# AIR QUALITY IMPACT ASSSESSMENT

## PROPOSED MINOR MODIFICATION TO HOLCIM REGIONAL DISTRIBUTION CENTRE (RDC) ROOTY HILL

**Umwelt (Australia) Pty Limited**

**Job No: 3869**

**1 September 2010**

A PEL Company

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| **PROJECT TITLE:** | **PROPOSED MINOR MODIFICATION TO HOLCIM REGIONAL DISTRIBUTION CENTRE (RDC) ROOTY HILL** |
| **JOB NUMBER:** | **3869** |
| **PREPARED FOR:** | Emma Lodge |
| | **UMWELT (AUSTRALIA) PTY LIMITED** |
| **PREPARED BY:** | Philip Henschke |
| **QA PROCEDURES CHECKED BY:** | Aleks Todoroski |
| **APPROVED FOR RELEASE BY:** | Aleks Todoroski |
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Queensland Environment Pty Ltd trading as
**PAEHolmes** ABN 86 127 101 642

**SYDNEY:**
Suite 2B, 14 Glen Street
Eastwood NSW 2122
Ph: +61 2 9874 8644
Fax: +61 2 9874 8904

**BRISBANE:**
Level 1, La Melba, 59 Melbourne Street South Brisbane Qld 4101
PO Box 3306 South Brisbane Qld 4101
Ph: +61 7 3004 6400
Fax: +61 7 3844 5858

Email: info@paeholmes.com

Website: www.paeholmes.com

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# 1 INTRODUCTION

This report has been prepared by PAEHolmes for Umwelt (Australia) Pty Limited who is in turn acting on behalf of Holcim (Australia) Pty Limited (Holcim).

Project Approval was granted under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) in April 2006 (Approval No. 05_0051) to construct and operate the RDC. Since the approval was granted and building on the recent change in ownership Holcim conducted a review of the approved RDC project for which construction has not yet commenced. During the review process Holcim identified some potential design improvements and efficiencies and is now seeking to modify the 2006 Project Approval to allow these minor design modifications.

The purpose of this study is to assess the likely air quality impacts due to the proposed modifications, it follows the methodology used in the previous Air Quality Assessment of the RDC, completed by Holmes Air Sciences in 2005 (**Holmes Air Sciences, 2005**).

The assessment is based on a conventional approach following the procedures outlined by the NSW Department of Environment, Climate Change and Water (NSW DECCW) in its document titled "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (**DEC, 2005**).

In summary, the report provides information on the following:

- A description of the proposed modifications and the local setting;
- Relevant air quality goals;
- Meteorological conditions in the area;
- A discussion as to the likely existing air quality conditions in the area;
- The methods used to estimate dust emissions from on-site activities; and
- The expected dust impacts due to emissions from the modified RDC.

# 2 OVERVIEW OF THE APPROVED RDC

Holcim currently supplies the Sydney market with quarry products from the company's Penrith Lakes Development Corporation (PLDC) operations. However, this resource is nearly depleted and the facility is approaching closure. Consequently Holcim has had to locate alternative sources of quarry products to meet the needs of its Sydney market. These quarry materials will come from quarries outside the Sydney basin, including the new Lynwood Quarry near Marulan in the Southern Tablelands region of NSW. The approved RDC will allow Holcim to receive, store and distribute construction materials to meet customer requirements in the Sydney region.

The RDC is approved to handle up to 4 Mt of quarry product per annum. Construction materials such as sand and aggregate will be transported by rail to the RDC from quarries. These materials will be blended by equipment at the RDC as required and distributed by road to the Sydney market.

The approved RDC includes the following:

- A regional office building and materials testing laboratory;
- A rail siding and rail unloading facility;

- Elevated steel storage bins and truck load out facilities;
- Ground storage and reclaim facilities;
- Blending Plant/Pug Mill;
- A conveyor system linking the unloading station to the storage and truck load out facilities;
- Workshop, stores, site offices and amenities facilities, truck washdown facilities, truck refuelling, weighbridges, truck and car parking;
- Concrete Batching Plant (CBP);
- Bridges at two locations over Angus Creek; and
- Realignment of the existing North Parade and creation of New North Parade.

The approved RDC will operate 24 hours per day, seven days a week. The RDC will take approximately two years to build and will employ approximately 220 people during construction. During operation of the approved RDC, approximately 250 people will be employed on-site. At 4 Mtpa the approved RDC will dispatch approximately 400 heavy vehicles from the site on an average day. All traffic to the RDC will access the site via Kellogg Road, with the exception of some minor laboratory traffic. Those vehicles accessing Kellogg road to/from the south will do so via Woodstock Avenue direct from the M7. Heavy vehicles accessing Kellogg Road to/from the north would do so via Glendenning Road and Power Street direct from the M7.

# 3 LOCAL SETTING AND DESCRIPTION OF THE PROPOSED MODIFICATIONS

Landuse in the vicinity of the RDC site is a mixture of industrial premises, reserves, recreational and residential areas. The site is bound by Humes and Woodstock Avenue to the north, the Nurragingy Reserve to the east, the Main Western Railway line to the south and the OneSteel Mini Mill to the west.

The RDC site is situated in the centre of the Cumberland Plain and is surrounded by low-lying gently undulating terrain. Angus Creek, a tributary of Eastern Creek flows through the southern portion of the RDC site into the Nurrangingy Reserve.

**Figure 1** shows the proposed modified layout of the RDC. The proposed modifications include:

- Changing from elevated steel storage bins to on-ground concrete storage bays, reducing the height of the storage facilities by about 10 metres;
- Changing the configuration and location of the rail unloader and rail sidings to accommodate shorter trains, for the initial phase of the development;
- Reducing the payload capacity of trains, for the initial phase of development;
- The removal of ground storage bins that were originally sited west of the steel storage bins;
- Closure of North parade by Blacktown City Council rather than relocation of the road;
- An increased ground storage area at the radial stacker; and
- Minor changes to the locations of the office, workshop and other internal facilities to improve operating efficiencies and in response to the layout changes outlined above.

No modifications are being sought to the current RDC approvals concerning the:

- Number or size  of vehicles accessing the RDC site;
- Traffic arrangements and volumes;
- Approved maximum capacity of 4 million tonnes per annum
- Concrete batching plant; or
- Regional Office Building and Materials Testing Laboratory.

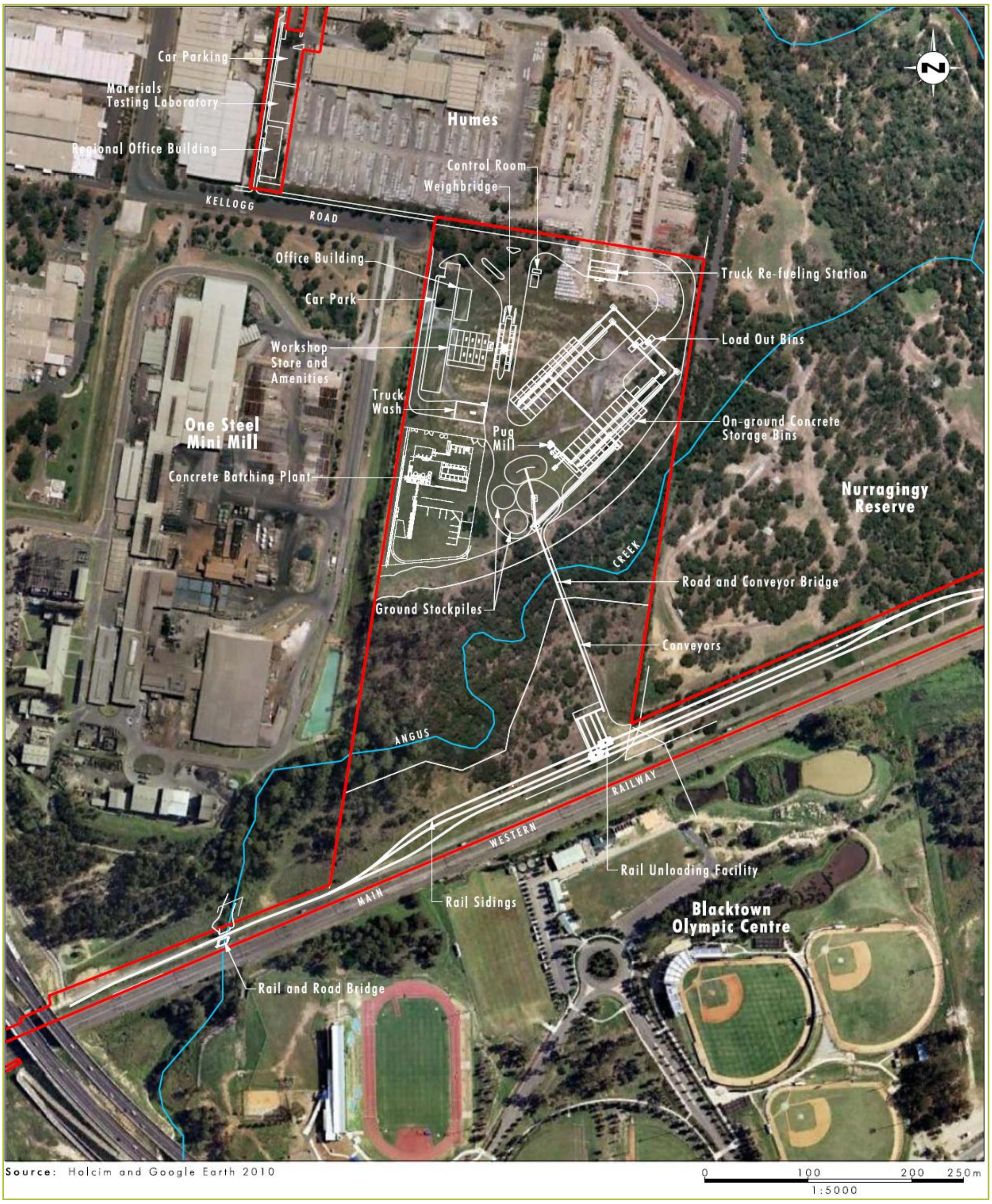



**Figure 1: Proposed site layout**

# 4 AIR QUALITY ASSESSMENT CRITERIA

**Table 1** and **Table 2** summarise the air quality assessment criteria that are relevant to this study. The air quality goals relate to the total dust levels in the air and not just the dust from the Project. In other words, some consideration of background levels needs to be made when using these goals to assess impacts, as discussed in **Section 5.3**.

**Table 1: Air quality assessment criteria for particulate matter concentrations**

| POLLUTANT | STANDARD / GOAL | AVERAGING PERIOD | AGENCY |
|---|---|---|---|
| Total suspended particulate matter (TSP) | 90 $\mu g/m^3$ | Annual mean | National Health and Medical Research Council (NHMRC) |
| Particulate matter < 10 $\mu m$ ($PM_{10}$) | 50 $\mu g/m^3$ | 24-hour maximum | NSW DECCW |
| | 30 $\mu g/m^3$ | Annual mean | NSW DECCW |
| | 50 $\mu g/m^3$ | (24-hour average, 5 exceedances permitted per year) | National Environment Protection Measurement (NEPM) |

In addition to health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces. **Table 2** shows the maximum acceptable increase in dust deposition over the existing dust levels. The criteria for dust fallout levels are set to protect against nuisance impacts (**DEC, 2005**).

**Table 2: NSW DECCW criteria for dust fallout**

| Pollutant | Averaging period | Maximum increase in deposited dust level | Maximum total deposited dust level |
|---|---|---|---|
| Deposited dust | Annual | 2 $g/m^2$/month | 4 $g/m^2$/month |

# 5 EXISTING ENVIRONMENT

This section describes the dispersion meteorology, local climatic conditions and existing dust levels in the area.

## 5.1 Dispersion Meteorology

The Gaussian dispersion model used for this assessment, AUSPLUME, requires information about the dispersion characteristics of the area. In particular, wind speed, wind direction, atmospheric stability class[a] and mixing height[b] data is required. Meteorological data collected in the study area is discussed below.

[a] In dispersion modelling stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme, as used in this study, there are six stability classes A through to F. Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

[b] The term mixing height refers to the height of the turbulent layer of air near the earth's surface into which ground-level emissions will be rapidly mixed. A plume emitted above the mixed-layer will remain isolated from the ground until such time as the mixed-layer reaches the height of the plume. The height of the mixed-layer is controlled mainly by convection (resulting from solar heating of the ground) and by mechanically generated turbulence as the wind blows over the rough ground.

The DECCW has collected meteorological information at St Marys, approximately 8 km to the west-southwest of the site. This data consists of hourly records of wind speed, wind direction and temperature and is suitable for dispersion modelling.

Windroses generated from meteorological data collected at this site have been reviewed for this assessment. Windroses from 2003, 2005, 2007 and 2009 are shown in **Figure 2, Figure 3, Figure 4** and **Figure 5** respectively.

It can be seen from the windroses that there is little variation in the wind pattern distribution for these years. On an annual basis, the most common winds were from the SSW, S and N. This pattern is evident in all seasons to various degrees. In the summer months strong winds from the ESE were also common.

The dispersion modelling for the approved RDC utilised the 2003 meteorological data to assess the air quality impacts. Comparison of the 2003 with 2005, 2007 and 2009 windroses shows very little variation, indicating that the 2003 meteorological data set collected at this site is representative of the local wind pattern distribution. Therefore to allow easy comparison of the impacts between the approved and the proposed modified RDC the 2003 data set has been used in the dispersion modelling to assess the impacts of the Project.

