and $PM_{2.5}$, as summarised in **Table 3-4**.

**Table 3-4** also compares the revised emissions calculations with those in the original AQA. There are minor decreases in total TSP and $PM_{10}$ emission for annual activities due to the adoption of a cyclone to control dust from drilling activities and reduced haulage. $PM_{2.5}$ emissions have increased slightly due to the inclusion of diesel emissions.

The detailed TSP, $PM_{10}$ and $PM_{2.5}$ emissions inventories annual activities at the quarry and Gardenland (unchanged compared with the original AQA) are provided in **Appendix A**.

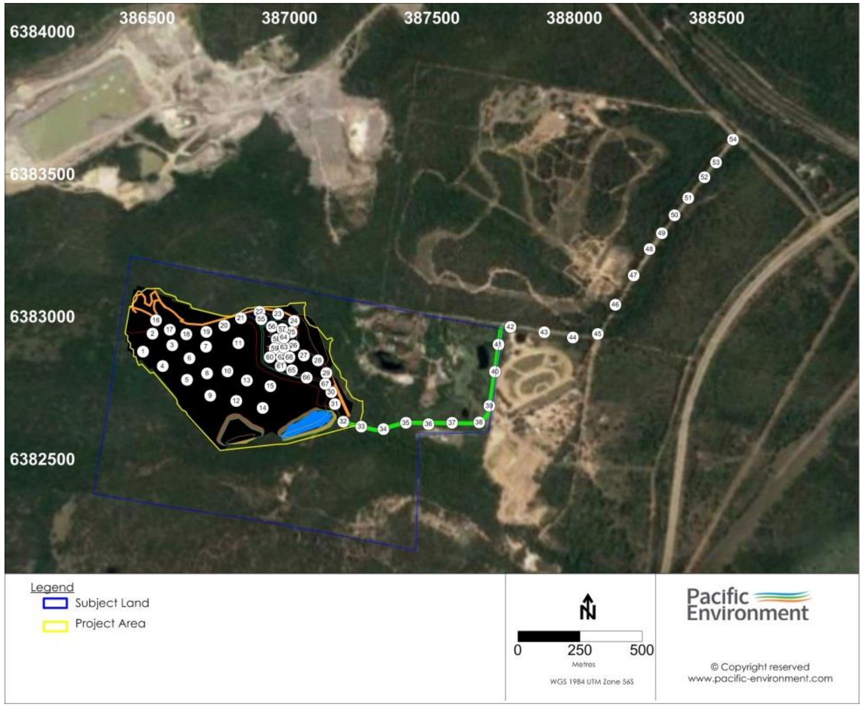
The locations of the sources used for this updated AQA are presented in **Figure 3-4** .

*Table 3-3: Annual and maximum day activity*

| ACTIVITY | Maximum annual activity | | Maximum per day | | Annual activity (based on maximum day @300 days/y) | |
|---|---|---|---|---|---|---|
| | Intensity | Units | Intensity | Units | Intensity | Units |
| **Extraction Area** | | | | | | |
| Drilling rock | 7,500 | holes/y | 25 | holes/day | 7500 | holes/y |
| Blasting rock | 12 | blasts/y | 1 | blasts/day | 300 | blasts/y |
| Excavator loading | 600,000 | t/y | 4,400 | t/day | 1,320,000 | t/y |
| Hauling to Processing area | 600,000 | t/y | 4,400 | t/day | 1,320,000 | t/y |
| **Processing Area** | | | | | | |
| Unloading at processing area | 600,000 | t/y | 4,400 | t/day | 1,320,000 | t/y |
| Rehandle rock to hopper | 600,000 | t/y | 4,400 | t/day | 1,320,000 | t/y |
| Primary Crushing (controlled) | 600,000 | t/y | 4,000 | t/day | 1,200,000 | t/y |
| Screening (controlled) | 600,000 | t/y | 3,400 | t/day | 1,020,000 | t/y |
| Secondary Crushing (controlled) | 600,000 | t/y | 2,000 | t/day | 600,000 | t/y |
| Tertiary Crushing (controlled) | 600,000 | t/y | 1,000 | t/day | 300,000 | t/y |
| Crushing (Fines) (controlled) | 600,000 | t/y | 1,500 | t/day | 450,000 | t/y |
| Fines Screening (controlled) | 600,000 | t/y | 1,000 | t/day | 300,000 | t/y |
| Pug Mill | 100,000 | t/y | 1,000 | t/day | 300,000 | t/y |
| Stacking stockpiles/bins - aggregate | 600,000 | t/y | 2,000 | t/day | 600,000 | t/y |
| FEL loading trucks - aggregate | 600,000 | t/y | 4,400 | t/day | 1,320,000 | t/y |
| Haul of product trucks (unsealed road) | 600,000 | t/y | 6,000 | t/day | 1,800,000 | t/y |
| Haul of product trucks to Italia Road (sealed road) | 600,000 | t/y | 6,000 | t/day | 1,800,000 | t/y |

*Table 3-4: Estimated dust emissions (kg/y)*

| ACTIVITY | TSP | | PM$_{10}$ | | | PM2.5 | | |
|---|---|---|---|---|---|---|---|---|
| | Annual | | Annual | | Maximum Day | Annual | | Maximum Day |
| | Original | Update | Original | Update | | Original | Update | |
| **Extraction Area** | | | | | | | | |
| Drilling rock | 1,328 | 664 | 690 | 345 | 345 | 40 | 20 | 20 |
| Blasting rock | 1,304 | 1,304 | 678 | 678 | 16,958 | 39 | 39 | 978 |
| Excavator loading | 622 | 622 | 294 | 294 | 648 | 45 | 45 | 98 |
| Hauling to Processing area | 24,818 | 16,131 | 6,377 | 4,145 | 9,119 | 638 | 414 | 912 |
| **Processing Area** | | | | | | | | |
| Unloading at processing area | 311 | 311 | 147 | 147 | 324 | 22 | 22 | 49 |
| Rehandle rock to hopper | 311 | 311 | 147 | 147 | 324 | 22 | 22 | 49 |
| Primary Crushing (controlled) | 360 | 360 | 162 | 162 | 324 | 30 | 30 | 60 |
| Screening (controlled) | 660 | 660 | 222 | 222 | 377 | 15 | 15 | 26 |
| Secondary Crushing (controlled) | 360 | 360 | 162 | 162 | 162 | 30 | 30 | 30 |
| Tertiary Crushing (controlled) | 360 | 360 | 162 | 162 | 81 | 30 | 30 | 15 |
| Crushing (Fines) (controlled) | 900 | 900 | 360 | 360 | 270 | 21 | 21 | 16 |
| Fines Screening (controlled) | 1,080 | 1,080 | 660 | 660 | 330 | 660 | 660 | 330 |
| Pug Mill | 180 | 180 | 110 | 110 | 330 | 110 | 110 | 330 |
| Stacking stockpiles/bins - aggregate | 311 | 311 | 147 | 147 | 147 | 22 | 22 | 22 |
| FEL loading trucks - aggregate | 622 | 622 | 294 | 294 | 648 | 45 | 45 | 98 |
| Haul of product trucks (unsealed road) | 12,409 | 12,409 | 3,188 | 3,188 | 9,565 | 319 | 319 | 957 |
| Haul of product trucks to Italia Road (sealed road) | 36,370 | 40,006 | 6,981 | 7,679 | 23,038 | 1,689 | 1,858 | 5,574 |
| Grading roads | 1,412 | 1,412 | 1,412 | 1,412 | 1,412 | 1,412 | 1,412 | 1,412 |
| **Wind Erosion** | | | | | | | | |
| WE - Extraction Area | 26,798 | 26,798 | 13,399 | 13,399 | 13,399 | 2,010 | 2,010 | 2,010 |
| WE- from conveyors | 27 | 45 | 14 | 23 | 23 | 2 | 3 | 3 |
| WE - Processing Area (stockpiles/bins) | 416 | 416 | 208 | 208 | 208 | 31 | 31 | 31 |
| **Diesel Emissions** | | | | | | | | |
| Diesel usage on-site | - | - | - | - | - | - | 370 | 370 |
| **Total (kg/y)** | **110,959** | **105,264** | **35,816** | **33,946** | **78,031** | **7,232** | **7,529** | **13,390** |




| Activity | Source ID |
|---|---|
| Drilling rock | 1-15 |
| Blasting rock | 1-15 |
| Excavator loading | 1-15 |
| Hauling to processing area | 16-25 |
| Unloading at processing area | 55 |
| Rehandle rock to hopper | 55 |
| Primary crushing (controlled) | 55 |
| Screening (controlled) | 56 |
| Secondary crushing (controlled) | 57 |
| Tertiary crushing (controlled) | 57 |
| Crushing (fines) (controlled) | 57 |
| Fines screening (controlled) | 57 |
| Pug mill | 57 |
| Stacking stockpiles/bins - aggregate | 58-64 |
| FEL loading trucks - aggregate | 58-64 |
| Haul of product trucks (unsealed road) | 26-28, 65-66, 68 |
| Haul of product trucks to Italia Road (sealed road) | 29-54, 67 |
| Grading roads | 16-28, 65-66, 68 |
| Wind erosion – extraction area | 1-15 |
| Wind erosion – conveyors | 55-64 |
| Wind erosion – processing area (stockpiles/bins) | 58-64 |

*Figure 3-4: Source locations*

## 3.6 Annual average concentrations

**Table 3-5** presents the predicted annual average concentrations and levels at each of the sensitive receptor locations for both the Project alone and when including Gardenland and existing background concentrations.

Contour plots of the predicted annual average concentrations due to the Project alone and cumulatively are presented in **Figure 3-5** to **Figure 3-8.**

The results show that there are no sensitive receivers predicted to experience annual average concentrations above the relevant impact assessment criterion for TSP or dust deposition, either due to the Project or when including existing background concentrations.

There are no receptors predicted to exceed the annual average $PM_{10}$ criterion of 25 $\mu g/m^3$ due to the Project alone, however, when considering the cumulative concentrations, there is one receptor (ID C – Hunter Valley Paintball) predicted to experience minor exceedance with a cumulative concertation of 25.3 $\mu g/m^3$. As Hunter Valley Paintball is only open Saturdays and Sundays for recreational activities, that in themselves are likely to generate dust emissions, it is considered unlikely that any individual would be adversely impacted as direct result of the quarry activities.

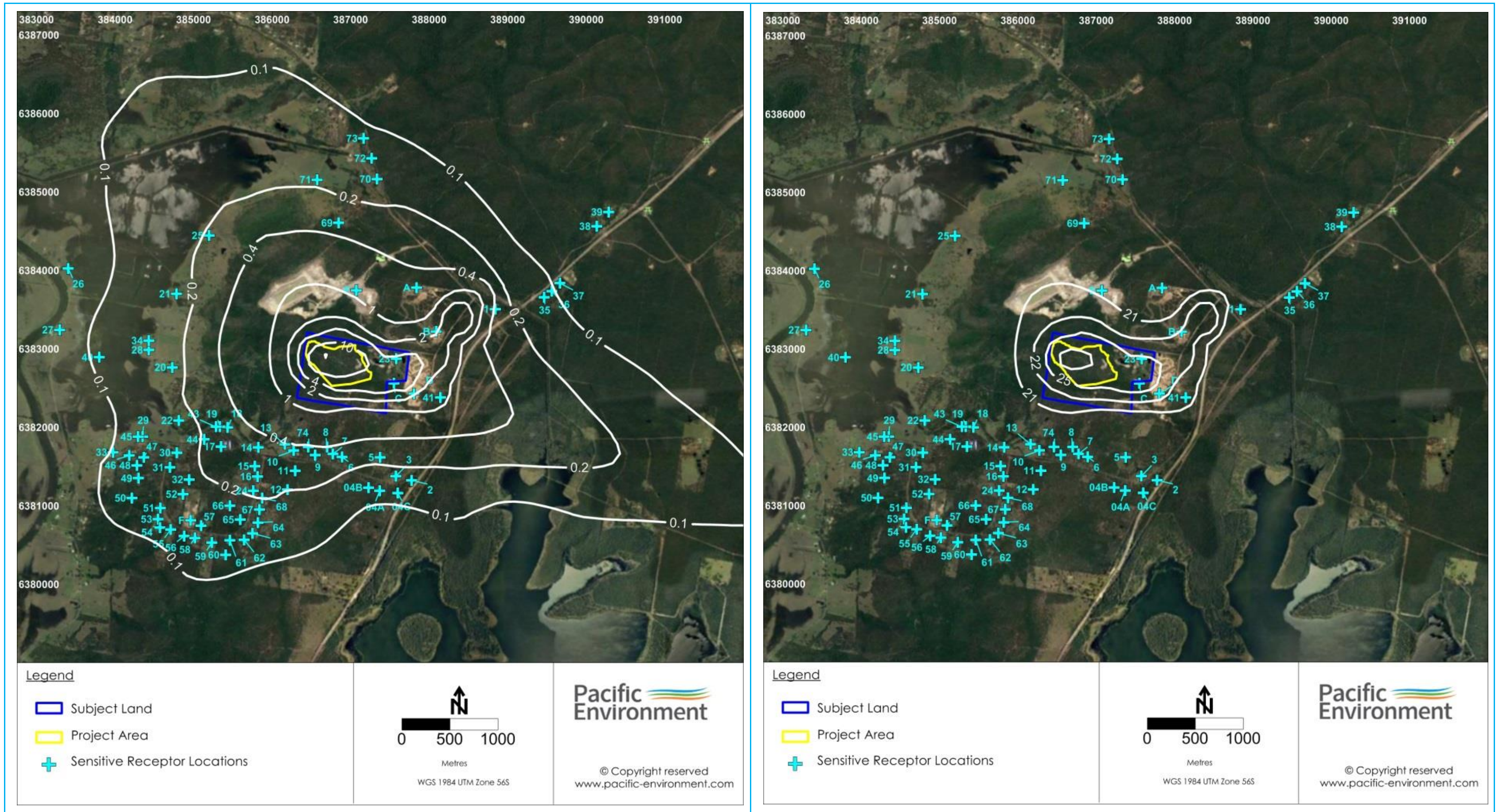
There are no receptors predicted to exceed the annual average $PM_{2.5}$ criterion of 8 $\mu g/m^3$ due to the Project alone, However, when considering the cumulative concentrations, there are two receptors (ID 23 – Managers House, Gardenland and ID C – Hunter Valley Paintball) predicted to experience minor exceedances of 0.1 $\mu g/m^3$ at ID 23 and 0.3 $\mu g/m^3$ at ID C. Receptor ID 23 is located at Gardenland and given the minor predicted exceedance and the conservative nature of the assessment, considered unlikely to occur in practice. As noted above, due to the intermittent use of Hunter Valley Paintball it is considered unlikely that any individual would be adversely impacted as direct result of the quarry activities.