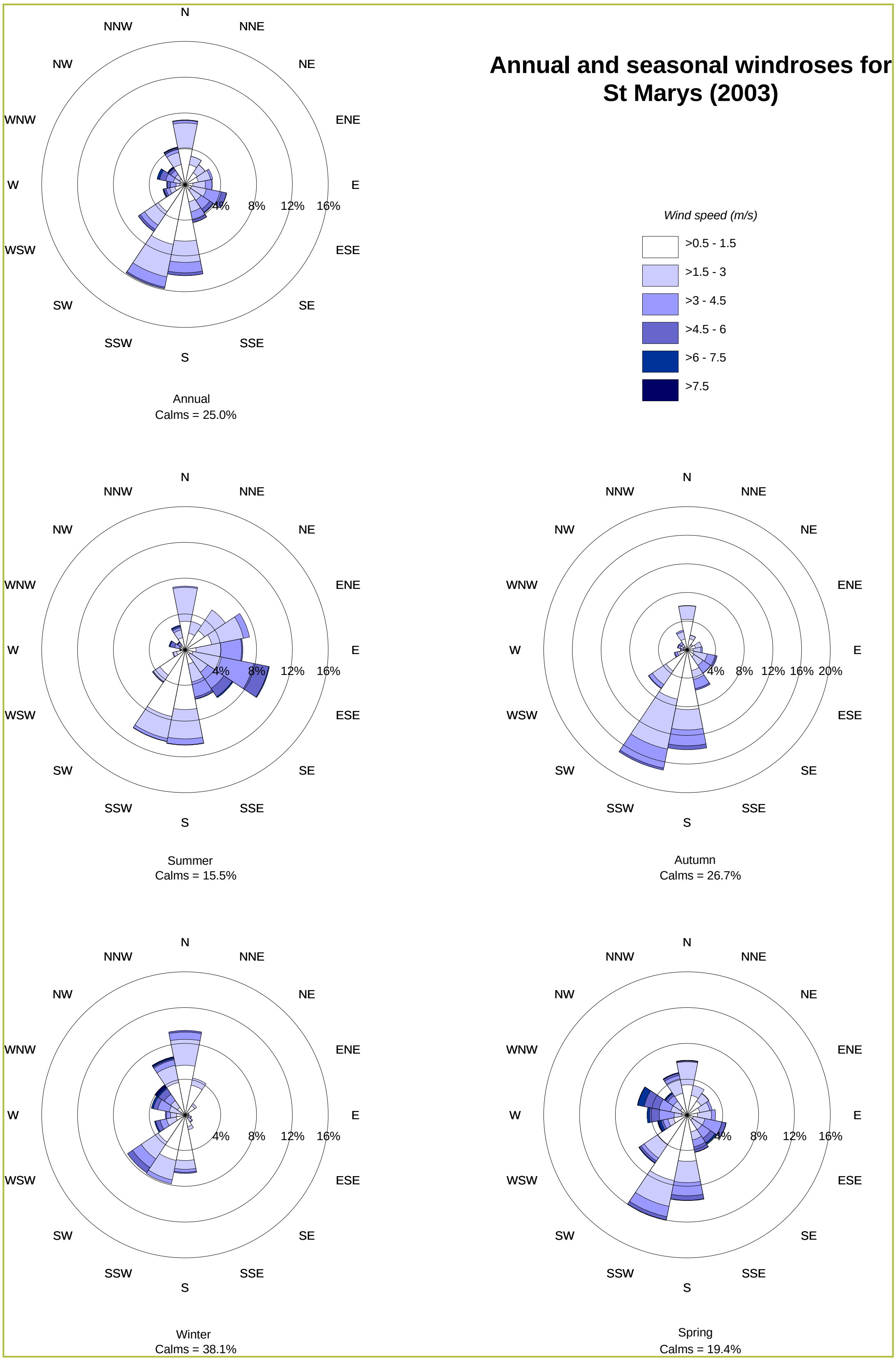



**Figure 2: Annual and seasonal windrose for St Marys, 2003**

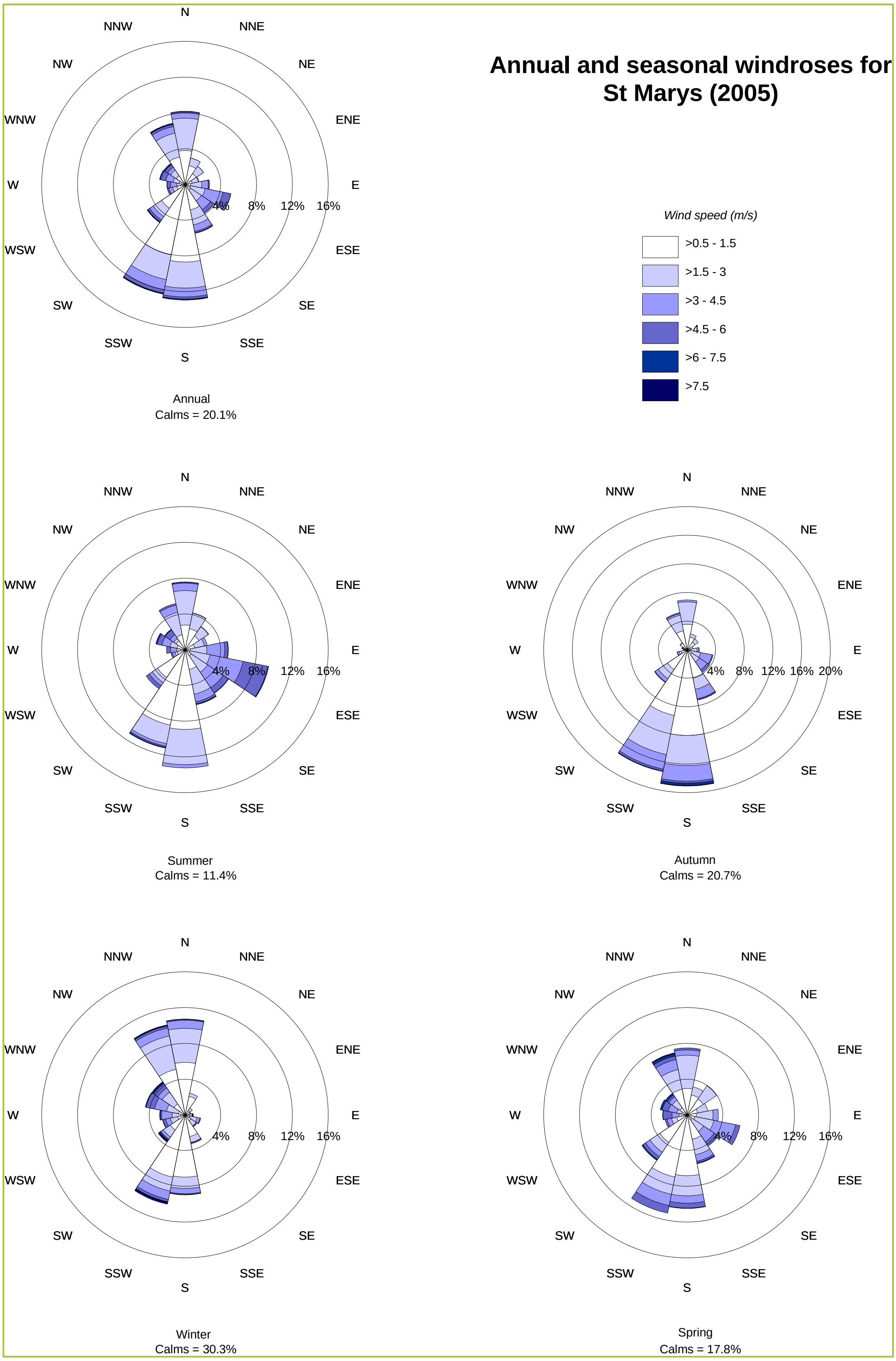



**Figure 3: Annual and seasonal windrose for St Marys, 2005**

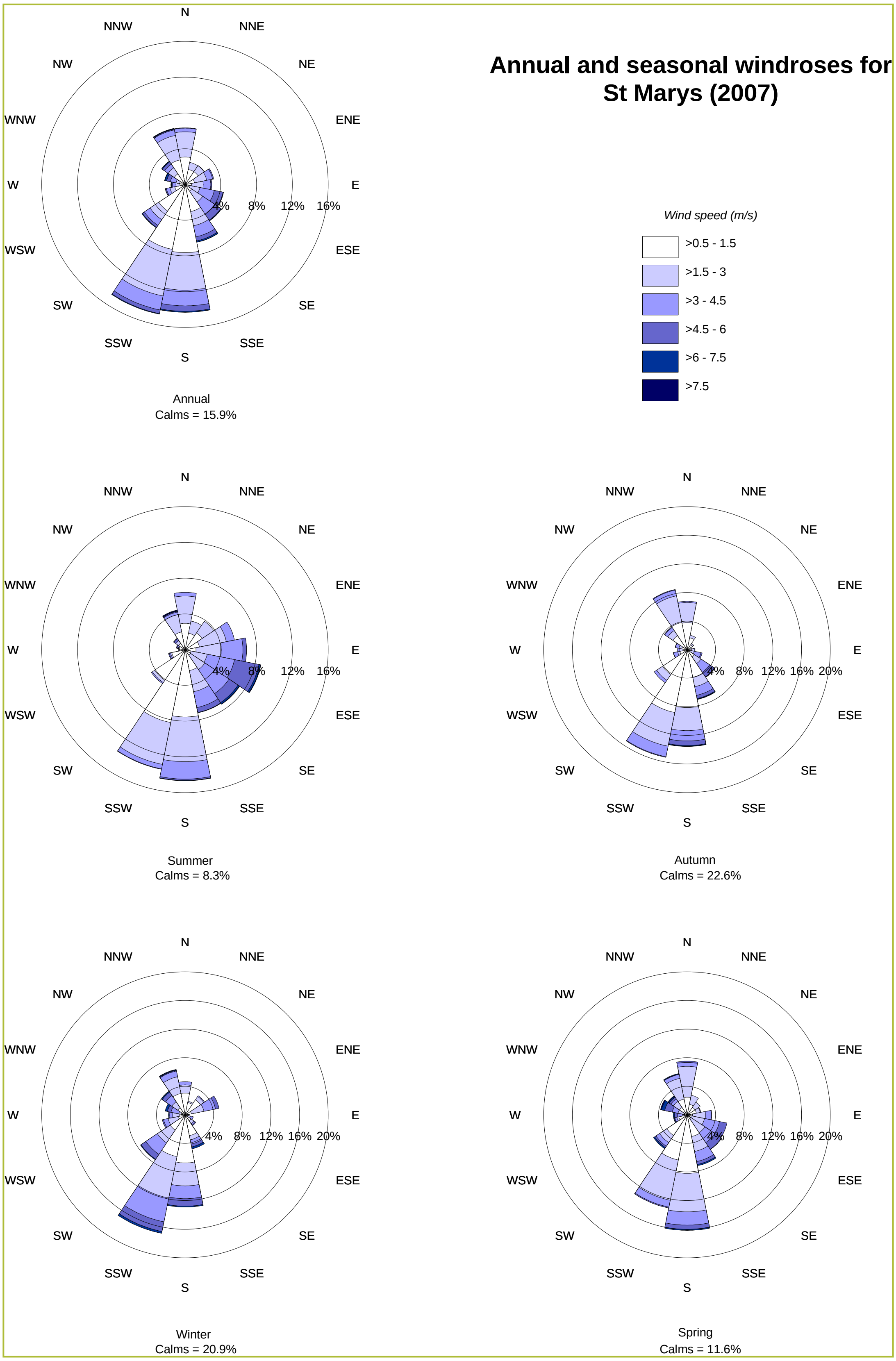



**Figure 4: Annual and seasonal windrose for St Marys, 2007**

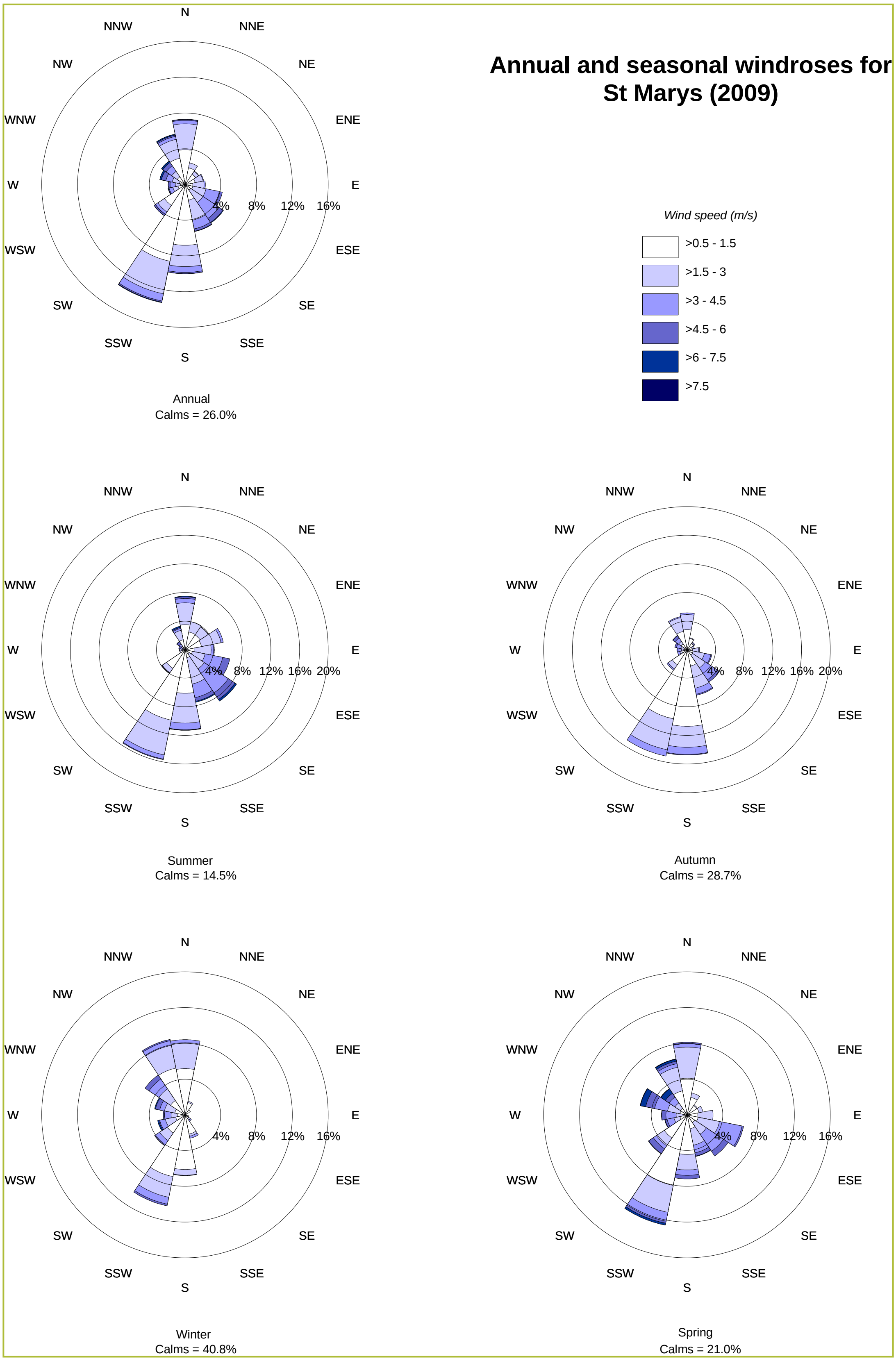



**Figure 5: Annual and seasonal windrose for St Marys, 2009**

To use the wind data to assess dispersion it is necessary to also have data on atmospheric stability. A stability class was calculated for each hour of the meteorological data using sigma-theta according to the method recommended by the US EPA (**US EPA, 1986**). **Table 3** shows the frequency of occurrence of the stability categories expected in the area. The most common stability occurrences at the St Marys site in 2003 were calculated to be F class stabilities (29%) which suggest that dust emissions will disperse slowly for a significant proportion of the time.

**Table 3: Frequency of occurrence of stability classes in the area**

| Stability Class | St Marys, 2003 data |
|---|---|
| A | 18.9 |
| B | 6.6 |
| C | 10.5 |
| D | 24.0 |
| E | 11.3 |
| F | 28.7 |
| **Total** | **100** |

Mixing height was determined using a scheme defined by **Powell** (**1976**) for day-time conditions and an approach described by **Venkatram** (**1980**) for night-time conditions. These two methods provide a good estimate of mixing height in the absence of upper air data.

Joint wind speed, wind direction and stability class frequency tables for the St Marys data are presented in **Appendix A**.

## 5.2 Local Climatic Conditions

The Bureau of Meteorology (BoM) collects climatic information from Prospect Reservoir, located approximately 8 km southeast of the site. Meteorological data from this station is averaged over approximately a 123 year period and is presented in **Table 4** (**Bureau of Meteorology, 2010**). This station provides information on the long-term average values of climatic elements such as temperature, humidity and rainfall.

The meteorological information collected at this BoM station does not include all the required parameters suitable for dispersion modelling. Meteorological data collected at the DECCW St Marys site was used for the dispersion modelling, as discussed in **Section 5.1**.

Temperature data shows that January is typically the warmest month with a mean daily maximum of 28.3 $^{o}$C. July is the coldest month with a mean daily minimum of 6.1 $^{o}$C. Rainfall data collected at Prospect Reservoir shows that February is the wettest month with a mean rainfall of 96.6 mm over 8.2 rain days. Annually the area experiences, on average, 868.9 mm of rain per year.

**Table 4: Temperature, Humidity and Rainfall from Prospect Reservoir**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Daily maximum temperature (°C)** | | | | | | | | | | | | | |
| Mean | 28.3 | 27.9 | 26.3 | 23.7 | 20.3 | 17.3 | 16.8 | 18.7 | 21.3 | 23.7 | 25.3 | 27.4 | 23.1 |
| **Daily minimum temperature (°C)** | | | | | | | | | | | | | |
| Mean | 17.6 | 17.7 | 16.1 | 13.0 | 10.0 | 7.4 | 6.1 | 6.8 | 9.4 | 12.1 | 14.2 | 16.3 | 12.2 |
| **Rainfall (mm)** | | | | | | | | | | | | | |
| Monthly Mean | 93.9 | 96.6 | 95.7 | 74.0 | 72.1 | 75.1 | 57.2 | 50.5 | 47.2 | 59.2 | 72.1 | 75.0 | 868.9 |
| No. Days | 8.0 | 8.2 | 8.3 | 7.0 | 6.5 | 6.9 | 5.6 | 5.8 | 6.2 | 6.8 | 7.2 | 7.5 | 84.0 |
| **9am Temperature (°C)** | | | | | | | | | | | | | |
| Mean | 21.3 | 21.0 | 19.6 | 16.9 | 13.5 | 10.7 | 9.6 | 11.1 | 14.5 | 17.4 | 18.4 | 20.6 | 16.2 |
| **9am Relative Humidity (%)** | | | | | | | | | | | | | |
| Mean | 75 | 79 | 79 | 77 | 80 | 79 | 76 | 70 | 65 | 65 | 70 | 70 | 74 |
| **3pm Temperature (°C)** | | | | | | | | | | | | | |
| Mean | 26.8 | 26.3 | 24.8 | 22.4 | 19.2 | 16.5 | 15.9 | 17.4 | 19.6 | 22.1 | 23.4 | 25.9 | 21.7 |
| **3pm Relative Humidity (%)** | | | | | | | | | | | | | |
| Mean | 52 | 54 | 55 | 52 | 57 | 55 | 50 | 45 | 45 | 46 | 50 | 49 | 51 |

Station No. 067019 Commenced 1887; Last Record 2010; Elevation: 61m; Latitude: -33.82; Longitude: 150.91

Source: Bureau of Meteorology (2010)

## 5.3 Existing air quality

Air quality standards and goals refer to cumulative pollutant levels which include the Project and existing sources. To fully assess impacts against all the relevant air quality standards and goals (see **Section 4**) it is necessary to have information or estimates on existing dust concentration and deposition levels in the area in which the project is likely to contribute to these levels.

The DECCW operates air quality monitoring stations at St Marys and at Prospect Reservoir. Concentrations of $PM_{10}$ are measured continuously at these sites using a Tapered Element Oscillating Microbalance (TEOM) and these data are available from the DECCW website. Monitoring data from the DECCW's St Marys and Prospect sites from 2003 to 2009 are shown below in **Table 5** (**DECCW, 2010**). The Prospect site was commissioned in February 2007.

**Table 5: DECCW monitoring data for the area**

| $PM_{10}$ concentrations by TEOM ($\mu g/m^3$) | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **St Marys** | | | | | | | | | | | | | | |
| 2003 | Average | 30 | 20 | 23 | 19 | 13 | 14 | 13 | * | 19 | 15 | 19 | 20 | 19 |
| | Maximum | 70 | 32 | 212 | 56 | 30 | 28 | 32 | * | 43 | 22 | 34 | 42 | 212 |
| 2004 | Average | 24 | 25 | 20 | 19 | * | 16 | 14 | 11 | 10 | 10 | 17 | * | 17 |
| | Maximum | 51 | 45 | 37 | 38 | * | 26 | 27 | 19 | 19 | * | 29 | * | 51 |
| 2005 | Average | 20 | * | 13 | 20 | 17 | 20 | 15 | 21 | 15 | 20 | 17 | 30 | 19 |
| | Maximum | 47 | * | 26 | 31 | 31 | 46 | 28 | 54 | 33 | 49 | 26 | 51 | 54 |
| 2006 | Average | 22 | 23 | 20 | 19 | 18 | 11 | 11 | 15 | 18 | 25 | 29 | 23 | 20 |
| | Maximum | 51 | 35 | 34 | 36 | 32 | 21 | * | 23 | 63 | 38 | 73 | 58 | 73 |
| 2007 | Average | 25 | 19 | 17 | 19 | 18 | 10 | 12 | 13 | 16 | 26 | 15 | * | 17 |
| | Maximum | 45 | 27 | 28 | 38 | 41 | 20 | 28 | 27 | 32 | 47 | 36 | * | 47 |
| 2008 | Average | 19 | 14 | 16 | 11 | 16 | 10 | 12 | 12 | 18 | 17 | 16 | 18 | 15 |
| | Maximum | * | 38 | 27 | 20 | 26 | 18 | 33 | 30 | 41 | 34 | 27 | 34 | 41 |
| 2009 | Average | 22 | 20 | 19 | 20 | 15 | 10 | 11 | 18 | 80 | 16 | 29 | 20 | 23 |
| | Maximum | 33 | 41 | * | 187 | 26 | 17 | 29 | 40 | 1661 | 40 | 122 | 31 | 1661 |
| **Prospect** | | | | | | | | | | | | | | |
| 2007 | Average | * | * | 18 | 21 | 21 | 14 | 14 | 15 | 18 | 26 | 16 | 17 | 18 |
| | Maximum | * | * | 28 | 42 | 46 | 27 | 26 | 31 | 34 | 46 | 34 | 27 | 46 |
| 2008 | Average | 21 | 16 | * | 14 | 20 | 14 | 17 | 13 | 23 | 19 | 18 | 21 | 18 |
| | Maximum | 35 | 34 | * | 23 | 26 | 33 | 40 | 24 | 42 | 36 | 34 | 42 | 42 |
| 2009 | Average | 20 | 23 | 22 | 25 | 22 | 15 | 14 | 19 | 82 | 17 | 31 | 19 | 26 |
| | Maximum | 32 | 50 | 40 | 222 | 50 | 29 | * | 41 | 1680 | 43 | 134 | 31 | 1680 |

Source: DECCW (2010)

One of the main reasons for analysing monitoring data is to determine existing air quality so that the assessment criteria can be determined in accordance with the DECCW's modelling guidelines (**DEC, 2005**).

The annual average $PM_{10}$ concentration recorded for the years 2003 to 2009 at the St Marys site by TEOM was 19, 17, 19, 20, 17, 15 and 23 $\mu g/m^3$ respectively. This is below the DECCW air quality goal of 30 $\mu g/m^3$. The annual average $PM_{10}$ concentration recorded for the years 2007 to 2009 at the Prospect site by TEOM was 18, 18 and 26 $\mu g/m^3$ respectively.

Maximum 24-hour concentrations were above the DECCW 50 $\mu g/m^3$ goal on several occasions at both the St Marys and Prospect sites. The highest 24-hour average $PM_{10}$ concentrations were generally measured in the warmer months of the year. It is noted that during September 2009 a widespread dust storm was experienced in Sydney causing the abnormally high reading. As a result of the dust storm occurring in September 2009, it is noted that the annual average $PM_{10}$ concentrations for 2009 were higher that the preceding years.

For estimating the background concentrations at sensitive receptors, the conservative 2009 annual average $PM_{10}$ value recorded at the DECCW's St Marys site has been considered for this assessment.

Annual average TSP concentrations can be estimated from measured $PM_{10}$ concentrations by assuming that 40% of the TSP is $PM_{10}$. This relationship was obtained from data collected by co-located TSP and $PM_{10}$ monitors operated for reasonably long periods of time in the Hunter Valley (**NSW Minerals Council, 2000**). Use of this relationship indicates that annual average TSP concentrations are of the order of 58 $\mu g/m^3$, which is less than the DECCW assessment criterion of 90 $\mu g/m^3$.

Annual average dust deposition levels can be estimated in a similar process to the method used to estimate TSP concentrations by assuming a TSP concentration of 90 $\mu g/m^3$ will have a corresponding dust deposition value of 4 $g/m^2$/month. The use of this relationship indicates an annual average dust deposition of 2.6 g/ $m^2$/month for the surrounding area.

From the monitoring data available it has been assumed that the following background concentrations apply at the nearest residences.

- Annual average TSP of 58 $\mu g/m^3$
- Annual average $PM_{10}$ of 23 $\mu g/m^3$ (average of St Marys 2003 to 2009 data)
- Annual average dust deposition of 2.6 $g/m^2$/month

In addition, the DECCW guidelines require an assessment against 24-hour $PM_{10}$ concentrations. This assessment adopts the goal that the predicted 24-hour average $PM_{10}$ concentration from the development should be less than 50 $\mu g/m^3$ at the nearest residences.

# 6 ESTIMATED DUST EMISSIONS

Dust emissions will arise from a range of activities associated with the RDC. Total dust emissions due to the project have been estimated by analysing the activities taking place at the site when operating at full capacity.

The activities have been combined with emission factors developed, both locally and by the US EPA, to estimate the amount of dust produced. There have been significant revisions to the US EPA emission factors for dust generating activities since 2003. The emission factors applied are considered to be the most up to date methods for determining dust generation rates. The fraction of fine, inhalable and coarse particles for each activity has been taken into account for the dispersion modelling.

The operational description for the Project and site plan has been used to determine equipment movement distances and routes, stockpile locations and areas, infrastructure, activity operating hours, equipment sizes and other details that are necessary to estimate dust emissions.

The assessment has taken a conservative approach to estimating the dust emissions. The estimated emissions are based on the maximum capacity of the facility and are representative of the worst-case operations. The emission estimation has also assumed that 10% of the total material unloaded from trains will be diverted to the radial stacker. This material is then rehandled by front end loader for transfer to trucks. As the radial stacker has been proposed as a contingency measure this method of transfer would be minimal in each year.

Operations at the approved CBP have assumed that annual production would be 200,000 $m^3/y$. Modelling inputs for the approved CBP have been taken from a previous air quality assessment for the site, conducted by **Holmes Air Sciences** in **2003**. For the purposes of this assessment these values have not been adjusted as no changes are proposed to this aspect of the project.

Also, it is recognised that a street sweeper will be employed to minimise dust emissions from vehicles travelling on-site. The calculated dust emissions for this assessment have not taken into account any reduction in dust emissions with the operation of a street sweeper due to the scientific uncertainty of likely reductions. The estimated dust emissions from vehicles travelling on-site are therefore considered to be conservative.

The Projects most significant dust generating activities have been identified, with corresponding dust emission estimates presented in **Table 6**. Details of the calculations of the dust emissions are presented in **Appendix B**.

**Table 6: Estimated dust emissions due to the proposed modified RDC**

| Activity | TSP emission rate (kg/y) |
|---|---|
| RDC: Trains unloading to unloading station | 1,097 |
| RDC: Transfer conveyors unloading to storage bins* | 987 |
| RDC: Transfer conveyors unloading to radial stacker | 183 |
| RDC: FEL transferring from radial stacker to trucks | 366 |
| RDC: Total truck movements on-site (sealed road) | 13,636 |
| RDC: Dispatch/loadout of materials to trucks | 3,656 |
| RDC: Wind erosion from stockpiles and exposed areas | 3,504 |
| RDC: Vehicles on CBP site | 5,486 |
| RDC: Vehicle exhausts at CBP | 1,295 |
| RDC: Dumping to ground bins at CBP | 366 |
| RDC: FEL loading to hoppers at CBP | 366 |
| RDC: Unloading to storage bins at CBP | 110 |
| RDC: Residual dust from loading cement/ash to silos at CBP** | 658 |
| RDC: Unloading from bins to trucks at CBP | 366 |
| RDC: Wind erosion from exposed areas at CBP | 1,051 |
| ***TOTAL*** | **33,126** |

** Assumes that 10% of materials are diverted directly to the radial stacker before being transferred to trucks or the main storage bins.*

*** The closed system design feeds residual dust back into the silos. Inclusion of this dust emission is therefore a conservative approach to the assessment.*

The calculations have assumed some reduction to dust emissions from enclosing transfer points and use of water sprays. It can be seen from **Table 6** that vehicle movements on-site are calculated to generate the most dust on an annual basis.

# 7 APPROACH TO ASSESSMENT

Off-site dust concentration and dust deposition levels due to the modified RDC have been predicted using AUSPLUME. AUSPLUME (Version 6.0) is an advanced Gaussian dispersion model developed on behalf of the Victorian EPA (**VEPA, 1986**) and is based on the United States Environmental Protection Agency's Industrial Source Complex (ISC) model. It is widely used throughout Australia and is regarded as a "state-of-the-art" model. AUSPLUME is the model required for use by the NSW DECCW unless project characteristics dictate otherwise (**DEC, 2005**).

This section is provided so that technical reviewers can appreciate how the modelling of different particle size categories was carried out. The modelling has been based on the use of three particle-size categories 0 to 2.5 μm - referred to as $PM_{2.5}$ or fine particles (FP), 2.5 to 10 μm - referred to as CM (coarse matter) and 10 to 30 μm - referred to as the Rest). Mass emission rates in each of these size ranges have been determined using the factors derived from the **SPCC (1986)** study and TSP emission rates calculated using emission factors derived from **US EPA (1985)** and **NERDDC (1988)** work (see **Appendix B**).

The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 4.7% of the TSP
- $PM_{2.5-10}$ (CM) is 34.4% of TSP
- $PM_{10-30}$ (Rest) is 60.9% of TSP.

Modelling was done using three AUSPLUME source groups. Each group corresponded to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 μm. The predicted concentration in the three plot output files for each group were then combined according to the weightings above to determine the concentration of $PM_{10}$ and TSP.

The AUSPLUME model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions on dust generating industries where wind speed is an important factor in determining the rate at which dust is generated.

For the current study the operations were represented by a series of volume sources located according to the site layout. **Figure 6** shows the location of the modelled sources. Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. It is important to do this in the AUSPLUME model to ensure that long-term average emission rates are not combined with worst-case dispersion conditions which are associated with light winds. Light winds at the RDC site would correspond with periods of low dust generation (because wind erosion and other wind dependent emissions rates will be low) and also correspond with periods of poor dispersion. If these measures are not taken then the model has the potential to significantly overstate impacts.