*Table 3-5: Predicted annual average concentrations and levels due to Project-alone and cumulatively*

| **Pollutant** | | **PM10 (µg/m3)** | | **PM2.5 (µg/m3)** | | **TSP (µg/m3)** | | **Dust deposition (g/m2/month)** | |
|---|---|---|---|---|---|---|---|---|---|
| **Averaging period** | | **Annual** | | | | | | | |
| **Receptor ID** | | **Project alone** | **Cumulative** | **Project alone** | **Cumulative** | **Project alone** | **Cumulative** | **Project alone** | **Cumulative** |
| ***Assessment Criteria*** | | *N/A* | *25 µg/m3* | *N/A* | *8 µg/m3* | *N/A* | *90 µg/m3* | *2 g/m2/month* | *4 g/m2/month* |
| 1 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.7 | 50.7 | 0.07 | 1.9 |
| 2 | | 0.1 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 3 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 04A | Proposed Kingshill residential area | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 04B | Proposed Kingshill residential area | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 04C | Proposed Kingshill residential area | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 5 | | 0.2 | 20.2 | 0.1 | 7.1 | 0.3 | 50.3 | 0.02 | 1.8 |
| 6 | Respite Centre | 0.3 | 20.3 | 0.1 | 7.1 | 0.4 | 50.4 | 0.02 | 1.8 |
| 7 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.4 | 50.5 | 0.02 | 1.8 |
| 8 | | 0.4 | 20.4 | 0.1 | 7.1 | 0.5 | 50.6 | 0.03 | 1.8 |
| 9 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.4 | 50.4 | 0.03 | 1.8 |
| 10 | | 0.4 | 20.4 | 0.1 | 7.1 | 0.5 | 50.5 | 0.03 | 1.8 |
| 11 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.3 | 50.3 | 0.02 | 1.8 |
| 12 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 13 | | 0.4 | 20.4 | 0.1 | 7.1 | 0.5 | 50.5 | 0.04 | 1.8 |
| 14 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.4 | 50.4 | 0.03 | 1.8 |
| 15 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.3 | 50.3 | 0.02 | 1.8 |
| 16 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.3 | 50.3 | 0.02 | 1.8 |
| 17 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.3 | 50.3 | 0.02 | 1.8 |
| 18 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.3 | 50.3 | 0.02 | 1.8 |
| 19 | | 0.2 | 20.2 | 0.1 | 7.1 | 0.3 | 50.3 | 0.02 | 1.8 |
| 20 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 21 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 22 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 23 | Gardenland Managers Residence | 4.1 | 24.5 | 1.1 | **8.1** | 12.7 | 63.4 | 0.41 | 2.2 |
| 24 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.3 | 0.02 | 1.8 |
| 25 | | 0.2 | 20.2 | 0.1 | 7.1 | 0.2 | 50.2 | 0.01 | 1.8 |
| 26 | | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.00 | 1.8 |

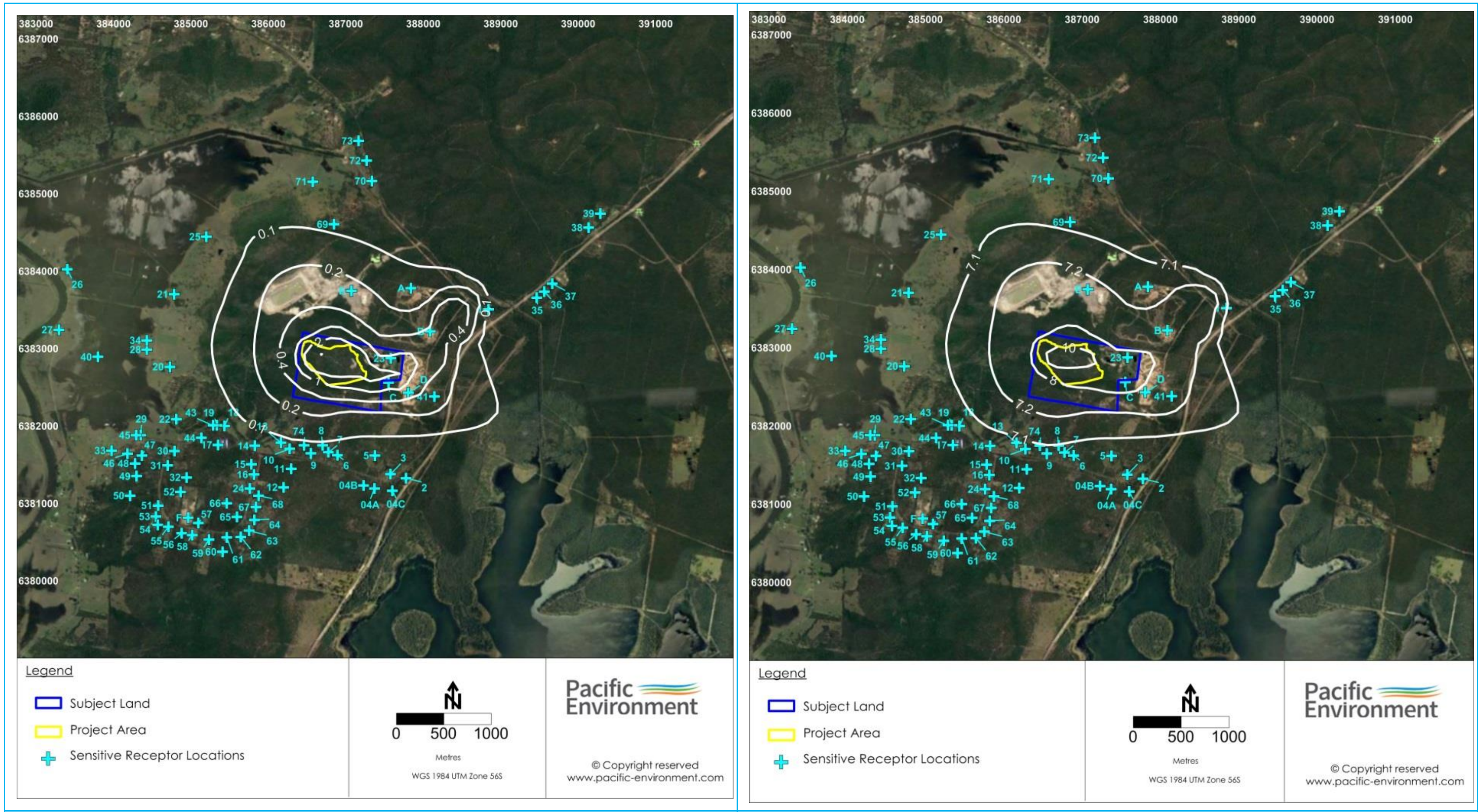
| Pollutant | $PM_{10}$ (µg/m3) | | $PM_{2.5}$ (µg/m3) | | TSP (µg/m³) | | Dust deposition (g/m²/month) | |
|---|---|---|---|---|---|---|---|---|
| Averaging period | Annual | | | | | | | |
| Receptor ID | Project alone | Cumulative | Project alone | Cumulative | Project alone | Cumulative | Project alone | Cumulative |
| | *Assessment Criteria* | | | | | | | |
| | *N/A* | *25 µg/m³* | *N/A* | *8 µg/m³* | *N/A* | *90 µg/m³* | *2 g/m²/month* | *4 g/m²/month* |
| 27 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.00 | 1.8 |
| 28 | 0.1 | 20.1 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 29 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 30 | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 31 | 0.1 | 20.1 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 32 | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 33 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 34 | 0.1 | 20.1 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 35 | 0.1 | 20.1 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 36 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 37 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 38 | 0.0 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.00 | 1.8 |
| 39 | 0.0 | 20.0 | 0.0 | 7.0 | 0.1 | 50.1 | 0.00 | 1.8 |
| 40 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.00 | 1.8 |
| 41 | 1.3 | 21.3 | 0.3 | 7.3 | 1.9 | 52.0 | 0.16 | 2.0 |
| 43 | 0.2 | 20.2 | 0.1 | 7.1 | 0.3 | 50.3 | 0.02 | 1.8 |
| 44 | 0.2 | 20.2 | 0.1 | 7.1 | 0.2 | 50.3 | 0.02 | 1.8 |
| 45 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 46 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 47 | 0.1 | 20.1 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 48 | 0.1 | 20.1 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 49 | 0.1 | 20.1 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 50 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 51 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 52 | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 53 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 54 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 55 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 56 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 57 | 0.1 | 20.1 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 58 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 59 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 60 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 61 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 62 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 63 | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.2 | 0.01 | 1.8 |

| Pollutant | | PM10 (µg/m3) | | PM2.5 (µg/m3) | | TSP (µg/m³) | | Dust deposition (g/m²/month) | |
|---|---|---|---|---|---|---|---|---|---|
| Averaging period | | Annual | | | | | | | |
| Receptor ID | | Project alone | Cumulative | Project alone | Cumulative | Project alone | Cumulative | Project alone | Cumulative |
| | | *Assessment Criteria* | | | | | | | |
| | | *N/A* | *25 µg/m³* | *N/A* | *8 µg/m³* | *N/A* | *90 µg/m³* | *2 g/m²/month* | *4 g/m²/month* |
| 64 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 65 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 66 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 67 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 68 | | 0.2 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 69 | | 0.3 | 20.3 | 0.1 | 7.1 | 0.4 | 50.4 | 0.03 | 1.8 |
| 70 | | 0.1 | 20.2 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 71 | | 0.2 | 20.2 | 0.1 | 7.1 | 0.2 | 50.2 | 0.01 | 1.8 |
| 72 | | 0.1 | 20.1 | 0.0 | 7.0 | 0.2 | 50.2 | 0.01 | 1.8 |
| 73 | | 0.1 | 20.1 | 0.0 | 7.0 | 0.1 | 50.1 | 0.01 | 1.8 |
| 74 | | 0.4 | 20.4 | 0.1 | 7.1 | 0.5 | 50.5 | 0.03 | 1.8 |
| A | MG Car club hill climb track | 0.5 | 20.5 | 0.1 | 7.1 | 1.0 | 51.0 | 0.06 | 1.9 |
| B | Motorplex | 1.7 | 21.7 | 0.4 | 7.4 | 5.1 | 55.1 | 0.37 | 2.2 |
| C | Hunter Valley Paintball | 5.2 | **25.3** | 1.3 | **8.3** | 17.0 | 67.0 | 0.76 | 2.6 |
| D | Motor Cross Track | 2.1 | 22.1 | 0.5 | 7.5 | 4.1 | 54.2 | 0.18 | 2.0 |
| E | Boral Seaham Quarry | 0.9 | 20.9 | 0.2 | 7.3 | 1.4 | 51.4 | 0.05 | 1.9 |
| F | Quarry | 0.3 | 20.3 | 0.1 | 7.1 | 0.2 | 50.2 | 0.01 | 1.8 |