Dust concentrations and deposition rates have been predicted in the vicinity of the RDC. Local terrain has been assumed to be flat for modelling purposes.

The modelling has been performed using the meteorological data discussed in **Section 5.1** and the dust emission estimates from **Section 5**. All dust sources have been modelled assuming 24-hour per day operations. As an example the AUSPLUME model output file is provided in **Appendix C**.

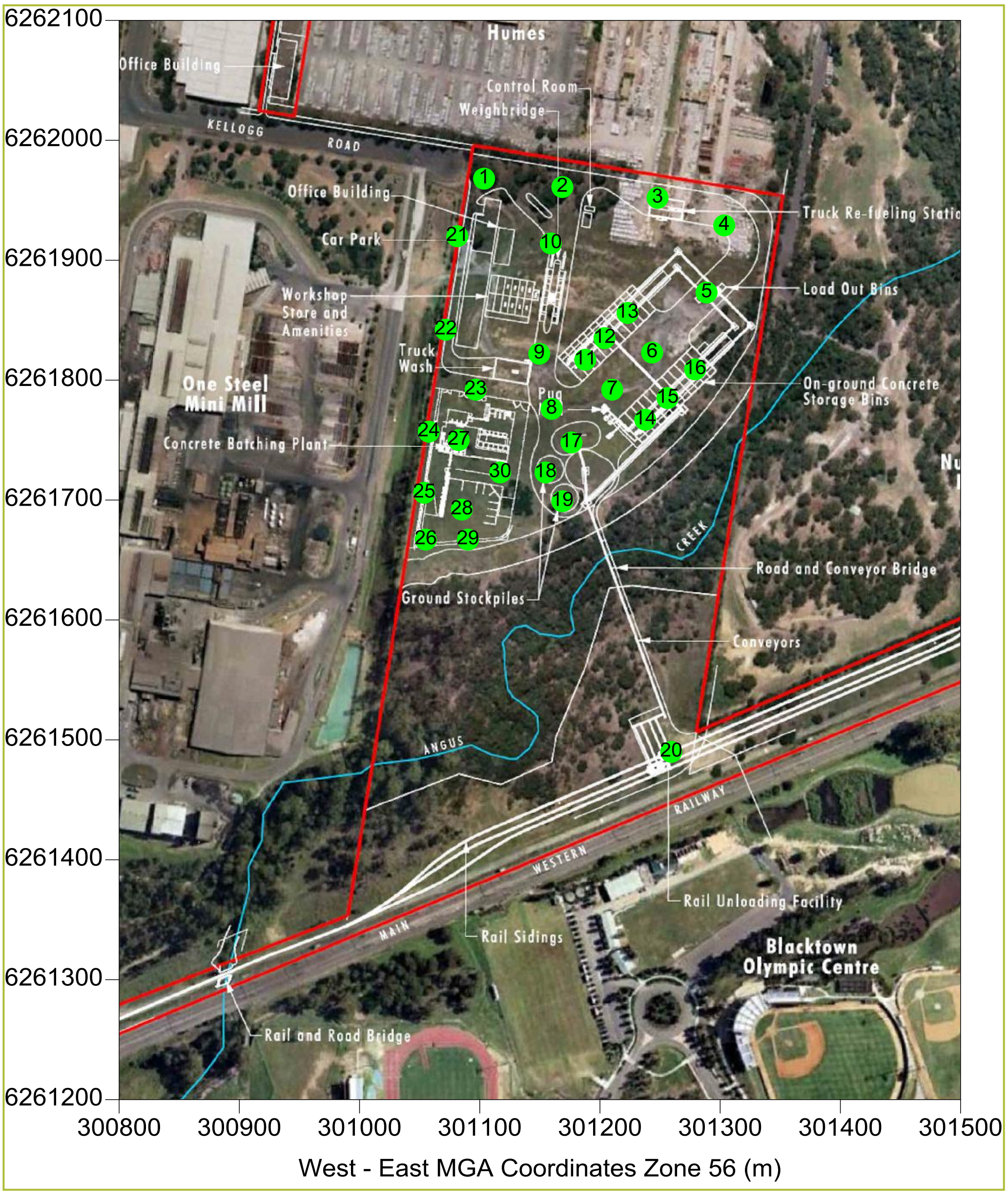



**Figure 6: Source locations**

# 8 ASSESSMENT OF IMPACTS

## 8.1 Preamble

This section provides an interpretation of the predicted dust concentrations and deposition levels.

Dust concentrations and deposition rates due to the Project have been presented as isopleth diagrams showing the following:

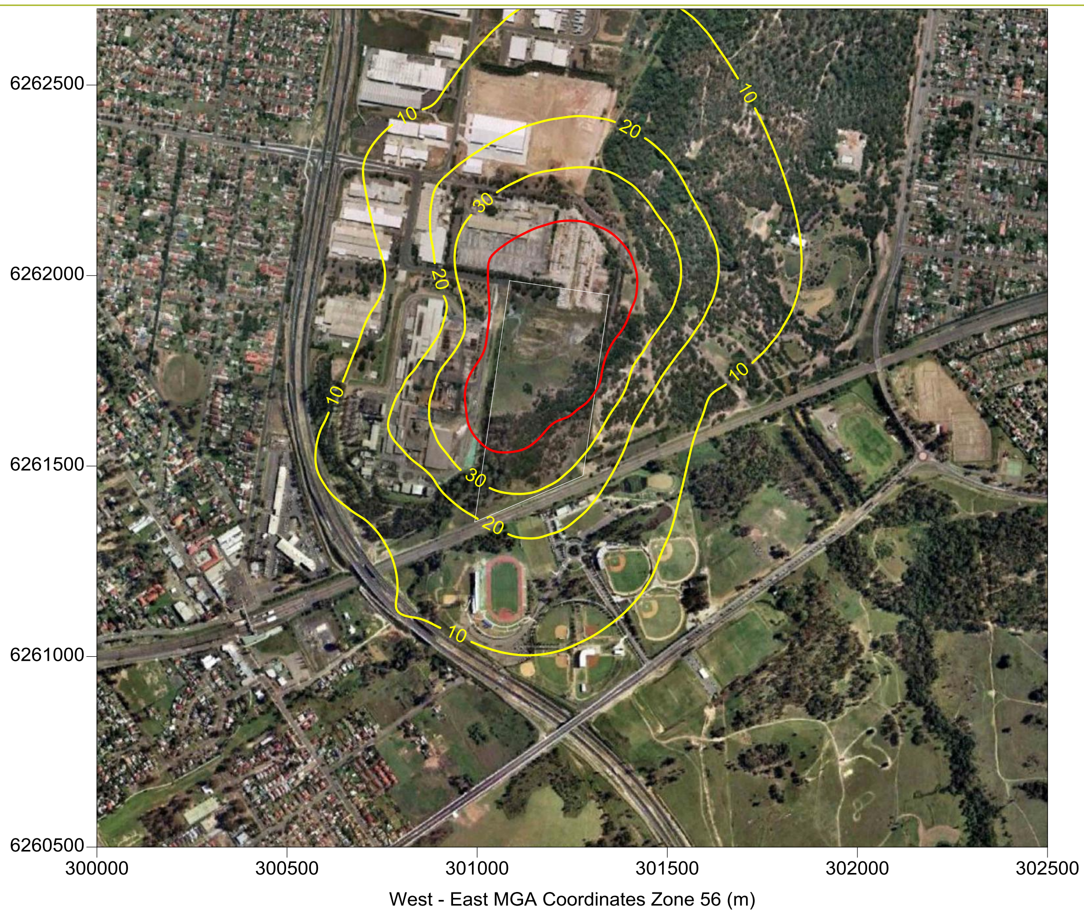
1. Predicted maximum 24-hour average $PM_{10}$ concentration
2. Predicted annual average $PM_{10}$ concentration
3. Predicted annual average TSP concentration, and
4. Predicted annual average dust deposition

The maximum 24-hour average contour plots do not represent the dispersion pattern for any particular day, but show the highest predicted 24-hour average concentration that occurred at each location for the worst day in the year. The maxima are used to show concentrations which can possibly be reached under the modelled conditions.

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, and as a result the isopleths will not always match exactly with predicted impacts at any specific location.

## 8.2 $PM_{10}$ Concentrations

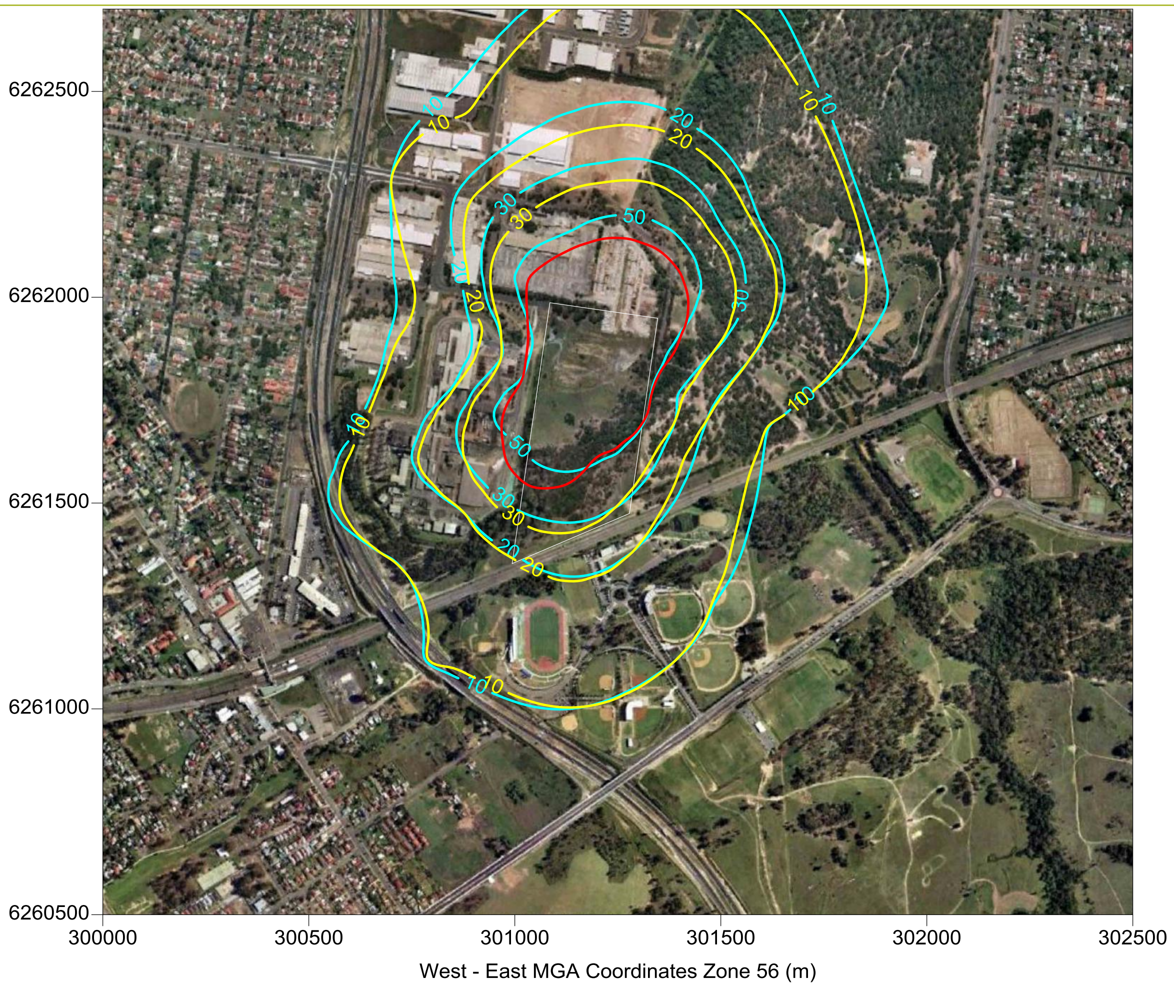
**Figure 7** shows the predicted maximum 24-hour average $PM_{10}$ concentrations due to proposed operations. At the residential areas to the west and east of the site the predicted concentrations are less than 10 $\mu g/m^3$. At the Blacktown Olympic Centre directly to the south of the site the predicted maximum 24-hour average concentrations are of the order of 20 $\mu g/m^3$. The predicted air quality impacts at the adjacent Nurragingy Reserve show the 50 $\mu g/m^3$ contour level encroaches into a small area to the northeast of the site, as shown in **Figure 7**.




| Species: | Location: | Scenario: | Percentile: | Averaging Time: |
|---|---|---|---|---|
| $PM_{10}$ | Rooty Hill, NSW | Modification | Maximum | 24-hour |
| **Model Used:** | **Units:** | **Guideline:** | **Met Data:** | **Plot:** |
| AUSPLUME | µg/m$^3$ | 50 µg/m$^3$ (shown as a red line) | St Marys 2003 | P. Henschke |

**Figure 7: Predicted 24-hour average $PM_{10}$ concentrations (µg/m$^2$)**

A comparison of the 24-hour average $PM_{10}$ impacts from the Approved RDC to the Modified RDC is presented in **Figure 8**. The predicted impacts from the Approved RDC are shown as the blue contour lines. The predicted impacts from the Modified RDC are shown as the yellow contour lines. The proposed modifications to the RDC site would lead to a minor reduction in the 24-hour average $PM_{10}$ impacts for the site.

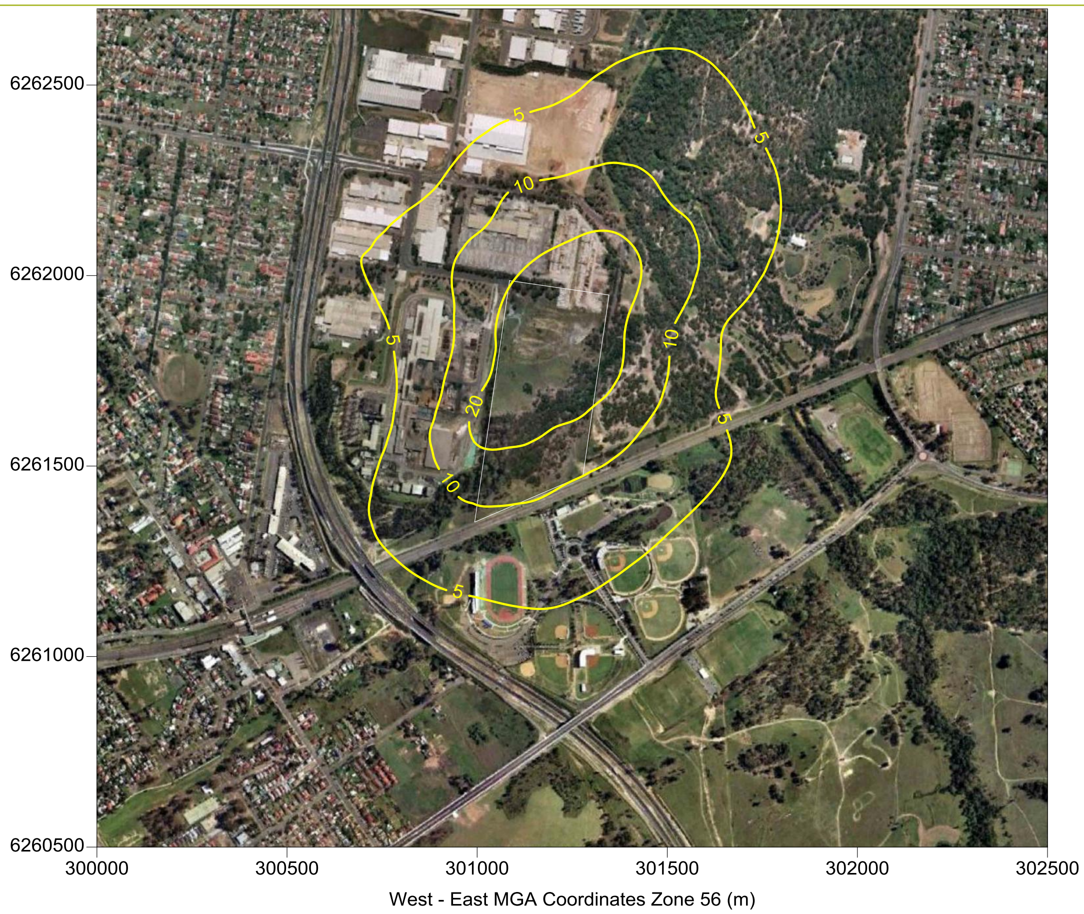



| Species: | Location: | Scenario: | Percentile: | Averaging Time: |
|---|---|---|---|---|
| $PM_{10}$ | Rooty Hill, NSW | Approved (blue) vs Modification (yellow) | Maximum | 24-hour |
| **Model Used:** | **Units:** | **Guideline:** | **Met Data:** | **Plot:** |
| AUSPLUME | µg/m$^3$ | 50 µg/m$^3$ (shown as a red line) | St Marys 2003 | P. Henschke |

**Figure 8: Comparison of predicted 24-hour average $PM_{10}$ concentrations (µg/m$^3$)**

As per the 2003 assessment, further investigation was conducted on the predicted 24-hour average $PM_{10}$ impacts. Nurragingy Reserve can see up to 2,000 visitors in one day and the critical assessment criteria will be short-term (24-hour) dust concentrations. Visitors to the reserves could spend up to about 12 hours in the area (the reserve is closed at night); however there is no air quality goal for $PM_{10}$ in NSW for averaging times less than 24-hours. The dispersion model has been re-run to predict maximum 12-hour average $PM_{10}$ concentrations and the results are shown in **Figure 9**. The purpose of these results is to show the likely concentrations during daytime hours when there would be visitors at the reserves. Although there is no 12-hour average $PM_{10}$ goal the results from **Figure 9** show that concentrations are below 50 µg/m$^3$ during daytime hours. This level of impact is considered to be acceptable.

It is also important to note that the air quality modelling has not taken into account the screening impact of the vegetation that exists between the site and open public areas of the reserve; as such the predicted $PM_{10}$ concentrations represent a conservative impact.




| Species: | Location: | Scenario: | Percentile: | Averaging Time: |
|---|---|---|---|---|
| $PM_{10}$ | Rooty Hill, NSW | Modification | Maximum | 12-hour |
| **Model Used:** | **Units:** | **Guideline:** | **Met Data:** | **Plot:** |
| AUSPLUME | µg/m$^3$ | N/A | St Marys 2003 | P. Henschke |

**Figure 9: Predicted 12-hour average $PM_{10}$ concentrations (µg/m$^2$)**

Contemporaneous analysis for the cumulative 24-hour average $PM_{10}$ concentrations has also been considered at nearby residences surrounding the site. Locations of these residences are shown in **Figure 10**. The maximum 24-hour average concentrations at these receptors are presented in **Tables 7** to **9**. The left side of the tables present the highest measured 24-hour average $PM_{10}$ concentrations with the associated predicted incremental impact at these locations due to operations occurring at the RDC. The right side shows the total predicted concentration on days with the highest predicted incremental ground-level concentrations. Measured exceedences of the 50 µg/m$^3$ criterion at the St Marys site were excluded from this analysis.


**Figure 10: Cumulative 24-hour average $PM_{10}$ locations**

The cumulative analysis in **Tables 7** to **9**, show that at the sensitive receptor locations; there are no predicted cumulative 24-hour average exceedences due to the operation of the project.

**Table 7: Cumulative 24-hour average $PM_{10}$ Analysis Receptor 1**

| Date | $PM_{10}$ 24-hour average (µg/m³) | | | Date | $PM_{10}$ 24-hour average (µg/m³) | | |
|---|---|---|---|---|---|---|---|
| | Background | Predicted Increment | Total | | Highest Predicted Increment | Background | Total |
| 25/02/2009 | 40.5 | 0.6 | 41.1 | 9/09/2009 | 5.4 | 5.0 | 10.4 |
| 2/10/2009 | 40.4 | 0.1 | 40.5 | 3/12/2009 | 4.8 | 14.8 | 19.7 |
| 25/08/2009 | 40.0 | 0.0 | 40.0 | 1/04/2009 | 4.3 | 15.6 | 19.9 |
| 7/02/2009 | 38.8 | 0.0 | 38.9 | 14/07/2009 | 4.1 | 6.9 | 11.1 |
| 6/02/2009 | 38.2 | 0.3 | 38.4 | 31/01/2009 | 4.0 | 21.5 | 25.4 |
| 15/09/2009 | 37.6 | 0.0 | 37.6 | 7/08/2009 | 3.7 | 11.0 | 14.7 |
| 14/09/2009 | 35.4 | 0.0 | 35.4 | 12/03/2009 | 3.7 | 8.2 | 11.8 |
| 16/11/2009 | 34.8 | 0.4 | 35.1 | 3/07/2009 | 3.6 | 5.6 | 9.2 |
| 19/11/2009 | 34.7 | 1.4 | 36.1 | 23/02/2009 | 3.5 | 20.5 | 24.0 |
| 23/08/2009 | 34.6 | 0.0 | 34.6 | 12/12/2009 | 3.4 | 21.5 | 24.8 |

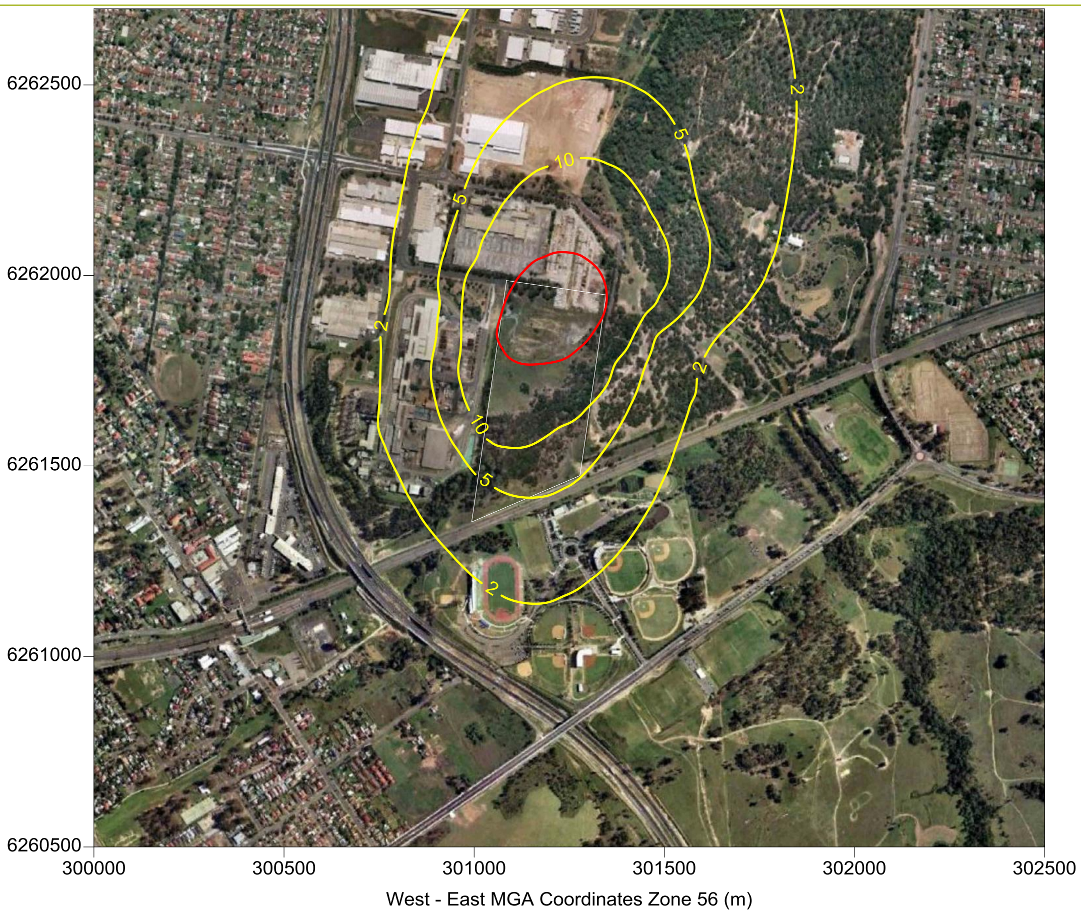
**Table 8: Cumulative 24-hour average $PM_{10}$ Analysis Receptor 2**

| Date | $PM_{10}$ 24-hour average (µg/m³) | | | Date | $PM_{10}$ 24-hour average (µg/m³) | | |
|---|---|---|---|---|---|---|---|
| | Background | Predicted Increment | Total | | Highest Predicted Increment | Background | Total |
| 25/02/2009 | 40.5 | 2.5 | 43.0 | 21/02/2009 | 5.1 | 19.8 | 24.9 |
| 2/10/2009 | 40.4 | 1.3 | 41.7 | 12/04/2009 | 4.6 | 12.8 | 17.4 |
| 25/08/2009 | 40.0 | 0.0 | 40.0 | 14/03/2009 | 4.5 | 8.4 | 13.0 |
| 7/02/2009 | 38.8 | 1.2 | 40.1 | 29/01/2009 | 4.3 | 19.7 | 24.0 |
| 6/02/2009 | 38.2 | 3.7 | 41.9 | 31/01/2009 | 4.2 | 21.5 | 25.7 |
| 15/09/2009 | 37.6 | 0.0 | 37.6 | 3/02/2009 | 3.7 | 26.1 | 29.9 |
| 14/09/2009 | 35.4 | 0.0 | 35.4 | 6/02/2009 | 3.7 | 38.2 | 41.9 |
| 16/11/2009 | 34.8 | 0.0 | 34.8 | 1/04/2009 | 3.7 | 15.6 | 19.3 |
| 19/11/2009 | 34.7 | 1.2 | 36.0 | 18/02/2009 | 3.7 | 8.1 | 11.7 |
| 23/08/2009 | 34.6 | 0.0 | 34.6 | 14/06/2009 | 3.5 | 16.5 | 20.0 |

**Table 9: Cumulative 24-hour average $PM_{10}$ Analysis Receptor 3**

| Date | $PM_{10}$ 24-hour average (µg/m³) | | | Date | $PM_{10}$ 24-hour average (µg/m³) | | |
|---|---|---|---|---|---|---|---|
| | Background | Predicted Increment | Total | | Highest Predicted Increment | Background | Total |
| 25/02/2009 | 40.5 | 0.0 | 40.5 | 21/07/2009 | 5.8 | 15.2 | 21.0 |
| 2/10/2009 | 40.4 | 0.2 | 40.6 | 29/06/2009 | 3.8 | 10.9 | 14.7 |
| 25/08/2009 | 40.0 | 1.7 | 41.7 | 26/08/2009 | 3.8 | 11.6 | 15.3 |
| 7/02/2009 | 38.8 | 0.5 | 39.3 | 8/05/2009 | 3.7 | 25.8 | 29.6 |
| 6/02/2009 | 38.2 | 0.0 | 38.2 | 27/03/2009 | 3.5 | 32.0 | 35.5 |
| 15/09/2009 | 37.6 | 0.9 | 38.4 | 12/08/2009 | 3.4 | 10.1 | 13.5 |
| 14/09/2009 | 35.4 | 0.3 | 35.6 | 2/08/2009 | 3.3 | 11.7 | 15.0 |
| 16/11/2009 | 34.8 | 0.0 | 34.8 | 7/06/2009 | 3.3 | 10.9 | 14.2 |
| 19/11/2009 | 34.7 | 0.2 | 35.0 | 31/03/2009 | 3.1 | 14.8 | 17.9 |
| 23/08/2009 | 34.6 | 1.8 | 36.4 | 15/06/2009 | 3.0 | 13.0 | 15.9 |

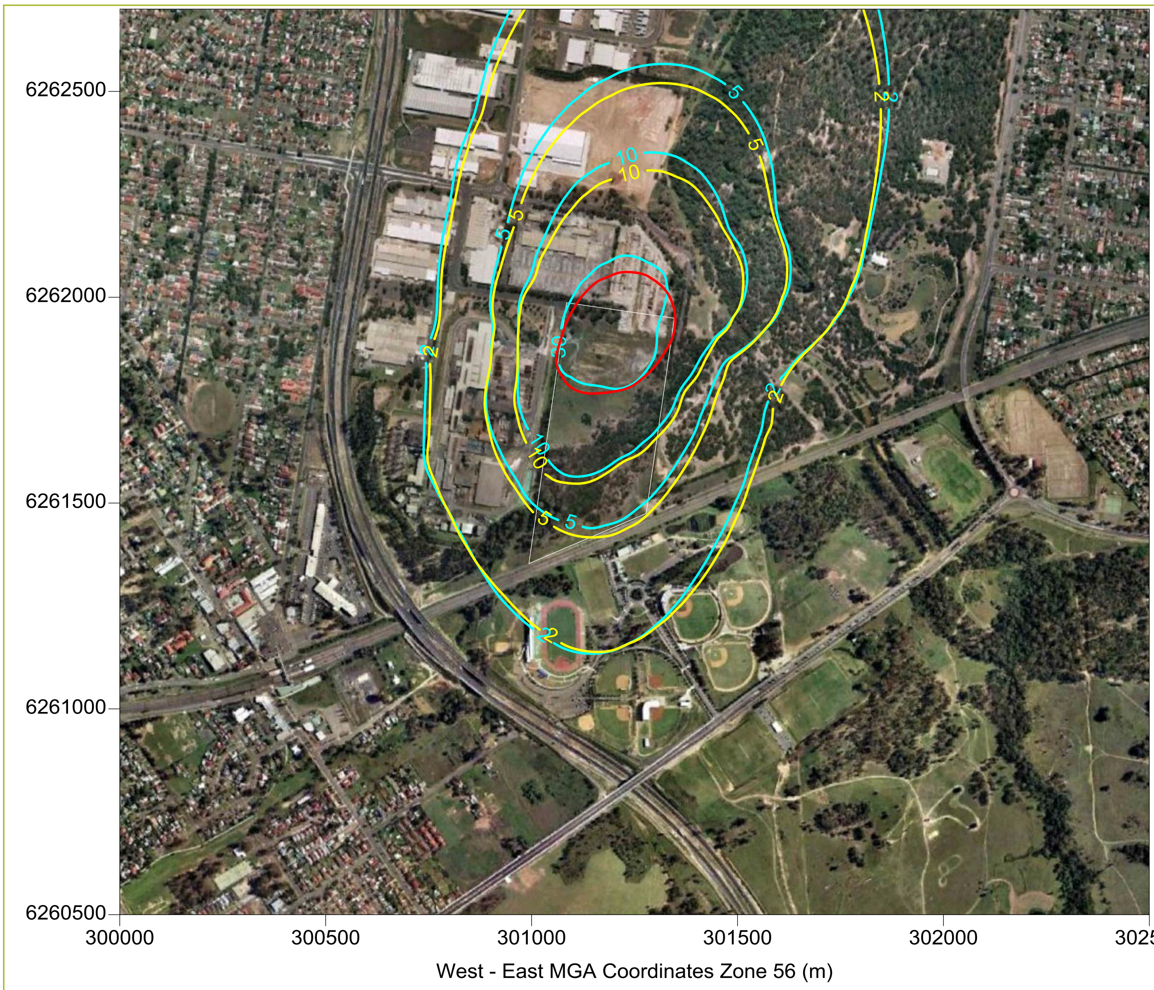
**Figure 11** shows the predicted annual average $PM_{10}$ concentrations due to the RDC operations. Assuming a background concentration of 23 μg/m$^3$ it can be seen that the dust emissions from the project would not cause exceedances of the air quality goal (30 μg/m$^3$) at any neighbouring residential areas. The predicted $PM_{10}$ contribution from the RDC is less than 2 μg/m$^3$ at the nearest residential areas. The impact at the Blacktown Olympic Centre and Nurragingy reserve is predicted to be below the relevant criterion.