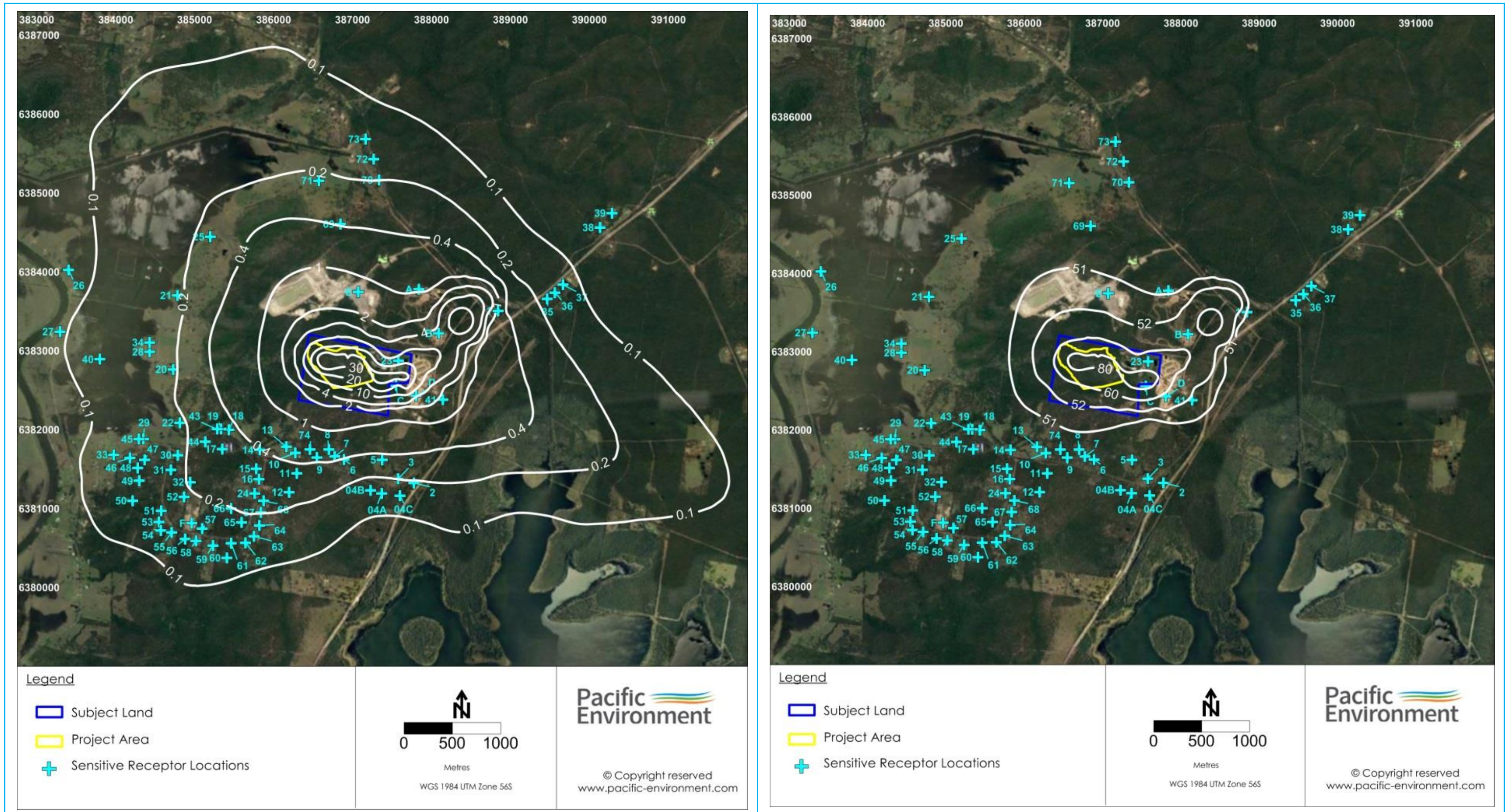

| Project-only | Cumulative |
|---|---|

*Figure 3-5: Predicted annual average $PM_{10}$ concentrations ($\mu g/m^3$)*



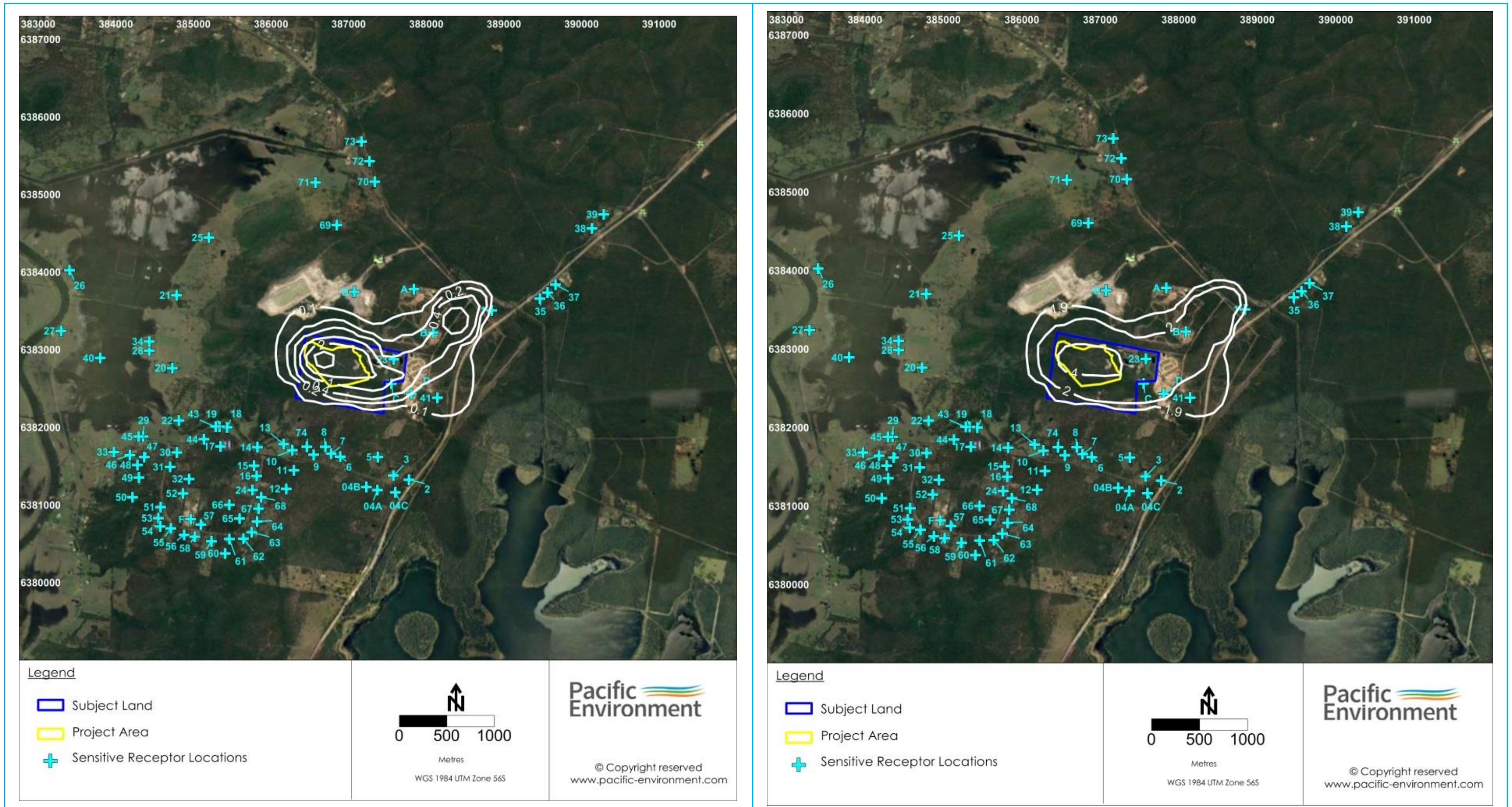

| Project-only | Cumulative |
|---|---|

*Figure 3-6: Predicted annual average $PM_{2.5}$ concentrations ($\mu g/m^3$)*




| Project-only | Cumulative |
|---|---|

*Figure 3-7: Predicted annual average TSP concentrations ($\mu g/m^3$)*




| Project-only | Cumulative |
|---|---|

*Figure 3-8: Predicted annual average dust deposition levels (g/m²/month)*

# 3.7 24-hour average concentrations

## 3.7.1 Introduction

It is important to note that it is not possible to accurately predict cumulative 24-hour average concentrations many years into the future using dispersion modelling, principally due to the variability in ambient levels and spatial and temporal variation in any day-to-day anthropogenic activity. Experience shows that the worst-case 24-hour average $PM_{10}$ concentrations are strongly influenced by other sources in the area, such as bushfires and dust storms, which are essentially unpredictable.

The cumulative 24-hour average assessment was completed by combining the predicted concentrations from the quarry for each day with the measured concentrations on the same day from the Beresfield OEH site and the predicted concentrations from Gardenland.

## 3.7.2 $PM_{10}$

**Table 3-6** presents the maximum predicted 24-hour average $PM_{10}$ concentrations at the sensitive receptors, due to both the Project alone and cumulatively (background concentrations plus Gardenland) for both a “typical day” and “maximum day”.

- Typical day
  - This is based on the assumption that the annual maximum material movement and processing activities occur equally each day.
- Maximum day
  - This is based on the maximum possible amount of material that could be removed and processed in a single day and conservatively assumes this occurs each day of the year.

In reality, it is considered unlikely that the “maximum day” scenario would occur more than a few days in a year, and thus unlikely that this scenario would match up with days of high background concentrations and unfavourable meteorological conditions. In combination with the proposed air quality monitoring at the site boundary, it is therefore considered highly unlikely that any additional exceedances would occur

Contour plots of the maximum predicted 24-hour average concentrations of $PM_{10}$ due to the Project alone are presented in **Figure 3-9.**

There are no predicted exceedances of the 24-hour average $PM_{10}$ criterion of 50 $\mu g/m^3$ due to the Project alone for typical day activities. There two predicted exceedances of the 24-hour average $PM_{10}$ criterion of 50 $\mu g/m^3$ due to the Project alone for maximum day activities, at receptor ID C – Hunter Valley Paintball.

When considering cumulative concentrations on a typical day, there is one additional exceedance predicted at receptor ID C – Hunter Valley Paintball. **Figure 3-10** shows each predicted 24-hour concentration (due to typical day activities) at receptor ID C, matched with the corresponding 24-hour average concentration at the OEH Beresfield monitoring station. This shows that the vast majority (95%) of cumulative 24-hour concentrations are predicted to be below 40 $\mu g/m^3$.

The cumulative assessment for “maximum day” activities shows there are a number of predicted exceedances of the $PM_{10}$ assessment criteria as detailed below:

- Receptor C – Hunter Valley Paintball (61 days)
- Receptor D – Motor Cross Track (7 days)
- Receptor 23- Gardenland Managers House (4 days)

**Figure 3-11** to **Figure 3-13** shows each predicted 24-hour concentration (due to maximum day activities) at each of these receptors, matched with the corresponding 24-hour average concentration at the OEH Beresfield monitoring station.

At receptor ID C - Hunter Valley Paintball, approximately 72% of cumulative 24-hour average concentrations are below 40 $\mu g/m^3$ and at the Motor Cross Track (ID D) approximately 92% are below 40 $\mu g/m^3$ and at Receptor 23, approximately 89% are below 40 $\mu g/m^3$. The Hunter Valley Paintball (ID C) is open intermittently every day between the hours of 9 am and 8 pm, subject to demand. As it is a recreational facility, the same members of the public will not be at the facility 24/7. The Motor Cross Track (ID D) is only in use on the occasional Saturday and Sunday, and the quarry operates for shorter hours on Saturday, and not all on Sunday, it is therefore considered highly unlikely that maximum activities would occur on a day when both the site(s) are occupied and the meteorological conditions are such that an exceedance would occur.

It is also important to consider that both the emission calculations and dispersion modelling assumed that all activities occur continuously, which in reality is unlikely. In addition, the receptors are not occupied 24/7. The impact assessment criteria are based on exposure to these concentrations 24 hours a day, 365 days a year for an entire lifetime, with little risk of ill effects. It is considered that those taking part in activities at the Paintball and/or Motor Cross site would be in relatively good health and not contain sensitive groups such as the very young or elderly, similar to those who work at both sites and would work at the Project.

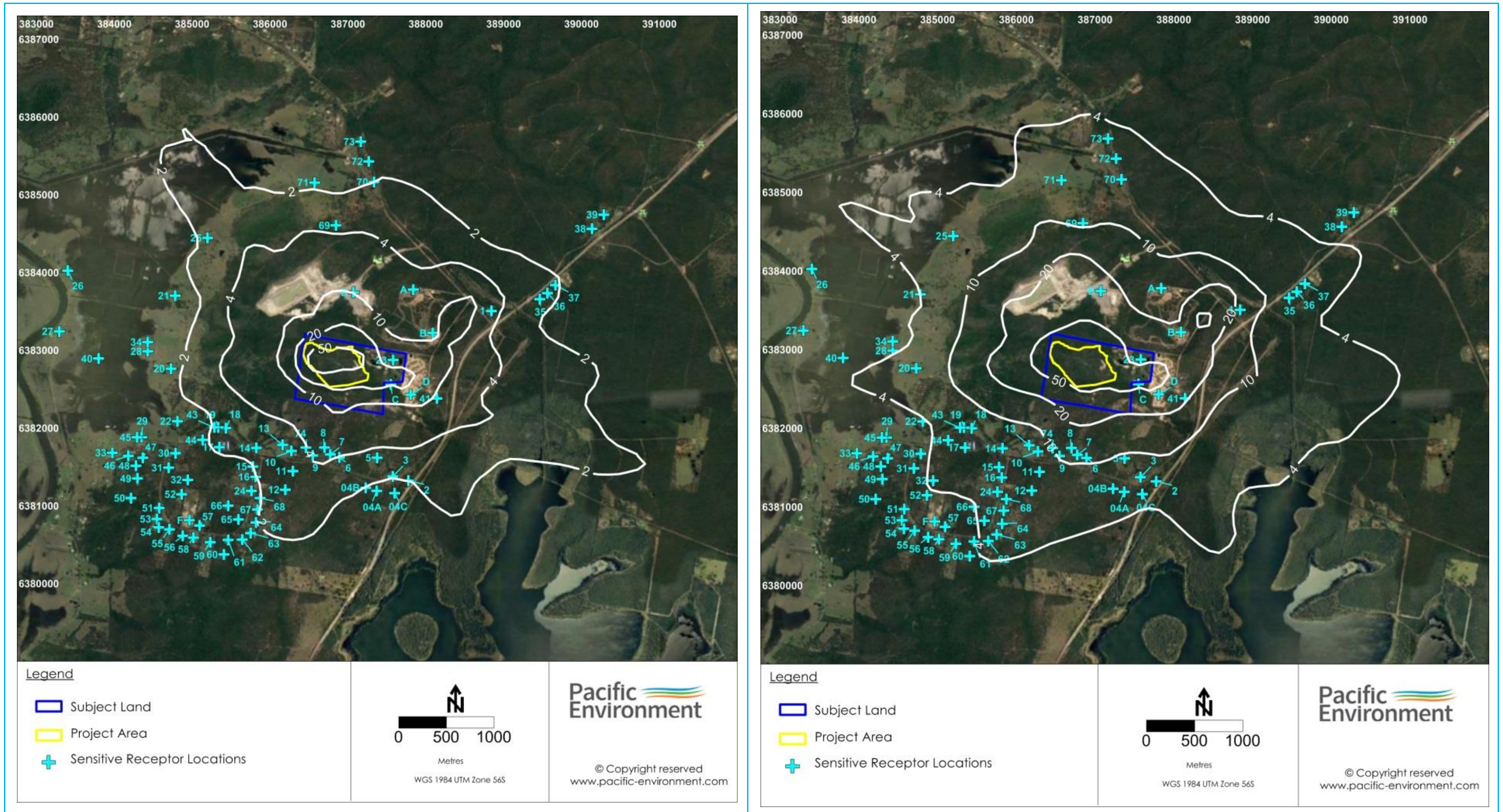
When considering the predicted exceedances at Hunter Valley Paintball (ID C) and Motor Cross Track (ID D), it is important to note that neither staff nor public will be present at the site 24/7. Safe Work Australia publish workplace exposure standards for airborne concentrations of a particular chemical or substance in the workers' breathing zone that should not cause adverse health effects or cause undue discomfort to nearly all workers.

The Safe Work Australia Time Weighted Average (TWA) exposure standard for inhalable dust containing no asbestos and <1% crystalline silica is 10 $mg/m^3$. (This is a factor of 200 times the EPA impact assessment criteria for 24-hour average $PM_{10}$ of 50 $\mu g/m^3$). The TWA is an average exposure over an 8-hour period (expressed an 8-hour average concentration). Inhalable dust refers to the particle size that enters the mouth and noise during normal breathing and may be deposited in the respiratory tract. Whilst it is acknowledged that the TWA is not explicitly for $PM_{10}$, it does represent a concentration orders of magnitude above those referenced within environmental criteria. Eagleton Quarry will need to meet these standards in order to meet the requirements for its workers. On that basis, if levels at the site are safe then by default any receptor outside of the site, including those at Hunter Valley Paintball (ID C) and Motor Cross Track (ID D)  will also meet these standards.

*Table 3-6: Maximum predicted 24-hour average $PM_{10}$ concentrations*

| Receiver ID | Project alone | | Cumulative | |
|---|---|---|---|---|
| | Maximum 24-h average $PM_{10}$ (µg/m³) | | | |
| | *Assessment criteria = N/A* | | *Assessment criteria = 50 µg/m³* | |
| | *Typical day* | *Maximum day* | *Typical day* | *Maximum day* |
| 1 | 4.9 | 14.3 | 43.1 | 44.4 |
| 2 | 1.9 | 5.0 | 42.9 | 42.9 |
| 3 | 2.0 | 5.7 | 42.8 | 42.8 |
| 4A | 1.8 | 5.3 | 42.8 | 42.8 |
| 4B | 1.9 | 5.4 | 42.8 | 42.8 |
| 4C | 1.5 | 4.4 | 42.8 | 42.8 |
| 5 | 3.1 | 8.7 | 42.9 | 42.9 |
| 6 | 3.8 | 11.0 | 42.8 | 42.8 |
| 7 | 4.3 | 10.6 | 42.8 | 43.3 |
| 8 | 5.2 | 12.6 | 42.9 | 44.4 |
| 9 | 4.1 | 10.1 | 42.8 | 43.1 |
| 10 | 2.8 | 7.7 | 42.9 | 43.2 |
| 11 | 2.9 | 7.5 | 42.8 | 42.9 |
| 12 | 2.4 | 6.2 | 42.8 | 42.8 |
| 13 | 2.6 | 6.8 | 43.0 | 43.0 |
| 14 | 2.3 | 5.8 | 43.0 | 43.1 |
| 15 | 2.0 | 5.3 | 43.0 | 43.0 |
| 16 | 2.0 | 5.3 | 42.9 | 42.9 |
| 17 | 2.1 | 5.5 | 43.0 | 43.1 |
| 18 | 2.4 | 5.2 | 43.0 | 43.2 |
| 19 | 2.2 | 5.0 | 43.0 | 43.2 |
| 20 | 1.7 | 5.4 | 43.3 | 44.1 |
| 21 | 1.4 | 4.0 | 43.0 | 43.4 |
| 22 | 1.3 | 3.5 | 43.0 | 43.2 |
| 23 | 13.1 | 31.5 | 47.8 | **56.6** |
| 24 | 1.7 | 4.5 | 42.9 | 42.9 |
| 25 | 2.4 | 5.1 | 43.0 | 43.3 |
| 26 | 1.0 | 2.4 | 42.9 | 43.1 |
| 27 | 1.1 | 2.6 | 43.0 | 43.4 |
| 28 | 1.3 | 3.8 | 43.2 | 43.8 |
| 29 | 3.7 | 9.4 | 42.9 | 43.7 |
| 30 | 1.5 | 3.7 | 42.9 | 43.0 |
| 31 | 1.4 | 3.4 | 42.9 | 42.9 |
| 32 | 1.5 | 4.4 | 43.0 | 43.0 |
| 33 | 0.8 | 2.4 | 42.9 | 43.0 |
| 34 | 1.5 | 3.4 | 43.1 | 43.7 |
| 35 | 2.5 | 7.4 | 42.9 | 43.3 |
| 36 | 2.3 | 6.8 | 42.9 | 43.3 |
| 37 | 2.1 | 6.1 | 42.9 | 43.2 |
| 38 | 1.1 | 3.0 | 42.9 | 43.1 |
| 39 | 1.0 | 2.7 | 42.9 | 43.1 |
| 40 | 1.1 | 3.4 | 43.1 | 43.6 |
| 41 | 9.0 | 21.5 | 43.4 | 48.0 |
| 43 | 2.1 | 4.8 | 43.0 | 43.2 |
| 44 | 1.9 | 4.7 | 42.9 | 43.1 |
| 45 | 1.0 | 3.1 | 42.9 | 43.1 |
| 46 | 1.1 | 3.4 | 42.9 | 43.0 |
| 47 | 1.3 | 3.7 | 42.9 | 43.0 |
| 48 | 1.4 | 3.9 | 42.9 | 43.0 |
| 49 | 1.2 | 3.5 | 42.9 | 43.0 |
| 50 | 1.1 | 3.3 | 42.9 | 43.0 |
| 51 | 1.2 | 3.4 | 42.9 | 42.9 |
| 52 | 1.3 | 3.8 | 43.0 | 43.0 |
| 53 | 1.1 | 3.1 | 42.9 | 42.9 |
| 54 | 1.0 | 2.8 | 42.9 | 42.9 |
| 55 | 1.0 | 2.7 | 42.9 | 42.9 |
| 56 | 1.0 | 2.9 | 42.9 | 42.9 |
| 57 | 1.2 | 3.4 | 42.9 | 42.9 |
| 58 | 1.1 | 3.0 | 42.9 | 42.9 |
| 59 | 1.2 | 3.1 | 42.8 | 42.8 |
| 60 | 1.4 | 3.8 | 42.8 | 42.8 |
| 61 | 1.4 | 3.7 | 42.8 | 42.8 |
| 62 | 1.6 | 4.3 | 42.8 | 42.8 |
| 63 | 1.7 | 4.6 | 42.8 | 42.8 |

| Receiver ID | Project alone | | Cumulative | |
|---|---|---|---|---|
| | Maximum 24-h average $PM_{10}$ (µg/m³) | | | |
| | *Assessment criteria = N/A* | | *Assessment criteria = 50 µg/m³* | |
| | *Typical day* | *Maximum day* | *Typical day* | *Maximum day* |
| 64 | 1.9 | 5.2 | 42.8 | 42.8 |
| 65 | 1.5 | 4.3 | 42.8 | 42.8 |
| 66 | 1.5 | 3.9 | 42.9 | 42.9 |
| 67 | 2.0 | 5.3 | 42.8 | 42.8 |
| 68 | 1.9 | 5.3 | 42.8 | 42.9 |
| 69 | 2.9 | 8.3 | 43.0 | 43.5 |
| 70 | 2.0 | 5.4 | 42.9 | 43.2 |
| 71 | 1.9 | 5.3 | 42.9 | 43.2 |
| 72 | 1.6 | 4.6 | 42.9 | 43.2 |
| 73 | 1.4 | 4.1 | 42.9 | 43.1 |
| 74 | 1.0 | 3.1 | 42.9 | 43.1 |
| A | 4.8 | 13.3 | 43.5 | 44.6 |
| B | 7.4 | 22.2 | 44.7 | 48.4 |
| C | 19.3 | **52.3** | **53.8** | **82.9** |
| D | 12.3 | 31.9 | 43.5 | **57.9** |
| E | 9.9 | 26.7 | 43.6 | 48.4 |
| F | 1.1 | 3.1 | 42.9 | 42.9 |




| Typical Day | Maximum Day |
|---|---|

*Figure 3-9: Typical and maximum day - maximum predicted 24-hour average $PM_{10}$ due to the Project ($\mu g/m^3$)*

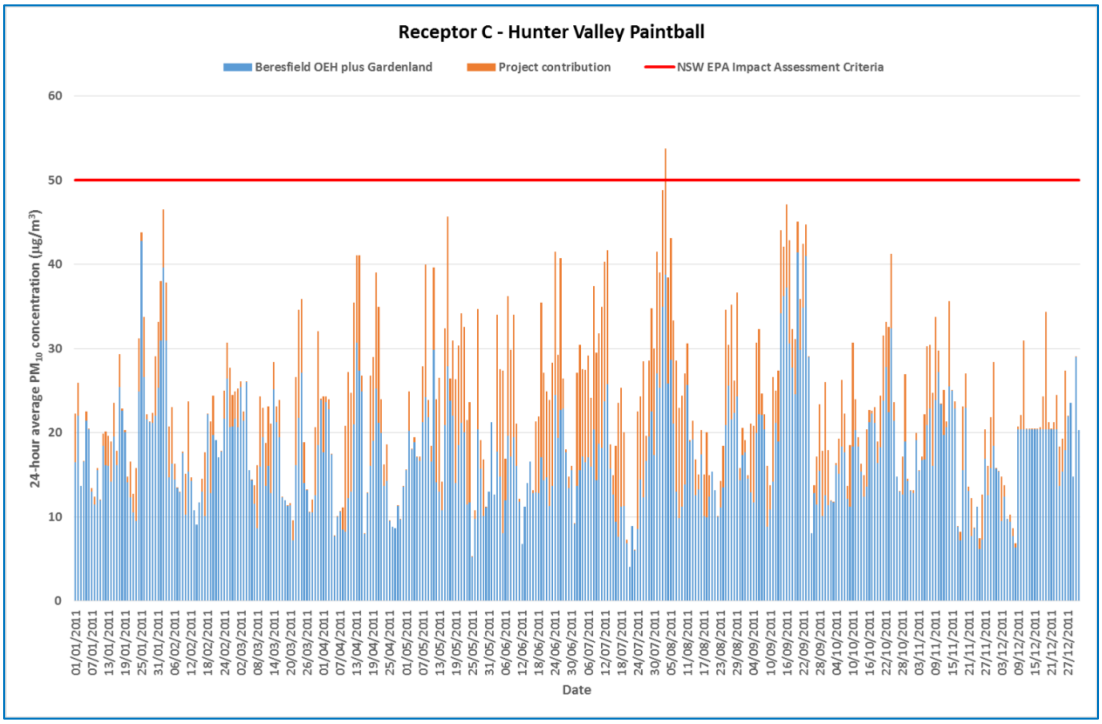



*Figure 3-10: Typical day - predicted 24-hour average $PM_{10}$ concentrations plus existing background and Gardenland (Receptor C)*

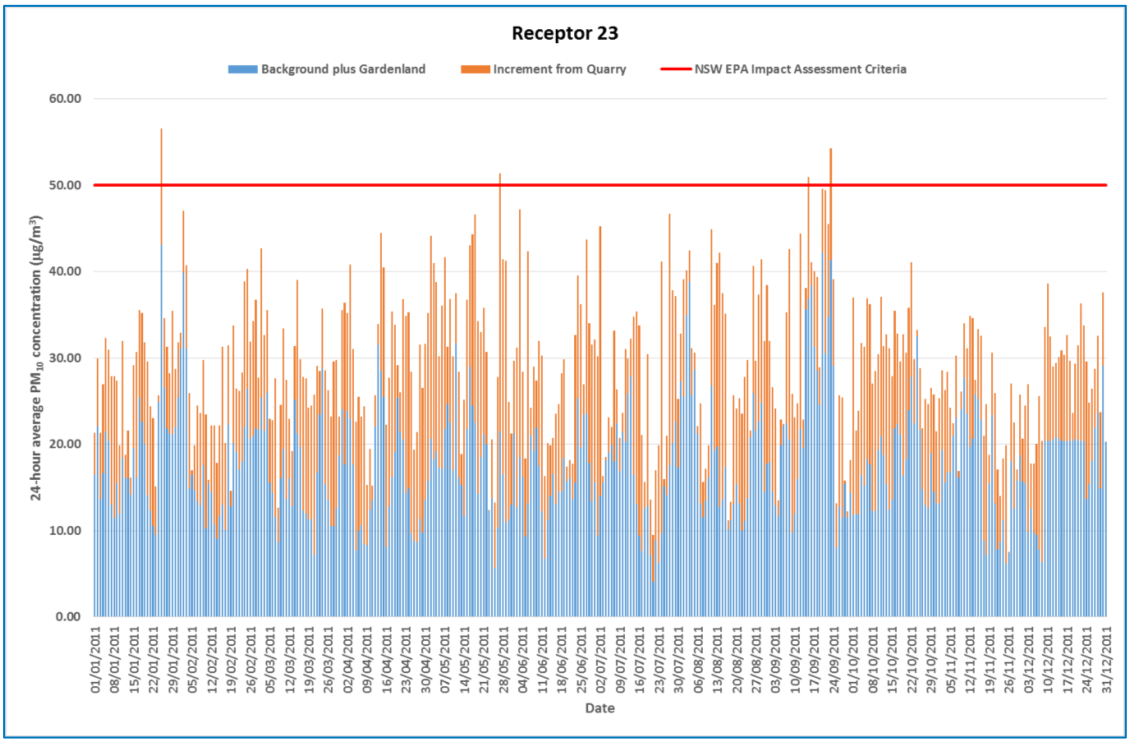



*Figure 3-11: Maximum day - predicted 24-hour average $PM_{10}$ concentrations plus existing background and Gardenland (Receptor 23)*