| **Species:** | **Location:** | **Scenario:** | **Percentile:** | **Averaging Time:** |
|---|---|---|---|---|
| $PM_{10}$ | Rooty Hill, NSW | Modification | Maximum | Annual |
| **Model Used:** | **Units:** | **Guideline:** | **Met Data:** | **Plot:** |
| AUSPLUME | μg/m$^3$ | 30 μg/m$^3$ (shown as a red line) | St Marys 2003 | P. Henschke |

**Figure 11: Predicted annual average $PM_{10}$ concentrations (μg/m$^2$)**

A comparison of the annual average $PM_{10}$ impacts from the Approved RDC to the Modified RDC is presented in **Figure 12**. The predicted impacts from the Approved RDC are shown as the blue contour lines. The predicted impacts from the Modified RDC are shown as the yellow contour lines. The proposed modifications to the RDC site would lead to a minor reduction in the annual average $PM_{10}$ impacts for the site.

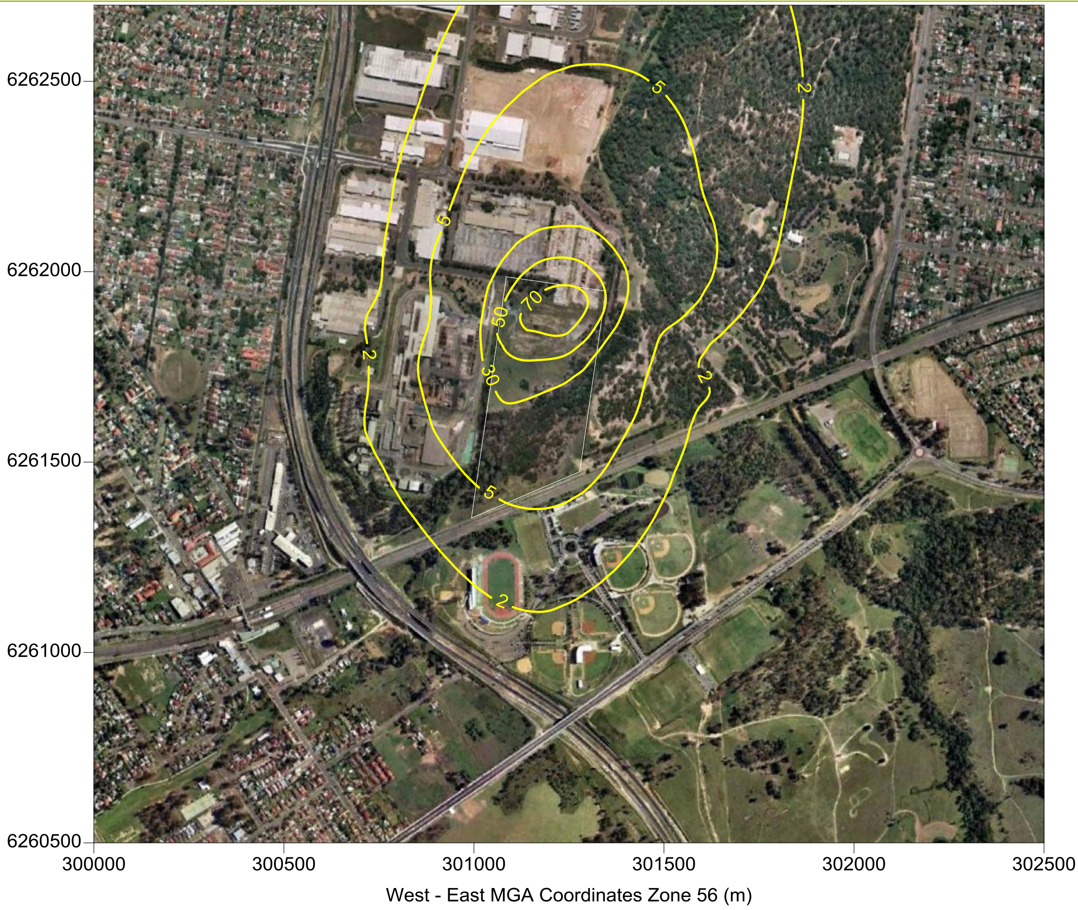



| **Species:** | **Location:** | **Scenario:** | **Percentile:** | **Averaging Time:** |
|---|---|---|---|---|
| $PM_{10}$ | Rooty Hill, NSW | Approved (blue) vs Modification (yellow) | Maximum | Annual |
| **Model Used:** | **Units:** | **Guideline:** | **Met Data:** | **Plot:** |
| AUSPLUME | µg/m$^3$ | 30 µg/m$^3$ (shown as a red line) | St Marys 2003 | P. Henschke |

**Figure 12: Comparison of predicted annual average $PM_{10}$ concentrations (µg/m$^3$)**

## 8.3 TSP Concentrations

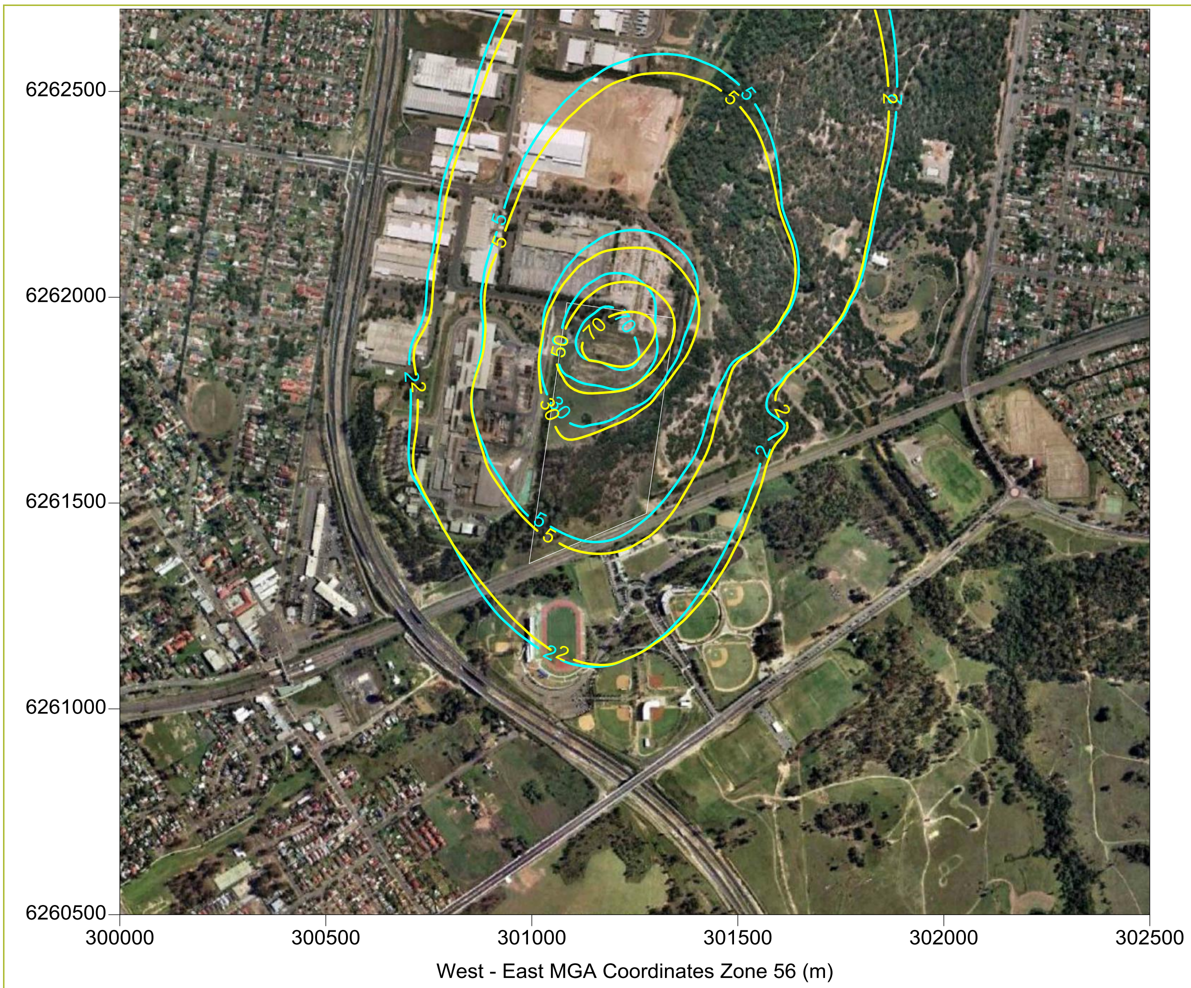
Predicted annual average TSP concentrations are shown in **Figure 13**. The model predictions show that the nearest residential area would experience annual average TSP concentrations less than 2 $\mu g/m^3$ due to the operations of the RDC. Compliance with the annual average 90 $\mu g/m^3$ TSP would be anticipated even when considering typical background levels of around 58 $\mu g/m^3$. The impact at the Blacktown Olympic Centre and Nurragingy reserve is predicted to be below the relevant criterion.




| Species: | Location: | Scenario: | Percentile: | Averaging Time: |
|---|---|---|---|---|
| TSP | Rooty Hill, NSW | Modification | Maximum | Annual |
| **Model Used:** | **Units:** | **Guideline:** | **Met Data:** | **Plot:** |
| AUSPLUME | $\mu g/m^3$ | 90 $\mu g/m^3$ (shown as a red line) | St Marys 2003 | P. Henschke |

**Figure 13: Predicted annual average TSP concentrations ($\mu g/m^2$)**

A comparison of the annual average TSP impacts from the Approved RDC to the Modified RDC is presented in **Figure 14**. The predicted impacts from the Approved RDC are shown as the blue contour lines. The predicted impacts from the Modified RDC are shown as the yellow contour lines. The proposed modifications to the RDC site would lead to a minor reduction in the annual average TSP impacts for the site.

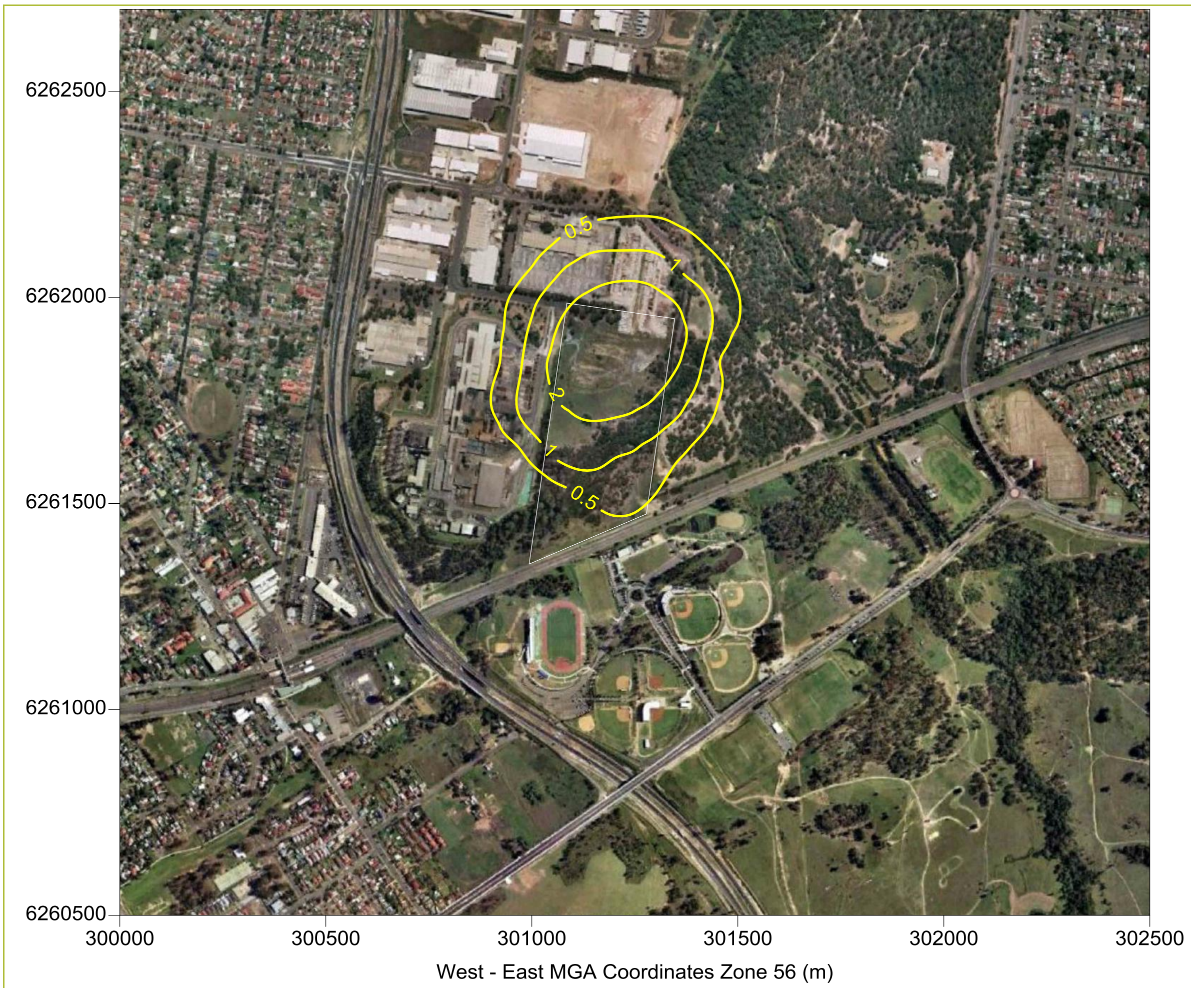



| Species: | Location: | Scenario: | Percentile: | Averaging Time: |
|---|---|---|---|---|
| TSP | Rooty Hill, NSW | Approved (blue) vs Modification (yellow) | Maximum | Annual |
| **Model Used:** | **Units:** | **Guideline:** | **Met Data:** | **Plot:** |
| AUSPLUME | µg/m$^3$ | 90 µg/m$^3$ (shown as a red line) | St Marys 2003 | P. Henschke |

**Figure 14: Comparison of predicted annual average TSP concentrations (µg/m$^3$)**

## 8.4 Dust Deposition

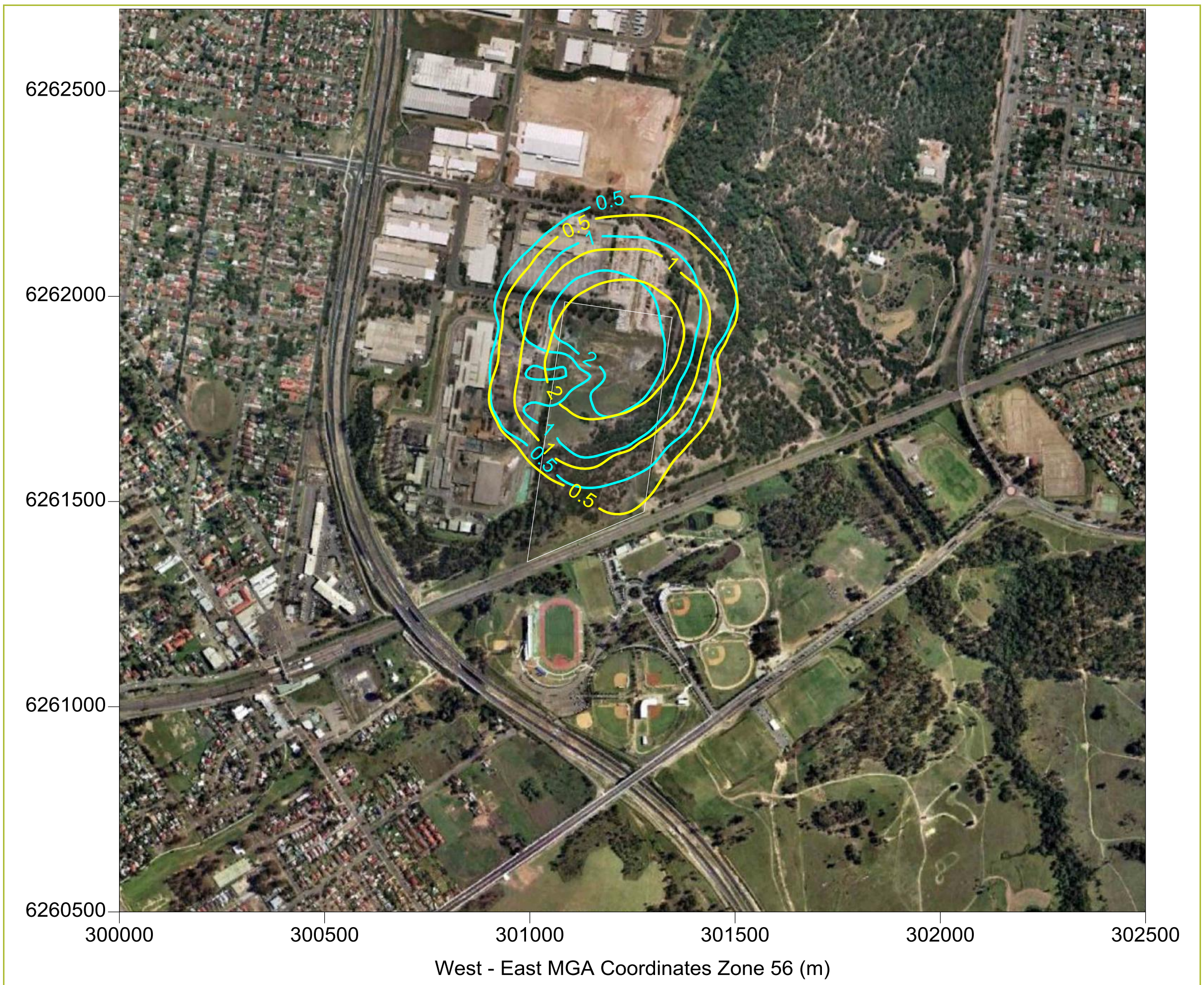
**Figure 15** shows the predicted annual average dust deposition. The contribution of dust emissions to existing dust deposition levels is predicted to be low at less than 0.1 g/m$^2$/month at the nearest residential area. Assuming a background deposition level of 2.6 g/m$^2$/month, it is unlikely that the operation of the RDC would cause of exceedances of the 4 g/m$^2$/month air quality criterion at these residential areas. The impact at the Blacktown Olympic Centre and Nurragingy reserve is predicted to be below the relevant criterion.




| **Species:** | **Location:** | **Scenario:** | **Percentile:** | **Averaging Time:** |
|---|---|---|---|---|
| DD | Rooty Hill, NSW | Modification | Maximum | Annual |
| **Model Used:** | **Units:** | **Guideline:** | **Met Data:** | **Plot:** |
| AUSPLUME | g/m$^2$/month | 4 g/m$^2$/month (shown as a red line) | St Marys 2003 | P. Henschke |

**Figure 15: Predicted dust deposition levels (g/m$^2$/month)**

A comparison of the annual dust deposition impacts from the Approved RDC to the Modified RDC is presented in **Figure 16**. The predicted impacts from the Approved RDC are shown as the blue contour lines. The predicted impacts from the Modified RDC are shown as the yellow contour lines. The proposed modifications to the RDC site would lead to a minor reduction in the annual dust deposition impacts for the site.




| **Species:** | **Location:** | **Scenario:** | **Percentile:** | **Averaging Time:** |
|---|---|---|---|---|
| DD | Rooty Hill, NSW | Approved (blue) vs Modification (yellow) | Maximum | Annual |
| **Model Used:** | **Units:** | **Guideline:** | **Met Data:** | **Plot:** |
| AUSPLUME | g/m$^2$/month | 4 g/m$^2$/month (shown as a red line) | St Marys 2003 | P. Henschke |

**Figure 16: Comparison of predicted dust deposition levels (g/m$^2$/month)**

## 8.5 Construction Issues

Air quality impacts during construction would largely result from dust generated during earthworks and other engineering activities associated with the facilities construction. The total amount of dust generated would depend on the silt and moisture content of the soil, the types of operations being carried out, exposed area, frequency of water spraying and speed of machinery.

As construction is likely to continue for up to two years, it is important that exposed areas be stabilised as quickly as possible and that appropriate dust suppression methods be used to keep dust impacts to a minimum. To ensure dust generation is controlled, the site would implement a construction dust management plan (as part of the overall construction environmental management plan) which will be utilised to help reduce any off-site impacts from these activities.

Mitigation measures to control dust include:

- Maintaining active road surfaces including wetting down;
- Limit vehicle speeds; and
- Rehabilitate completed sections of the site.

The dust emissions can be effectively managed through routine construction management techniques, such that their impact is expected to be negligible.

# 9 CONCLUSIONS

This report has assessed the air quality impacts associated with the operation of the Proposed Modified Regional Distribution Centre off Kellogg Road, Rooty Hill. Dispersion modelling has been used to assess the impact that dust emissions from the operation of the plant would have on the local air quality.

It is concluded that air quality impacts due to activities occurring at the Modified RDC would be at levels lower than the predicted impacts occurring from the Approved RDC with operations of the plant at a full capacity of 4 Mtpa. The proposal would generate less dust in total due to these proposed modifications.

The implementation of proposed dust control measures; including enclosures over transfer points, use of water sprays and street sweeper, should ensure that air quality impacts are lower than those predicted in this study.

Air quality monitoring data have indicated that existing short-term dust concentrations are above air quality goals on occasions. Particulate matter concentrations arising from non-Project related sources, such as bushfires and dust storms, may continue to result in elevated levels on occasions.

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## APPENDIX A

## Joint Wind Speed, Wind Direction and Stability Class Frequency Tables

St Marys 2003

STATISTICS FOR FILE: C:\Jobs\RHillRDC\metdata\StMarys\StMarys2003.aus

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

| WIND SECTOR | 0.50 TO 1.50 | 1.50 TO 3.00 | 3.00 TO 4.50 | 4.50 TO 6.00 | 6.00 TO 7.50 | 7.50 TO 9.00 | 9.00 TO 10.50 | GREATER THAN 10.50 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| NNE | 0.010046 | 0.006050 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.016096 |
| NE | 0.005822 | 0.004566 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.010388 |
| ENE | 0.004566 | 0.002626 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.007192 |
| E | 0.003995 | 0.002511 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.006621 |
| ESE | 0.002968 | 0.002740 | 0.000799 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.006507 |
| SE | 0.001941 | 0.002397 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004452 |
| SSE | 0.005936 | 0.001370 | 0.000457 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.007763 |
| S | 0.006050 | 0.002169 | 0.000571 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.008790 |
| SSW | 0.008219 | 0.001941 | 0.000000 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.010274 |
| SW | 0.004795 | 0.002169 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.006963 |
| WSW | 0.002283 | 0.000685 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.003196 |
| W | 0.002397 | 0.000913 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.003311 |
| WNW | 0.002740 | 0.001142 | 0.000342 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004224 |
| NW | 0.003995 | 0.000913 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.005023 |
| NNW | 0.012443 | 0.001826 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.014269 |
| N | 0.014954 | 0.007420 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.022374 |
| CALM | | | | | | | | | 0.051826 |
| TOTAL | 0.093151 | 0.041438 | 0.002740 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.189269 |

MEAN WIND SPEED (m/s) = 1.12
NUMBER OF OBSERVATIONS = 1658

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

| WIND SECTOR | 0.50 TO 1.50 | 1.50 TO 3.00 | 3.00 TO 4.50 | 4.50 TO 6.00 | 6.00 TO 7.50 | 7.50 TO 9.00 | 9.00 TO 10.50 | GREATER THAN 10.50 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| NNE | 0.001826 | 0.002055 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.003995 |
| NE | 0.000457 | 0.001941 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002511 |
| ENE | 0.000913 | 0.003311 | 0.001256 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.005479 |
| E | 0.000342 | 0.002397 | 0.001370 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004110 |
| ESE | 0.000571 | 0.003082 | 0.001370 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.005023 |
| SE | 0.000913 | 0.002626 | 0.000571 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004110 |
| SSE | 0.000342 | 0.001484 | 0.000457 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002397 |
| S | 0.001826 | 0.002740 | 0.000342 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.005023 |
| SSW | 0.002511 | 0.002968 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.005594 |
| SW | 0.001256 | 0.001256 | 0.000342 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002968 |
| WSW | 0.000457 | 0.001142 | 0.000228 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.001941 |
| W | 0.000457 | 0.000913 | 0.001370 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002968 |
| WNW | 0.000228 | 0.000685 | 0.001142 | 0.000799 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002854 |
| NW | 0.000571 | 0.000457 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.001256 |
| NNW | 0.002169 | 0.002626 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.005023 |
| N | 0.002397 | 0.005936 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.008562 |
| CALM | | | | | | | | | 0.001941 |
| TOTAL | 0.017237 | 0.035616 | 0.009475 | 0.001484 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.065753 |

MEAN WIND SPEED (m/s) = 2.19
NUMBER OF OBSERVATIONS = 576

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

| WIND SECTOR | 0.50 TO 1.50 | 1.50 TO 3.00 | 3.00 TO 4.50 | 4.50 TO 6.00 | 6.00 TO 7.50 | 7.50 TO 9.00 | 9.00 TO 10.50 | GREATER THAN 10.50 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| NNE | 0.000000 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000114 |
| NE | 0.000000 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000114 |
| ENE | 0.000114 | 0.001142 | 0.000685 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.001941 |
| E | 0.000114 | 0.002511 | 0.004224 | 0.000342 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.007192 |
| ESE | 0.000000 | 0.002511 | 0.007648 | 0.002854 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.013014 |
| SE | 0.000228 | 0.002169 | 0.005822 | 0.002626 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.010845 |
| SSE | 0.000457 | 0.002968 | 0.003995 | 0.001484 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.008904 |
| S | 0.002740 | 0.005822 | 0.004566 | 0.000799 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.013927 |
| SSW | 0.002740 | 0.003425 | 0.003425 | 0.000685 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.010274 |
| SW | 0.000799 | 0.002968 | 0.001941 | 0.000913 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.006621 |
| WSW | 0.000571 | 0.000799 | 0.001941 | 0.000799 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004110 |
| W | 0.000000 | 0.000571 | 0.002397 | 0.002055 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.005023 |
| WNW | 0.000114 | 0.000571 | 0.003767 | 0.004338 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.008790 |
| NW | 0.000000 | 0.000571 | 0.001826 | 0.001027 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.003425 |
| NNW | 0.001256 | 0.001370 | 0.000913 | 0.000571 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004110 |
| N | 0.001142 | 0.003881 | 0.000685 | 0.000457 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.006164 |
| CALM | | | | | | | | | 0.000457 |
| TOTAL | 0.010274 | 0.031507 | 0.043836 | 0.018950 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.105023 |

MEAN WIND SPEED (m/s) = 3.33
NUMBER OF OBSERVATIONS = 920

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

| WIND SECTOR | 0.50 TO 1.50 | 1.50 TO 3.00 | 3.00 TO 4.50 | 4.50 TO 6.00 | 6.00 TO 7.50 | 7.50 TO 9.00 | 9.00 TO 10.50 | GREATER THAN 10.50 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| NNE | 0.000571 | 0.000457 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.001027 |
| NE | 0.000000 | 0.000685 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000685 |
| ENE | 0.000457 | 0.001256 | 0.000457 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002169 |
| E | 0.000571 | 0.002626 | 0.001712 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004909 |
| ESE | 0.000913 | 0.005365 | 0.007306 | 0.002968 | 0.000342 | 0.000000 | 0.000000 | 0.000000 | 0.016895 |
| SE | 0.001142 | 0.004795 | 0.005137 | 0.001712 | 0.000799 | 0.000000 | 0.000000 | 0.000000 | 0.013584 |
| SSE | 0.003881 | 0.004224 | 0.004566 | 0.001027 | 0.000114 | 0.000114 | 0.000000 | 0.000000 | 0.013927 |
| S | 0.020205 | 0.010731 | 0.006050 | 0.002169 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.039269 |
| SSW | 0.022945 | 0.026142 | 0.008219 | 0.000913 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.058333 |
| SW | 0.011187 | 0.010046 | 0.003311 | 0.001598 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.026370 |
| WSW | 0.001712 | 0.002740 | 0.001826 | 0.001256 | 0.001027 | 0.000342 | 0.000000 | 0.000000 | 0.008904 |
| W | 0.000000 | 0.000571 | 0.002511 | 0.001142 | 0.000685 | 0.000000 | 0.000000 | 0.000000 | 0.004909 |
| WNW | 0.000228 | 0.003653 | 0.003311 | 0.001826 | 0.002740 | 0.000114 | 0.000000 | 0.000000 | 0.011872 |
| NW | 0.000228 | 0.002397 | 0.002968 | 0.001826 | 0.000913 | 0.000571 | 0.000342 | 0.000000 | 0.009247 |
| NNW | 0.001712 | 0.005137 | 0.002169 | 0.000685 | 0.000685 | 0.000228 | 0.000228 | 0.000000 | 0.010845 |
| N | 0.004795 | 0.006507 | 0.001826 | 0.000114 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.013356 |
| CALM | | | | | | | | | 0.003881 |
| TOTAL | 0.070548 | 0.087329 | 0.051370 | 0.017237 | 0.007877 | 0.001370 | 0.000571 | 0.000000 | 0.240183 |