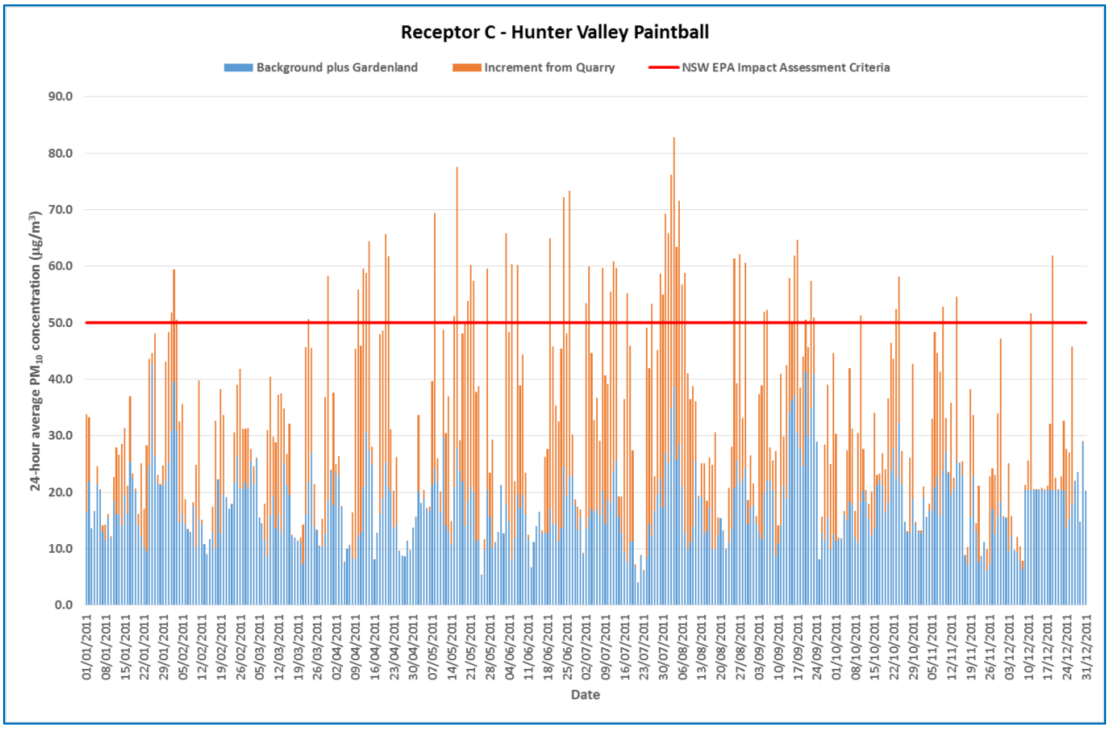



*Figure 3-12: Maximum day - predicted 24-hour average $PM_{10}$ concentrations plus existing background and Gardenland (Receptor C)*

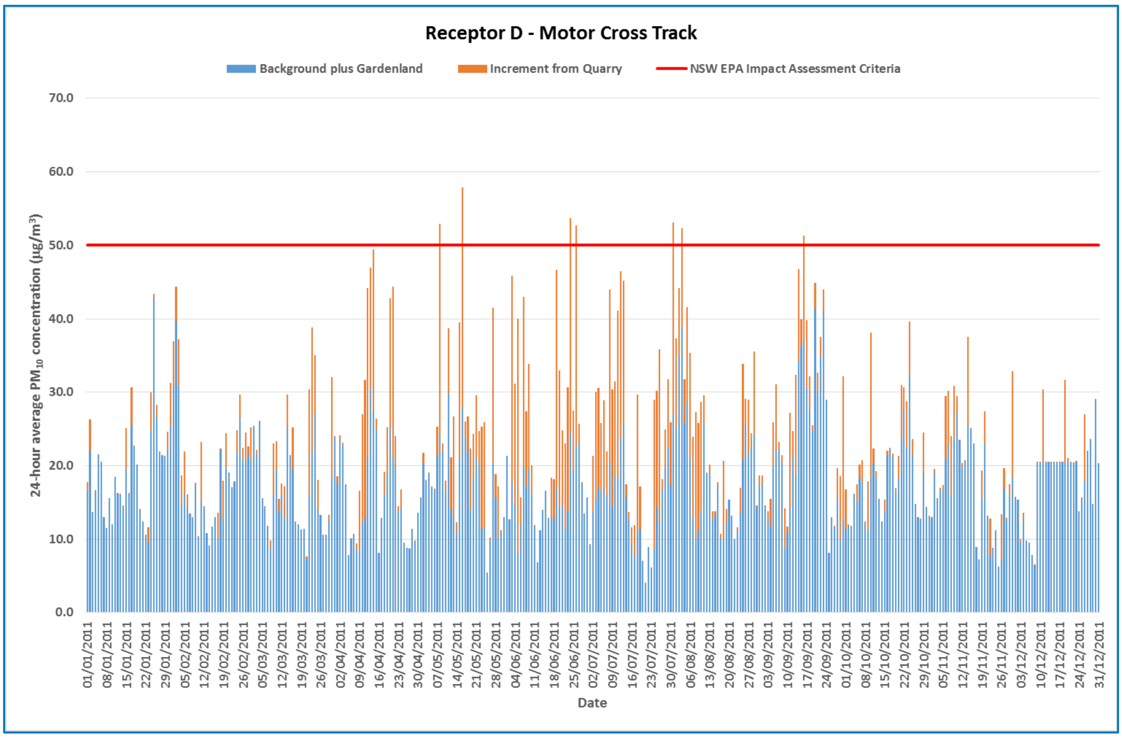



*Figure 3-13: Maximum day - predicted 24-hour average $PM_{10}$ concentrations plus existing background and Gardenland (Receptor D)*

## 3.7.3 $PM_{2.5}$

**Table 3-7** presents the maximum predicted 24-hour average $PM_{2.5}$ concentrations at the sensitive receptors, due to both the Project alone and cumulatively (background concentrations plus Gardenland) for both a “typical day” and “maximum day”.

Contour plots of the maximum predicted 24-hour average concentrations of $PM_{10}$ due to the Project alone are presented in **Figure 3-14.**

There are no predicted exceedances of the $PM_{2.5}$ assessment criteria, due to either the Project alone or cumulatively.

*Table 3-7: Maximum predicted 24-hour average $PM_{2.5}$ concentrations*

| Receiver ID | Project alone | | Cumulative | |
|---|---|---|---|---|
| | Maximum 24-h average $PM_{2.5}$ ($\mu g/m^3$) | | | |
| | *Assessment criteria = N/A* | | *Assessment criteria = 25 $\mu g/m^3$* | |
| | *Typical day* | *Maximum day* | *Typical day* | *Maximum day* |
| 1 | 1.3 | 3.2 | 18.9 | 19.0 |
| 2 | 0.6 | 1.1 | 18.8 | 18.8 |
| 3 | 0.6 | 1.3 | 18.8 | 18.8 |
| 4A | 0.5 | 1.2 | 18.8 | 18.8 |
| 4B | 0.5 | 1.2 | 18.8 | 18.8 |
| 4C | 0.4 | 1.0 | 18.8 | 18.8 |
| 5 | 0.9 | 1.9 | 18.8 | 18.8 |
| 6 | 1.1 | 2.0 | 18.8 | 18.8 |
| 7 | 1.2 | 2.2 | 18.8 | 18.8 |
| 8 | 1.3 | 2.4 | 18.8 | 18.8 |
| 9 | 1.0 | 1.9 | 18.8 | 18.8 |
| 10 | 0.9 | 1.6 | 18.8 | 18.8 |
| 11 | 0.8 | 1.4 | 18.8 | 18.8 |
| 12 | 0.6 | 1.1 | 18.8 | 18.8 |
| 13 | 0.7 | 1.4 | 18.8 | 18.8 |
| 14 | 0.6 | 1.1 | 18.8 | 18.8 |
| 15 | 0.5 | 1.0 | 18.8 | 18.8 |
| 16 | 0.5 | 1.0 | 18.8 | 18.8 |
| 17 | 0.5 | 1.0 | 18.8 | 18.9 |
| 18 | 0.5 | 0.9 | 18.8 | 18.9 |
| 19 | 0.5 | 0.9 | 18.8 | 18.9 |
| 20 | 0.5 | 0.9 | 18.9 | 19.1 |
| 21 | 0.4 | 0.7 | 18.9 | 18.9 |
| 22 | 0.3 | 0.7 | 18.8 | 18.9 |
| 23 | 3.8 | 7.8 | 20.0 | 22.1 |
| 24 | 0.5 | 0.9 | 18.8 | 18.8 |
| 25 | 0.5 | 1.0 | 18.8 | 18.9 |
| 26 | 0.2 | 0.4 | 18.8 | 18.9 |
| 27 | 0.2 | 0.5 | 18.9 | 18.9 |
| 28 | 0.4 | 0.7 | 18.9 | 19.0 |
| 29 | 0.3 | 0.6 | 18.8 | 18.9 |
| 30 | 0.3 | 0.7 | 18.8 | 18.8 |
| 31 | 0.3 | 0.6 | 18.8 | 18.8 |
| 32 | 0.4 | 0.8 | 18.8 | 18.8 |
| 33 | 0.2 | 0.5 | 18.8 | 18.9 |
| 34 | 0.3 | 0.6 | 18.9 | 19.0 |
| 35 | 0.7 | 1.6 | 18.8 | 18.9 |
| 36 | 0.6 | 1.5 | 18.8 | 18.9 |
| 37 | 0.6 | 1.3 | 18.8 | 18.9 |
| 38 | 0.3 | 0.7 | 18.8 | 18.9 |
| 39 | 0.3 | 0.6 | 18.8 | 18.9 |
| 40 | 0.3 | 0.6 | 18.9 | 19.0 |
| 41 | 2.1 | 4.4 | 18.9 | 18.9 |
| 43 | 0.4 | 0.8 | 18.8 | 18.9 |
| 44 | 0.4 | 0.8 | 18.8 | 18.9 |
| 45 | 0.3 | 0.6 | 18.8 | 18.9 |
| 46 | 0.3 | 0.6 | 18.8 | 18.9 |
| 47 | 0.4 | 0.6 | 18.8 | 18.8 |
| 48 | 0.4 | 0.7 | 18.8 | 18.8 |

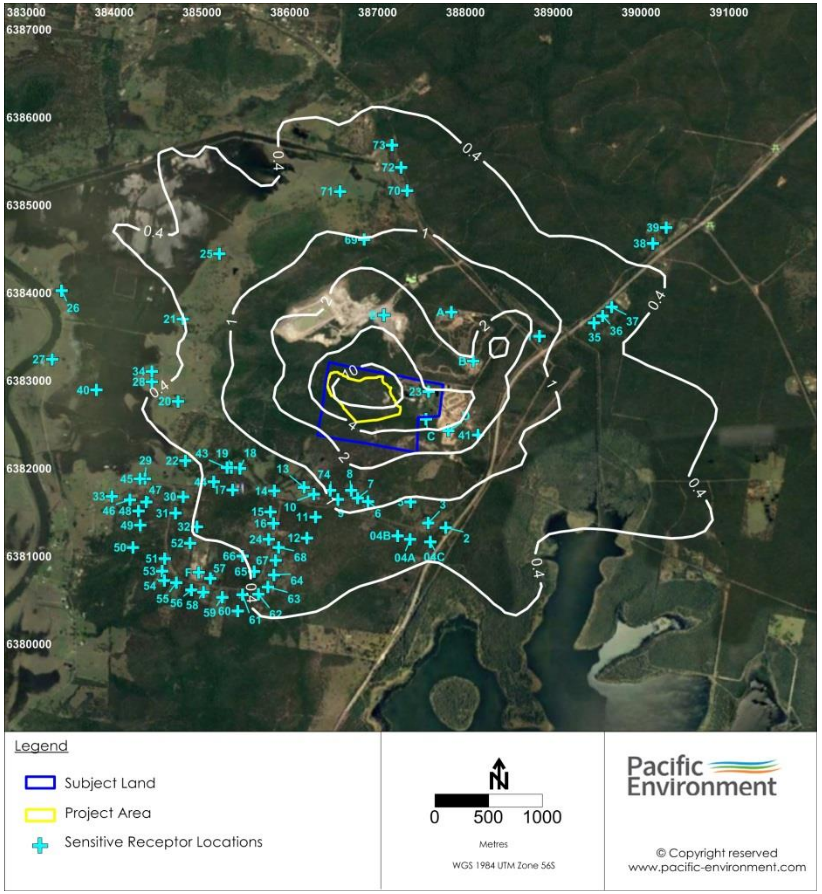
| Receiver ID | Project alone | | Cumulative | |
|---|---|---|---|---|
| | Maximum 24-h average $PM_{2.5}$ (µg/m³) | | | |
| | *Assessment criteria = N/A* | | *Assessment criteria = 25 µg/m³* | |
| | *Typical day* | *Maximum day* | *Typical day* | *Maximum day* |
| 49 | 0.3 | 0.6 | 18.8 | 18.8 |
| 50 | 0.3 | 0.6 | 18.8 | 18.8 |
| 51 | 0.3 | 0.6 | 18.8 | 18.8 |
| 52 | 0.4 | 0.7 | 18.8 | 18.8 |
| 53 | 0.3 | 0.6 | 18.8 | 18.8 |
| 54 | 0.3 | 0.5 | 18.8 | 18.8 |
| 55 | 0.3 | 0.5 | 18.8 | 18.8 |
| 56 | 0.3 | 0.5 | 18.8 | 18.8 |
| 57 | 0.3 | 0.6 | 18.8 | 18.8 |
| 58 | 0.3 | 0.6 | 18.8 | 18.8 |
| 59 | 0.3 | 0.6 | 18.8 | 18.8 |
| 60 | 0.4 | 0.6 | 18.8 | 18.8 |
| 61 | 0.4 | 0.6 | 18.8 | 18.8 |
| 62 | 0.4 | 0.7 | 18.8 | 18.8 |
| 63 | 0.5 | 0.8 | 18.8 | 18.8 |
| 64 | 0.5 | 0.9 | 18.8 | 18.8 |
| 65 | 0.4 | 0.7 | 18.8 | 18.8 |
| 66 | 0.4 | 0.7 | 18.8 | 18.8 |
| 67 | 0.5 | 0.9 | 18.8 | 18.8 |
| 68 | 0.5 | 0.9 | 18.8 | 18.8 |
| 69 | 1.0 | 1.7 | 18.9 | 18.9 |
| 70 | 0.6 | 1.1 | 18.8 | 18.9 |
| 71 | 0.6 | 1.0 | 18.8 | 18.9 |
| 72 | 0.5 | 0.9 | 18.8 | 18.9 |
| 73 | 0.4 | 0.8 | 18.8 | 18.8 |
| 74 | 1.0 | 1.8 | 18.8 | 18.8 |
| A | 1.5 | 3.3 | 19.0 | 19.2 |
| B | 2.0 | 5.6 | 19.3 | 20.1 |
| C | 4.9 | 11.8 | 19.0 | 23.5 |
| D | 3.2 | 6.6 | 18.9 | 18.9 |
| E | 3.3 | 5.3 | 19.0 | 19.2 |
| F | 0.3 | 0.6 | 18.8 | 18.8 |

### 3.7.4 Comparison with DPE VLAMP criteria

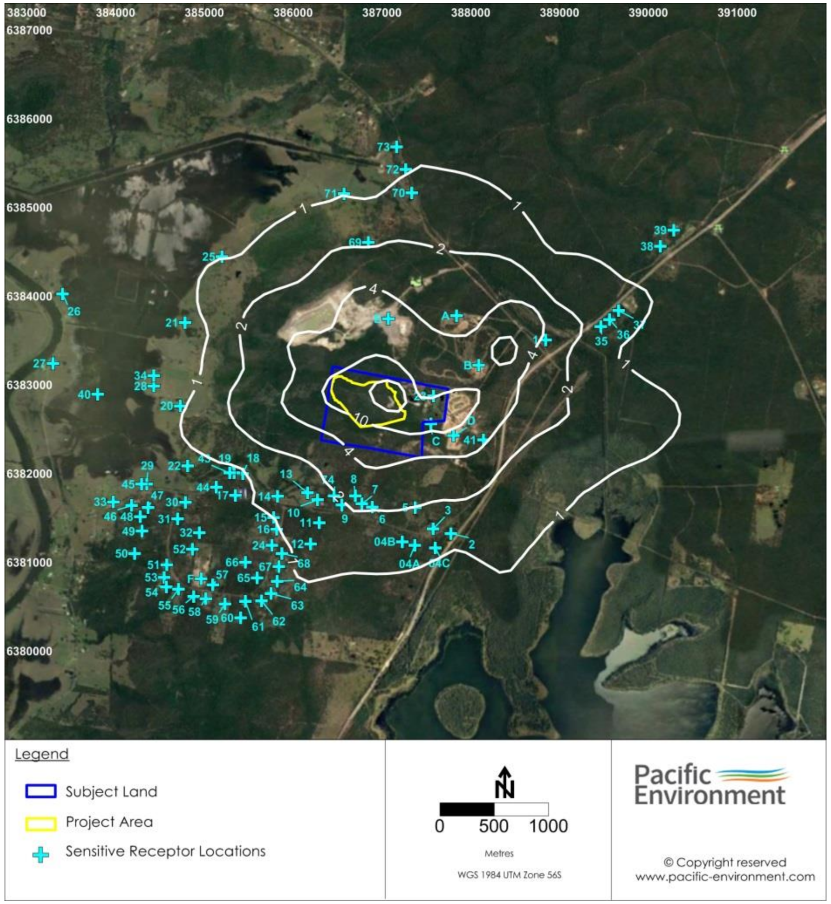
As discussed in **Section 2.7** the results have been compared with the DPE VLAMP criteria. For TSP, there are no predicted concentrations that will exceed the 90 µg/m³ criteria. Voluntary acquisition rights apply where the Proposal contributes to exceedances of the acquisition criteria at any residence or workplace on privately-owned land, or, on more than 25% of any privately-owned land, and a dwelling could be built on that land under exiting planning controls. For $PM_{10}$ 24-hour average concentrations from the Project, $PM_{10}$ annual average concentrations cumulatively, deposited dust annual-mean concentrations from the Project, and deposited dust annual-mean concentrations cumulatively, there is only one property that this applies to which is receptor 23.

**Figure 3-15** presents the contour plot for the 24-hour average $PM_{10}$ concentrations from the Project and annual average $PM_{10}$ concentrations cumulatively at the DPE VLAMP criteria.

**Figure 3-16** presents the annual average dust deposition concentrations from the project and cumulatively at the DPE VLAMP criteria.

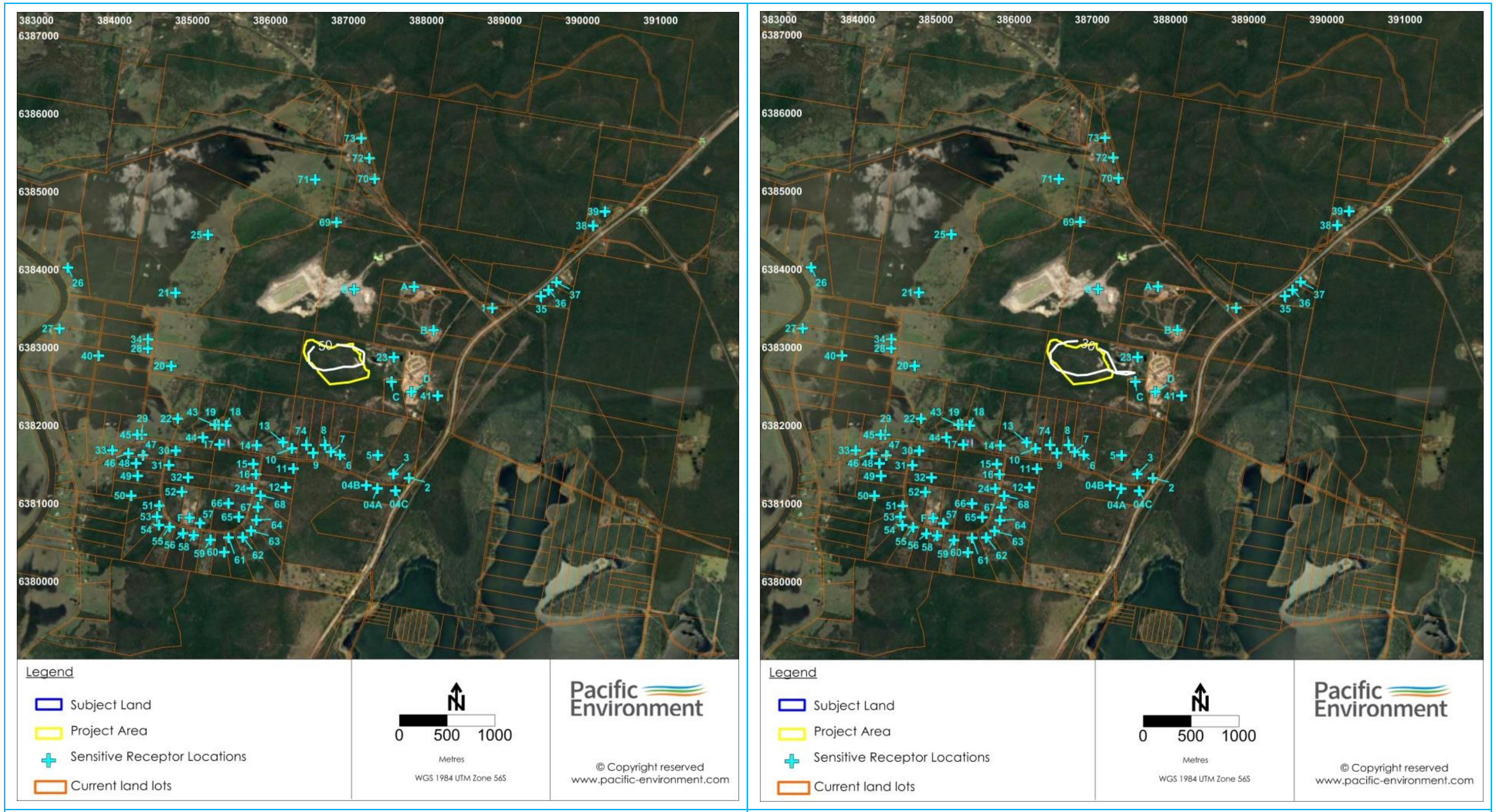



**Typical day**



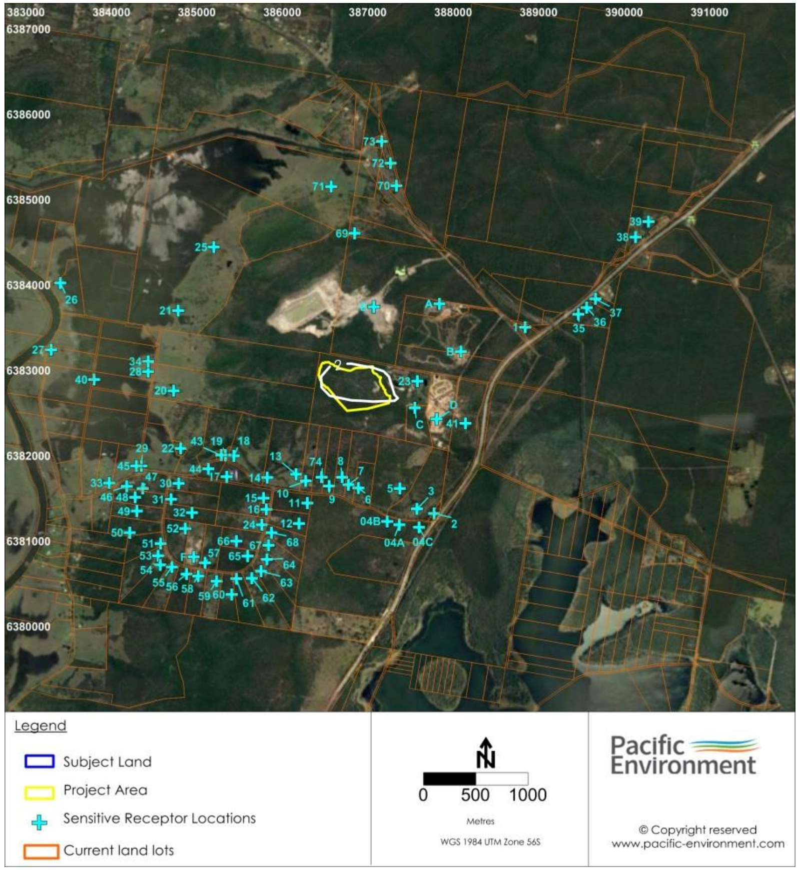

**Maximum day**

*Figure 3-14: Typical and maximum day - maximum predicted 24-hour average $PM_{2.5}$ concentrations due to the Project ($\mu g/m^3$)*

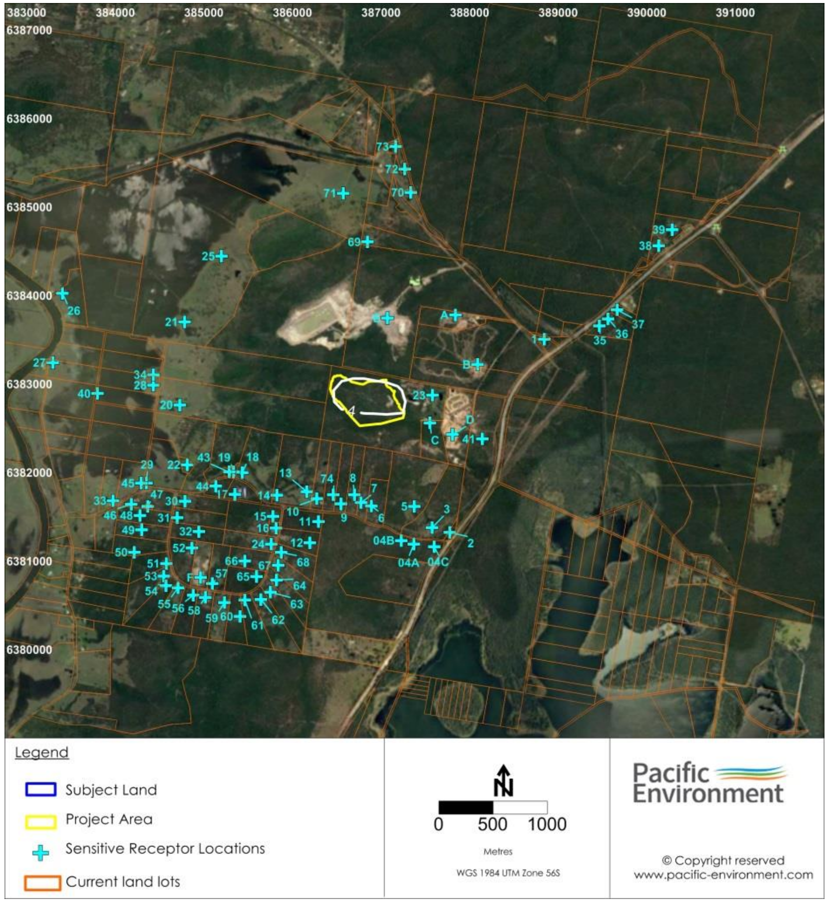



| 24-hour average | Annual average |
|---|---|

*Figure 3-15: 24-hour average $PM_{10}$ concentrations due to the Project and annual average $PM_{10}$ concentrations cumulatively at the DPE VLAMP criteria ($\mu g/m^3$)*




**Annual average due to the Project**




**Annual average cumulatively**

*Figure 3-16: Annual average dust deposition $_5$ concentrations due to the Project and cumulatively at the DPE VLAMP criteria ($\mu g/m^3$)*

# 4 Sealing of Italia Road

Since the updated air quality assessment was completed, it has been determined that the landowner is resistant to the sealing of 870m of Italia Road, the location of which is shown in red on **Figure 4-1**. At the current time it is therefore proposed that that this section of road will be covered with gravel and a water-cart used for dust control.

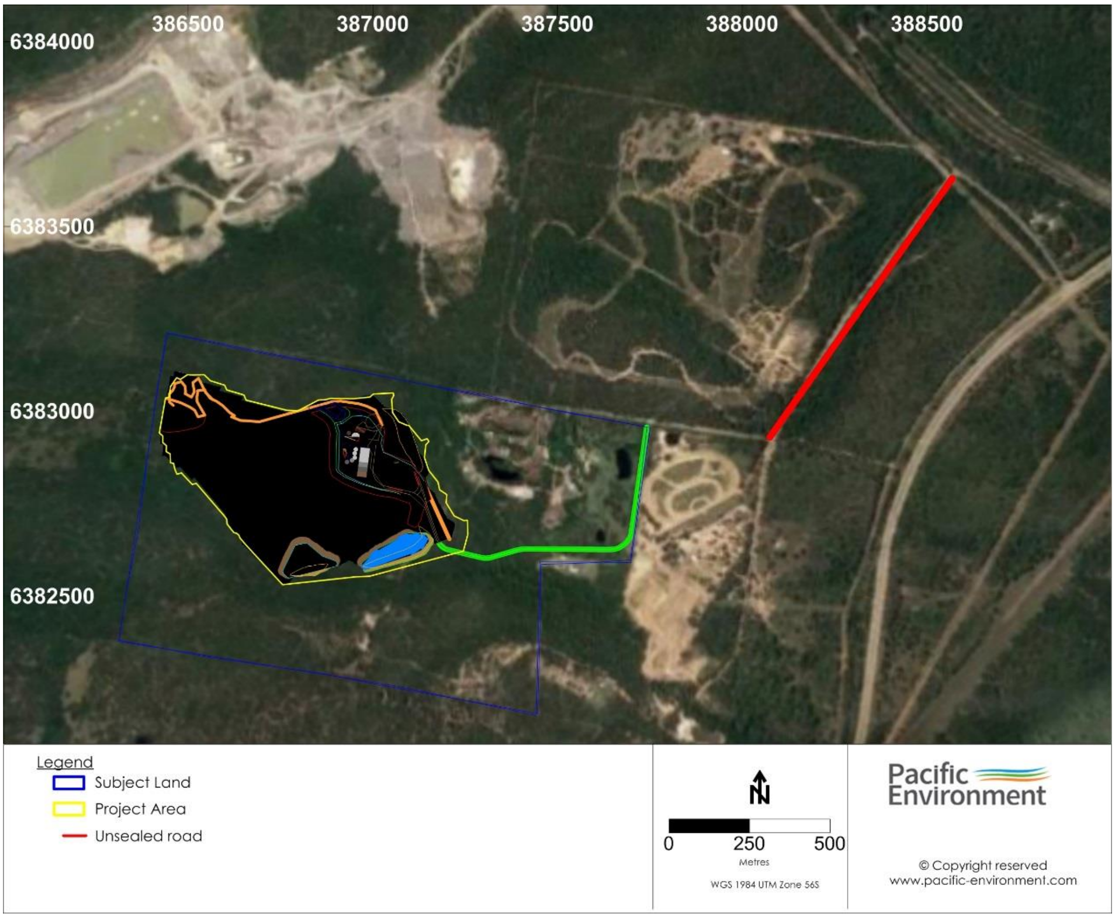



Figure 4-1: *Location of unsealed road assessed as sealed in AQA*

Table 4-1 compares the emissions as modelled and with the replacement of 870m of road as unsealed, rather than sealed.  Based on extensive experience, it considered that the minor change in total emissions (increase of 5.5% in TSP emissions, increase of 7.4% when considering pm'10 emission, a decrease in PM2.5 emissions) will not change the conclusions of the AQA.

Table 4-1: *Comparison of emissions per AQA and with additional unsealed road*

| ACTIVITY | TSP (kg/y) | | PM10 (kg/y) | | PM2.5 (kg/y) | |
|---|---|---|---|---|---|---|
| | Per AQA | With additional sealed road | Per AQA | With additional sealed road | Per AQA | With additional sealed road |
| **Extraction Area** | | | | | | |
| Drilling rock | 664 | 664 | 345 | 345 | 20 | 20 |
| Blasting rock | 1,304 | 1,304 | 678 | 678 | 39 | 39 |
| Excavator loading | 622 | 622 | 294 | 294 | 45 | 45 |
| Hauling to Processing area | 16,131 | 16,131 | 4,145 | 4,145 | 414 | 414 |
| **Processing Area** | | | | | | |
| Unloading at processing area | 311 | 311 | 147 | 147 | 22 | 22 |
| Rehandle rock to hopper | 311 | 311 | 147 | 147 | 22 | 22 |
| Primary Crushing (controlled) | 360 | 360 | 162 | 162 | 30 | 30 |
| Screening (controlled) | 660 | 660 | 222 | 222 | 15 | 15 |
| Secondary Crushing (controlled) | 360 | 360 | 162 | 162 | 30 | 30 |
| Tertiary Crushing (controlled) | 360 | 360 | 162 | 162 | 30 | 30 |
| Crushing (Fines) (controlled) | 900 | 900 | 360 | 360 | 21 | 21 |
| Fines Screening (controlled) | 1,080 | 1,080 | 660 | 660 | 660 | 660 |
| Pug Mill | 180 | 180 | 110 | 110 | 110 | 110 |
| Stacking stockpiles/bins - aggregate | 311 | 311 | 147 | 147 | 22 | 22 |
| FEL loading trucks - aggregate | 622 | 622 | 294 | 294 | 45 | 45 |
| Haul of product trucks (unsealed road) | 12,409 | 12,409 | 3,188 | 3,188 | 319 | 319 |
| Haul of product trucks to Italia Road (sealed road) | 40,006 | 24,186 | 7,679 | 4,642 | 1,858 | 1,123 |
| Haul of product trucks to Italia Road (unsealed road) | 0 | 21,591 | 0 | 5,548 | 0 | 555 |
| Grading roads | 1,412 | 1,412 | 1,412 | 1,412 | 1,412 | 1,412 |
| **Wind Erosion** | | | | | | |
| WE - Extraction Area | 26,798 | 26,798 | 13,399 | 13,399 | 2,010 | 2,010 |
| WE- from conveyors | 45 | 45 | 23 | 23 | 3 | 3 |
| WE - Processing Area (stockpiles/bins) | 416 | 416 | 208 | 208 | 31 | 31 |
| **Diesel Emissions** | | | | | | |
| Diesel usage on-site | 0 | 0 | 0 | 0 | 370 | 370 |
| **Total (kg/y)** | **105,264** | **111,035** | **33,946** | **36,457** | **7,529** | **7,349** |
| *% change with additional sealed road* | | *5.5* | | *7.4* | | *-2.4* |

# 5 Conclusions

The updated air quality impact assessment has applied current dispersion modelling methodologies with representative meteorological and existing background data.

The results of the modelling indicate that the predicted increment and cumulative annual average concentrations of $PM_{10}$, $PM_{2.5}$, TSP and dust deposition at the closest sensitive receivers comply with their relevant impact assessment criteria, with the exception of one minor exceedance of the annual average $PM_{10}$ criterion at the neighbouring Hunter Valley Paintball. Hunter Valley Paintball is open intermittently between the hours of 9 am and 8 pm, subject to demand. As it is a recreational facility, the same members of the public will not at the facility 24/7. As the Motor Cross Track is likely to generate dust emissions, it is considered unlikely that any individual would be adversely impacted as direct result of the quarry activities.

When considering typical day operations, there are two predicted exceedances of the $PM_{10}$ 24-hour average impact assessment criteria due to the Project alone at Hunter Valley Paintball. There are no predicted exceedances of the $PM_{2.5}$ 24-hour average impact assessment criteria due to the Project alone. A cumulative assessment of 24-hour average $PM_{10}$ and $PM_{2.5}$ concentrations, incorporating existing background levels and contribution from Gardenland, showed one minor additional exceedance for $PM_{10}$ (typical day activities) at the adjacent Hunter Valley Paintball facility.

When assessing maximum activities there are a number of predicted exceedances for $PM_{10}$ at the adjacent Hunter Valley Paintball facility, the nearby Motor Cross Facility, and the Managers House at Gardenland. The Motor Cross Facility is only in use on the occasional Saturday and Sunday, and as the quarry operates for shorter hours on Saturday, and not all on Sunday's, it is considered highly unlikely that maximum activities would occur on a day when both the site(s) are occupied and the meteorological conditions are such that an exceedance would occur.

There are no predicted exceedances of the $PM_{2.5}$ 24-hour average impact assessment criterion, either due to the Project alone, or cumulatively, for both typical and maximum day activities.

The dispersion modelling competed was based on the assumption that all activities at the site are occurring simultaneously, when in reality they will not be continuous at all times. It is therefore considered the predicted concentrations represent a conservative assessment and it is unlikely that any of the relevant impact assessment criteria will be exceeded at any of the nearby receptors due to the Project.

Notwithstanding, it is proposed that the worst case impacts would be managed on a day to day basis using a network of real-time monitoring stations, which will enable quarry personnel to respond to elevated dust levels prior to reaching critical levels and modify activities, their location or increase controls as required.

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# Appendix A: Emission Inventories

## TSP – annual activity - Quarry

| ACTIVITY | TSP emission (kg/y) | Intensity | Units | Emission factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Control | Units | Controls Assumed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Extraction Area** | | | | | | | | | | | | | | | | | | |
| Drilling rock | 663.75 | 7500 | holes/y | 0.59 | kg/hole | | | | | | | | | | | 85 | % control | Cyclone |
| Blasting rock | 1304 | 12 | blasts/y | 108.70 | kg/blast | 6250 | Area of blast in square metres | 625 | holes/blast | | | | | | | | | |
| Excavator loading | 622 | 600,000 | t/y | 0.00104 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Hauling to Processing area | 16131 | 600000 | t/y | 0.108 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 1.3 | km/return trip | 2.71 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| **Processing Area** | | | | | | | | | | | | | | | | | | |
| Unloading at processing area | 311 | 600000 | t/y | 0.00104 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Rehandle rock to hopper | 311 | 600000 | t/y | 0.00104 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Primary Crushing (controlled) | 360 | 600,000 | t/y | 0.0006 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Screening (controlled) | 660 | 600,000 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Secondary Crushing (controlled) | 360 | 600,000 | t/y | 0.0006 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Tertiary Crushing (controlled) | 360 | 600,000 | t/y | 0.0006 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Crushing (Fines) (controlled) | 900 | 600,000 | t/y | 0.0015 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Fines Screening (controlled) | 1,080 | 600,000 | t/y | 0.0018 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Pug Mill | 180 | 100,000 | t/y | 0.0018 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Stacking stockpiles/bins - aggregate | 311 | 600,000 | t/y | 0.00104 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| FEL loading trucks - aggregate | 622 | 600,000 | t/y | 0.00104 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Haul of product trucks (unsealed road) | 12,409 | 600,000 | t/y | 0.083 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 1 | km/return trip | 2.71 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| Haul of product trucks to Italia Road (sealed road) | 40,006 | 600,000 | t/y | 0.067 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 4.4 | km/return trip | 0.50 | kg/VKT | 3.0 | g/m2 silt loading | | | |
| Grading roads | 1,412 | 2,294 | km | 0.615 | kg/VKT | 8 | speed of graders in km/h | 287 | Grader hours | | | | | | | | | |
| **Wind Erosion** | | | | | | | | | | | | | | | | | | |
| WE - Extraction Area | 26798 | 30.59 | ha | 0.1 | kg/ha/h | 8760 | h/y | | | | | | | | | | | |
| WE- from conveyors | 45 | 0.05 | ha | 0.1 | kg/ha/y | 8760 | h/y | | | | | | | | | | | |
| WE - Processing Area (stockpiles/bins) | 416 | 0.95 | ha | 0.1 | kg/ha/h | 8760 | h/y | | | | | | | | | 50 | % Control | Water sprays |
| | | | | | | | | | | | | | | | | | | |
| **Total (kg/y)** | 105,264 | | | | | | | | | | | | | | | | | |

## PM$_{10}$ – annual activity - Quarry

| ACTIVITY | PM10 emission (kg/y) | Intensity | Units | Emission factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Control | Units | Controls Assumed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Extraction Area** | | | | | | | | | | | | | | | | | | |
| Drilling rock | 345.15 | 7500 | holes/y | 0.3068 | kg/hole | | | | | | | | | | | 85 | % control | Cyclone |
| Blasting rock | 678 | 12 | blasts/y | 56.525713 | kg/blast | 6250 | Area of blast in square metres | 625 | holes/blast | | | | | | | | | |
| Excavator loading | 294 | 600,000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Hauling to Processing area | 4145 | 600000 | t/y | 0.0276333 | kg/t | 32.7 | t/load | 47.32 | Vehicle gross mass (t) | 1.3 | km/return trip | 0.6950846 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| **Processing Area** | | | | | | | | | | | | | | | | | | |
| Unloading at processing area | 147 | 600000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Rehandle rock to hopper | 147 | 600000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Primary Crushing (controlled) | 162 | 600,000 | t/y | 0.00027 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Screening (controlled) | 222 | 600,000 | t/y | 0.00037 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Secondary Crushing (controlled) | 162 | 600,000 | t/y | 0.00027 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Tertiary Crushing (controlled) | 162 | 600,000 | t/y | 0.00027 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Crushing (Fines) (controlled) | 360 | 600,000 | t/y | 0.0006 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Fines Screening (controlled) | 660 | 600,000 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Pug Mill | 110 | 100,000 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Stacking stockpiles/bins - aggregate | 147 | 600,000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| FEL loading trucks - aggregate | 294 | 600,000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Haul of product trucks (unsealed road) | 3,188 | 600,000 | t/y | 0.0212564 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 1 | km/return trip | 0.6950846 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| Haul of product trucks to Italia Road (sealed road) | 7,679 | 600,000 | t/y | 0.0127988 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 4.4 | km/return trip | 0.0951182 | kg/VKT | 3.0 | g/m2 silt loading | | | |
| Grading roads | 1,412 | 2,294 | km | 0.615 | kg/VKT | 8 | speed of graders in km/h | 287 | Grader hours | | | | | | | | | |
| **Wind Erosion** | | | | | | | | | | | | | | | | | | |
| WE - Extraction Area | 13399 | 30.59 | ha | 0.05 | kg/ha/h | 8760 | h/y | | | | | | | | | | | |
| WE- from conveyors | 23 | 0.05 | ha | 0.05 | kg/ha/y | 8760 | h/y | | | | | | | | | | | |
| WE - Processing Area (stockpiles/bins) | 208 | 0.95 | ha | 0.05 | kg/ha/h | 8760 | h/y | | | | | | | | | 50 | % Control | Water sprays |
| **Total (kg/y)** | 33,946 | | | | | | | | | | | | | | | | | |

## $PM_{10}$ – maximum day activity - Quarry

| ACTIVITY | PM10 emission (kg/y) | Intensity | Units | Emission factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Control | Units | Controls Assumed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Extraction Area** | | | | | | | | | | | | | | | | | | |
| Drilling rock | 345.15 | 7500 | holes/y | 0.3068 | kg/hole | | | | | | | | | | | 85 | % control | Cyclone |
| Blasting rock | 16958 | 300 | blasts/y | 56.525713 | kg/blast | 6250 | Area of blast in square metres | 625 | holes/blast | | | | | | | | | |
| Excavator loading | 648 | 1,320,000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Hauling to Processing area | 9119 | 1,320,000 | t/y | 0.0276333 | kg/t | 32.7 | t/load | 47.32 | Vehicle gross mass (t) | 1.3 | km/return trip | 0.6950846 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| **Processing Area** | | | | | | | | | | | | | | | | | | |
| Unloading at processing area | 324 | 1,320,000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Rehandle rock to hopper | 324 | 1,320,000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Primary Crushing (controlled) | 324 | 1,200,000 | t/y | 0.00027 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Screening (controlled) | 377 | 1,020,000 | t/y | 0.00037 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Secondary Crushing (controlled) | 162 | 600,000 | t/y | 0.00027 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Tertiary Crushing (controlled) | 81 | 300,000 | t/y | 0.00027 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Crushing (Fines) (controlled) | 270 | 450,000 | t/y | 0.0006 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Fines Screening (controlled) | 330 | 300,000 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Pug Mill | 330 | 300,000 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Stacking stockpiles/bins - aggregate | 147 | 600,000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| FEL loading trucks - aggregate | 648 | 1,320,000 | t/y | 0.0004906 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Haul of product trucks (unsealed road) | 9,565 | 1,800,000 | t/y | 0.0212564 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 1 | km/return trip | 0.6950846 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| Haul of product trucks to Italia Road (sealed road) | 23,038 | 1,800,000 | t/y | 0.0127988 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 4.4 | km/return trip | 0.0951182 | kg/VKT | 3.0 | g/m2 silt loading | | | |
| Grading roads | 1,412 | 2,294 | km | 0.615 | kg/VKT | 8 | speed of graders in | 287 | Grader hours | | | | | | | | | |
| **Wind Erosion** | | | | | | | | | | | | | | | | | | |
| WE - Extraction Area | 13399 | 30.59 | ha | 0.05 | kg/ha/h | 8760 | h/y | | | | | | | | | | | |
| WE- from conveyors | 23 | 0.05 | ha | 0.05 | kg/ha/y | 8760 | h/y | | | | | | | | | | | |
| WE - Processing Area (stockpiles/bins) | 208 | 0.95 | ha | 0.05 | kg/ha/h | 8760 | h/y | | | | | | | | | 50 | % Control | Water sprays |
| | | | | | | | | | | | | | | | | | | |
| **Total (kg/y)** | 78,031 | | | | | | | | | | | | | | | | | |

## $PM_{2.5}$ – annual activity - Quarry

| ACTIVITY | PM2.5 emission (kg/y) | Intensity | Units | Emission factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Control | Units | Controls Assumed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Extraction Area** | | | | | | | | | | | | | | | | | | |
| Drilling rock | 19.9125 | 7500 | holes/y | 0.0177 | kg/hole | | | | | | | | | | | 85 | % control | Cyclone |
| Blasting rock | 39 | 12 | blasts/y | 3.26 | kg/blast | 6250 | metres | 625 | holes/blast | | | | | | | | | |
| Excavator loading | 45 | 600,000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Hauling to Processing area | 414 | 600000 | t/y | 0.003 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 1.3 | km/return trip | 0.07 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| **Processing Area** | | | | | | | | | | | | | | | | | | |
| Unloading at processing area | 22 | 600000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Rehandle rock to hopper | 22 | 600000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Primary Crushing (controlled) | 30 | 600,000 | t/y | 0.0001 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Screening (controlled) | 15 | 600,000 | t/y | 0.0000 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Secondary Crushing (controlled) | 30 | 600,000 | t/y | 0.0001 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Tertiary Crushing (controlled) | 30 | 600,000 | t/y | 0.0001 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Crushing (Fines) (controlled) | 21 | 600,000 | t/y | 0.0000 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Fines Screening (controlled) | 660 | 600,000 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Pug Mill | 110 | 100,000 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Stacking stockpiles/bins - aggregate | 22 | 600,000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| FEL loading trucks - aggregate | 45 | 600,000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Haul of product trucks (unsealed road) | 319 | 600,000 | t/y | 0.002 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 1 | km/return trip | 0.07 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| Haul of product trucks to Italia Road (sealed road) | 1,858 | 600,000 | t/y | 0.003 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 4.4 | km/return trip | 0.02 | kg/VKT | 3.0 | g/m2 silt loading | | | |
| Grading roads | 1,412 | 2,294 | km | 0.615 | kg/VKT | 8 | speed of graders in km/h | 287 | Grader hours | | | | | | | | | |
| **Wind Erosion** | | | | | | | | | | | | | | | | | | |
| WE - Extraction Area | 2010 | 30.59 | ha | 0.01 | kg/ha/h | 8760 | h/y | | | | | | | | | | | |
| WE- from conveyors | 3 | 0.05 | ha | 0.01 | kg/ha/y | 8760 | h/y | | | | | | | | | | | |
| WE - Processing Area (stockpiles/bins) | 31 | 0.95 | ha | 0.01 | kg/ha/h | 8760 | h/y | | | | | | | | | 50 | % Control | Water sprays |
| **Diesel Emissions** | | | | | | | | | | | | | | | | | | |
| Diesel usage on-site | 370 | 561 | kL/y | 0.66 | kg/kl | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **Total (kg/y)** | 7,529 | | | | | | | | | | | | | | | | | |

## PM$_{2.5}$ – maximum day activity - Quarry

| ACTIVITY | PM2.5 emission (kg/y) | Intensity | Units | Emission factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Control | Units | Controls Assumed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Extraction Area** | | | | | | | | | | | | | | | | | | |
| Drilling rock | 19.9125 | 7500 | holes/y | 0.0177 | kg/hole | | | | | | | | | | | 85 | % control | Cyclone |
| Blasting rock | 978 | 300 | blasts/y | 3.26 | kg/blast | 6250 | metres | 625 | holes/blast | | | | | | | | | |
| Excavator loading | 98 | 1,320,000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Hauling to Processing area | 912 | 1,320,000 | t/y | 0.003 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 1.3 | km/return trip | 0.07 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| **Processing Area** | | | | | | | | | | | | | | | | | | |
| Unloading at processing area | 49 | 1,320,000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Rehandle rock to hopper | 49 | 1,320,000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| Primary Crushing (controlled) | 60 | 1,200,000 | t/y | 0.0001 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Screening (controlled) | 26 | 1,020,000 | t/y | 0.0000 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Secondary Crushing (controlled) | 30 | 600,000 | t/y | 0.0001 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Tertiary Crushing (controlled) | 15 | 300,000 | t/y | 0.0001 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Crushing (Fines) (controlled) | 16 | 450,000 | t/y | 0.0000 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Fines Screening (controlled) | 330 | 300,000 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Pug Mill | 330 | 300,000 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | Water application - captured in emission factor |
| Stacking stockpiles/bins - aggregate | 22 | 600,000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | 50 | % control | Water sprays |
| FEL loading trucks - aggregate | 98 | 1,320,000 | t/y | 0.00007 | kg/t | 0.876 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | |
| Haul of product trucks (unsealed road) | 957 | 1,800,000 | t/y | 0.002 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 1 | km/return trip | 0.07 | kg/VKT | 5 | % silt content | 75 | % control | Watering Level 2 |
| Haul of product trucks to Italia Road (sealed road) | 5,574 | 1,800,000 | t/y | 0.003 | kg/t | 33 | t/load | 47.32 | Vehicle gross mass (t) | 4.4 | km/return trip | 0.02 | kg/VKT | 3.0 | g/m2 silt loading | | | |
| Grading roads | 1,412 | 2,294 | km | 0.615 | kg/VKT | 8 | speed of graders in km/h | 287 | Grader hours | | | | | | | | | |
| **Wind Erosion** | | | | | | | | | | | | | | | | | | |
| WE - Extraction Area | 2010 | 30.59 | ha | 0.01 | kg/ha/h | 8760 | h/y | | | | | | | | | | | |
| WE- from conveyors | 3 | 0.05 | ha | 0.01 | kg/ha/y | 8760 | h/y | | | | | | | | | | | |
| WE - Processing Area (stockpiles/bins) | 31 | 0.95 | ha | 0.01 | kg/ha/h | 8760 | h/y | | | | | | | | | 50 | % Control | Water sprays |
| **Diesel Emissions** | | | | | | | | | | | | | | | | | | |
| Diesel usage on-site | 370 | 561 | kL/y | 0.66 | kg/kl | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **Total (kg/y)** | 13,390 | | | | | | | | | | | | | | | | | |

## TSP – Gardenland

| ACTIVITY | TSP emission (kg/y) | Intensity | Units | Emission factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Control | Units | Source type | Emission Factor Source | Assumptions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turning - FEL | 6 | 16840 | t/y | 0.0003 | kg/t | 0.771912 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | | | |
| Loading - FEL | 6 | 16840 | t/y | 0.0003 | kg/t | 0.771912 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | | | |
| Hauling | 49 | 16840 | t/y | 0.012 | kg/t | 25 | t/load | 48.3 | Vehicle gross mass (t) | 0.5 | km/return trip | 0.58 | kg/VKT | 3 | % silt content | 75 | % control | | | |
| Unloading - FEL | 6 | 16840 | t/y | 0.0003 | kg/t | 0.771912 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | | | |
| **Screening** | | | | | | | | | | | | | | | | | | | | |
| Crushing (hammer mill | 21 | 14080 | t/y | 0.0015 | kg/t | | | | | | | | | | | | | | | |
| Screening | 15 | 14080 | t/y | 0.0011 | kg/t | | | | | | | | | | | | | | | |
| **Wind erosion** | | | | | | | | | | | | | | | | | | | | |
| WE total | 634 | 1 | ha | 0.1 | kg/ha | 8760 | hr/yr | | | | | | | | | | | | | |
| Hauling product to Italia Rd | 228 | 16840 | t/y | 0.054 | kg/t | 48 | t/load | 48.25 | Vehicle gross mass (t) | 3.2 | km/return trip | 0.80 | kg/VKT | 5 | % silt content | 75 | % control | 1 | | Assumed us of CT 6130 type truck with ~ 48 tonne capacity. |
| **Total** | 965 | | | | | | | | | | | | | | | | | | | |

## $PM_{10}$ – Gardenland

| ACTIVITY | $PM_{10}$ emission (kg/y) | Intensity | Units | Emission factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Control | Units | Source type | Emission Factor Source | Assumptions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turning - FEL | 3 | 16840 | t/y | 0.0002 | kg/t | 0.771912 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | | | |
| Loading - FEL | 3 | 16840 | t/y | 0.0002 | kg/t | 0.771912 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | | | |
| Hauling | 37 | 16840 | t/y | 0.009 | kg/t | 25 | t/load | 48.3 | Vehicle gross mass (t) | 0.5 | km/return trip | 0.44 | kg/VKT | 3 | % silt content | 75 | % control | | | |
| Unloading - FEL | 3 | 16840 | t/y | 0.0002 | kg/t | 0.771912 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | | | |
| **Screening** | | | | | | | | | | | | | | | | | | | | |
| Crushing (hammer mill) | 8 | 14080 | t/y | 0.0006 | kg/t | | | | | | | | | | | | | | | |
| Screening | 5 | 14080 | t/y | 0.00037 | kg/t | | | | | | | | | | | | | | | |
| **Wind erosion** | | | | | | | | | | | | | | | | | | | | |
| WE total | 317 | 1 | ha | 0.05 | kg/ha | 8760 | hr/yr | | | | | | | | | | | | | |
| Hauling product to site boundary | 44 | 16840 | t/y | 0.010 | kg/t | 48 | t/load | 48.25 | Vehicle gross mass (t) | 3.2 | km/return trip | 0.15 | kg/VKT | 5 | % silt content | 75 | % control | 1 | | Assumed us of CT 6130 type truck with ~ 48 tonne capacity. |
| **Total** | 420 | | | | | | | | | | | | | | | | | | | |

## $PM_{2.5}$ – Gardenland

| ACTIVITY | PM2.5 emission (kg/y) | Intensity | Units | Emission factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units | Variable 4 | Units | Variable 5 | Units | Control | Units | Source type | Emission Factor Source | Assumptions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turning - FEL | 0 | 16840 | t/y | 0.000025 | kg/t | 0.771912 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | | | |
| Loading - FEL | 0 | 16840 | t/y | 0.000025 | kg/t | 0.771912 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | | | |
| Hauling | 37 | 16840 | t/y | 0.008797 | kg/t | 25 | t/load | 48.3 | Vehicle gross mass (t) | 0.5 | km/return trip | 0.44 | kg/VKT | 3 | % silt content | 75 | % control | | | |
| Unloading - FEL | 0 | 16840 | t/y | 0.000025 | kg/t | 0.771912 | average of (wind speed/2.2)^1.3 in m/s | 2 | moisture content in % | | | | | | | | | | | |
| **Screening** | | | | | | | | | | | | | | | | | | | | |
| Crushing (hammer mill) | 0 | 14080 | t/y | 0.000035 | kg/t | | | | | | | | | | | | | | | |
| Screening | 0 | 14080 | t/y | 0.000025 | kg/t | | | | | | | | | | | | | | | |
| **Wind erosion** | | | | | | | | | | | | | | | | | | | | |
| WE total | 48 | 1 | ha | 0.007500 | kg/ha | 8760 | hr/yr | | | | | | | | | | | | | |
| Hauling product to Italia Road | 11 | 16840 | t/y | 0.002517 | kg/t | 48 | t/load | 48.25 | Vehicle gross mass (t) | 3.2 | km/return trip | 0.04 | kg/VKT | 5 | % silt content | 75 | % control | 1 | | Assumed us of CT 6130 type truck with ~ 48 tonne capacity. |
| **Total** | 97 | | | | | | | | | | | | | | | | | | | |