MEAN WIND SPEED (m/s) = 2.58
NUMBER OF OBSERVATIONS = 2104

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

| WIND SECTOR | 0.50 TO 1.50 | 1.50 TO 3.00 | 3.00 TO 4.50 | 4.50 TO 6.00 | 6.00 TO 7.50 | 7.50 TO 9.00 | 9.00 TO 10.50 | GREATER THAN 10.50 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| NNE | 0.002055 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002283 |
| NE | 0.002397 | 0.001712 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004110 |
| ENE | 0.003425 | 0.003767 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.007192 |
| E | 0.001484 | 0.002740 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004224 |
| ESE | 0.001256 | 0.002283 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.003539 |
| SE | 0.000571 | 0.001598 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002169 |
| SSE | 0.004338 | 0.001142 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.005479 |
| S | 0.019292 | 0.001370 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.020776 |
| SSW | 0.018265 | 0.001826 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.020091 |
| SW | 0.007763 | 0.001256 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.009132 |
| WSW | 0.001484 | 0.000571 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002055 |
| W | 0.000342 | 0.000799 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.001142 |
| WNW | 0.000685 | 0.001484 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002283 |
| NW | 0.000913 | 0.001142 | 0.000342 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002397 |
| NNW | 0.001142 | 0.002055 | 0.000571 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.003767 |
| N | 0.005822 | 0.002968 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.008790 |
| CALM | | | | | | | | | 0.013470 |
| TOTAL | 0.071233 | 0.026941 | 0.001256 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.112900 |

MEAN WIND SPEED (m/s) = 1.19
NUMBER OF OBSERVATIONS = 989

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

| WIND SECTOR | 0.50 TO 1.50 | 1.50 TO 3.00 | 3.00 TO 4.50 | 4.50 TO 6.00 | 6.00 TO 7.50 | 7.50 TO 9.00 | 9.00 TO 10.50 | GREATER THAN 10.50 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| NNE | 0.008333 | 0.000571 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.008904 |
| NE | 0.007420 | 0.001598 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.009018 |
| ENE | 0.005365 | 0.001941 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.007306 |
| E | 0.002169 | 0.001027 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.003196 |
| ESE | 0.001484 | 0.000799 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002283 |
| SE | 0.002397 | 0.000457 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002854 |
| SSE | 0.004566 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004795 |
| S | 0.013014 | 0.000913 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.013927 |
| SSW | 0.013356 | 0.000685 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.014041 |
| SW | 0.010388 | 0.000571 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.010959 |
| WSW | 0.005137 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.005251 |
| W | 0.002740 | 0.000571 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.003311 |
| WNW | 0.001712 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.001941 |
| NW | 0.002055 | 0.000571 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002626 |
| NNW | 0.004110 | 0.000799 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.004909 |
| N | 0.011986 | 0.001142 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.013128 |
| CALM | | | | | | | | | 0.178425 |
| TOTAL | 0.096233 | 0.012215 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.286872 |

MEAN WIND SPEED (m/s) = 0.69
NUMBER OF OBSERVATIONS = 2513

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

| WIND SECTOR | 0.50 TO 1.50 | 1.50 TO 3.00 | 3.00 TO 4.50 | 4.50 TO 6.00 | 6.00 TO 7.50 | 7.50 TO 9.00 | 9.00 TO 10.50 | GREATER THAN 10.50 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| NNE | 0.022831 | 0.009475 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.032420 |
| NE | 0.016096 | 0.010616 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.026826 |
| ENE | 0.014840 | 0.014041 | 0.002397 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.031279 |
| E | 0.008676 | 0.013813 | 0.007420 | 0.000342 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.030251 |
| ESE | 0.007192 | 0.016781 | 0.017123 | 0.005822 | 0.000342 | 0.000000 | 0.000000 | 0.000000 | 0.047260 |
| SE | 0.007192 | 0.014041 | 0.011644 | 0.004338 | 0.000799 | 0.000000 | 0.000000 | 0.000000 | 0.038014 |
| SSE | 0.019521 | 0.011416 | 0.009475 | 0.002626 | 0.000114 | 0.000114 | 0.000000 | 0.000000 | 0.043265 |
| S | 0.063128 | 0.023744 | 0.011644 | 0.003082 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.101712 |
| SSW | 0.068037 | 0.036986 | 0.011758 | 0.001712 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.118607 |
| SW | 0.036187 | 0.018265 | 0.005708 | 0.002626 | 0.000228 | 0.000000 | 0.000000 | 0.000000 | 0.063014 |
| WSW | 0.011644 | 0.006050 | 0.004224 | 0.002169 | 0.001027 | 0.000342 | 0.000000 | 0.000000 | 0.025457 |
| W | 0.005936 | 0.004338 | 0.006279 | 0.003425 | 0.000685 | 0.000000 | 0.000000 | 0.000000 | 0.020662 |
| WNW | 0.005708 | 0.007763 | 0.008676 | 0.006963 | 0.002740 | 0.000114 | 0.000000 | 0.000000 | 0.031963 |
| NW | 0.007763 | 0.006050 | 0.005479 | 0.002854 | 0.000913 | 0.000571 | 0.000342 | 0.000000 | 0.023973 |
| NNW | 0.022831 | 0.013813 | 0.003881 | 0.001256 | 0.000685 | 0.000228 | 0.000228 | 0.000000 | 0.042922 |
| N | 0.041096 | 0.027854 | 0.002740 | 0.000571 | 0.000114 | 0.000000 | 0.000000 | 0.000000 | 0.072374 |
| CALM | | | | | | | | | 0.250000 |
| TOTAL | 0.358676 | 0.235046 | 0.108676 | 0.037785 | 0.007877 | 0.001370 | 0.000571 | 0.000000 | 1.000000 |

MEAN WIND SPEED (m/s) = 1.66
NUMBER OF OBSERVATIONS = 8760

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 18.9%
B : 6.6%
C : 10.5%
D : 24.0%
E : 11.3%
F : 28.7%

## APPENDIX B

## Estimated Dust Emissions

## ESTIMATED DUST EMISSIONS: ROOTY HILL RDC

The dust emission inventories have been formulated from the operational description provided by Umwelt. Estimated emissions are presented for all significant dust generating activities associated with the operations. The relevant emission factors used for the study are described below.

### Loading, unloading and transferring material

The dust emission from this activity will depend on wind speed according to the **US EPA (1985)** emission factor equation. This means that the emissions will vary with wind speed. The actual emission is given by Equation 1.

Equation 1

$$E_{TSP} = k \times 0.0016 \times \left( \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right) \qquad kg/t$$

*where,*

$E_{TSP} = TSP \ \ emissions$

$k = 0.74$

$U = wind\ speed\ (m/s)$

$M = moisture\ \ content\ (\%)$

$[where\ 0.25 \le M \le 4.8]$

In cases where transfer points include some form of enclosure a reduction to emissions of 70% (Table 3 of **NPI, 2001**) has been used.

### Vehicle movements on sealed road surfaces

The emission factor used for vehicles movements on the sealed surfaces of the site was 0.15 kg per vehicle kilometre travelled (kg/VKT). No reductions in emissions from the use of water sprays or street sweepers have been considered.

### Vehicle exhausts

Emissions from heavy diesel vehicle exhausts can be estimated using the **US EPA (1985)** emission factor of 0.7 g/brake-horsepower hour (g/hp-h). Assume that the average power level of each truck on site 100 hp. This includes slowly manoeuvring on site and idling. Also assume that each truck spends 10 minutes on site.

### Residual dust from loading cement/ash to silos

Estimated dust emissions due to loading fly-ash and cement to the silo can be made by assuming the concentration of dust in the air discharged after de-dusting the conveying air and dry dust collection system when dry concrete mix is loaded to trucks is 50 mg/Nm$^3$ (the EPA licence limit). The volume of air handled is approximately 108 Nm$^3$/minute. It has been assumed that it will take one minute per tonne to load.

## Wind erosion from exposed areas and stockpiles

The emissions factor for wind erosion dust is 0.4 kg/ha/hour (**SPCC, 1983**). The emissions will also depend on the state of cleanliness of the area. This also varies with wind speed in the model.

## Emission Inventory - RDC

| ACTIVITY | TSP (kg/y) | Intensity | Units | Emission factor | Units | Variable 1 | Units | Variable 2 | Units | Variable 3 | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RDC: Trains unloading to unloading station | **1,097** | 4,000,000 | t/y | 0.00027 | kg/t | 0.772 | average | 2 | moisture content (%) | - | bcm |
| RDC: Transfer conveyors unloading to storage bins | **987** | 3,600,000 | t/y | 0.00027 | kg/t | 0.772 | average | 2 | moisture content (%) | - | bcm |
| RDC: Transfer conveyors unloading to radial stacker | **183** | 400,000 | t/y | 0.00046 | kg/t | 0.772 | average | 2 | moisture content (%) | - | bcm |
| RDC: FEL transferring from radial stacker to storage bins | **366** | 400,000 | t/y | 0.00091 | kg/t | 0.772 | average | 2 | moisture content (%) | - | bcm |
| RDC: Trucks movements on site (sealed road) | **13,636** | 4,000,000 | t/y | 0.00341 | kg/t | 33 | t/truck l | 0.75 | km/return trip | 0.15 | kg/VKT |
| RDC: Dispatch/loadout of materials to trucks | **3,656** | 4,000,000 | t/y | 0.00091 | kg/t | 0.772 | average | 2 | moisture content (%) | - | bcm |
| RDC: Wind erosion from stockpiles and exposed areas | **3,504** | 1 | ha | 3504 | kg/ha/y | 0.4 | kg/ha/h | 8760 | h/y | | |
| CBP: Vehicles on site | | trips per year | return km | factor (kg/VKT) | Emission (kg/y) | | BUSY | 200000 | m3/y | | |
| | Delivery - cement | 3000 | 0.4 | 0.2 | 240 | | | 667 | m3/d | | |
| | Delivery - ash | 1500 | 0.4 | 0.2 | 120 | | | 111 | m3/h | | |
| | Delivery - aggregat | 11100 | 0.5 | 0.2 | 1110 | | | | | | |
| | Dispatch - concret | 39900 | 0.5 | 0.2 | 3990 | | | | | | |
| | Staff | 12900 | 0.1 | 0.02 | 26 | **5486** | | | | | |
| CBP: Vehicle exhausts | hp | hours/truck | trucks/year | kg/hp-h | Emission (kg/y) | | | | | | |
| | 100 | 0.33 | 55500 | 0.0007 | | **1295** | | | | | |
| CBP: Dumping to ground bins | (U/2.2)^1.3 | moisture(%) | factor(kg/t) | tonne per year (t/ | Emission (kg/y) | | | | | | |
| | 0.772 | 2 | 0.000914048 | 400000 | | **366** | | | | | |
| CBP: FEL loading to hoppers | (U/2.2)^1.3 | moisture(%) | factor(kg/t) | tonne per year (t/ | Emission (kg/y) | | | | | | |
| | 0.772 | 2 | 0.000914048 | 400000 | | **366** | | | | | |
| CBP: Unloading to storage bins | (U/2.2)^1.3 | moisture(%) | factor(kg/t) | tonne per year (t/ | Emission (kg/y) | | | | | | |
| | 0.772 | 2 | 0.000274214 | 400000 | | **110** | | | | | |
| CBP: Residual dust from loading cement/ash to silos | Conc limit (mg/Nm | Air volume (Nm3/minute) | Time (min/t) | t/y | Emission (kg/y) | | | | | | |
| | 50 | 108 | 1 | 121500 | | **658** | | | | | |
| CBP: Unloading from bins to trucks | (U/2.2)^1.3 | moisture(%) | factor(kg/t) | tonne per year (t/ | Emission (kg/y) | | | | | | |
| | 0.772 | 2 | 0.000914048 | 400000 | | **366** | | | | | |
| CBP: Wind erosion from exposed areas | | Exposed area (ha) | factor(kg/ha/hour) | Hours/year | Emission (kg/y) | | | | | | |
| | | 0.3 | 0.4 | 8760 | | **1051** | | | | | |

## APPENDIX C

## AUSPLUME Model Output File

1

AUSPLUME Input File : Dust concentration

```
Concentration or deposition                          Concentration
Emission rate units                                  grams/second
Concentration units                                  microgram/m3
Units conversion factor                              1.00E+06
Constant background concentration                             0.00E+00
Terrain effects                                      Egan method
Plume depletion due to dry removal mechanisms included.
Smooth stability class changes?                      No
Other stability class adjustments ("urban modes")    None
Ignore building wake effects?                        Yes
Decay coefficient (unless overridden by met. file)   0.000
Anemometer height                                    10 m
Roughness height at the wind vane site               0.500 m
Use the convective PDF algorithm?                    No

                   DISPERSION CURVES
Horizontal dispersion curves for sources <100m high  Pasquill-Gifford
Vertical  dispersion  curves for sources <100m high  Pasquill-Gifford
Horizontal dispersion curves for sources >100m high  Briggs Rural
Vertical  dispersion  curves for sources >100m high  Briggs Rural
Enhance horizontal plume spreads for buoyancy?       Yes
Enhance  vertical  plume spreads for buoyancy?       Yes
Adjust horizontal P-G formulae for roughness height? Yes
Adjust  vertical  P-G formulae for roughness height? Yes
Roughness height                                     0.500m
Adjustment for wind directional shear                None

                    PLUME RISE OPTIONS
Gradual plume rise?                                  Yes
Stack-tip downwash included?                         Yes
Building downwash algorithm:                        Schulman-Scire method.
Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
Partial penetration of elevated inversions?          No
Disregard temp. gradients in the hourly met. file?   No
```

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

| Wind Speed Category | Stability Class A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 4 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 5 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 6 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are:  1.54,  3.09,  5.14,  8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
24 hours
average over all hours

AUSPLUME Input File : Dust concentration

SOURCE GROUPS

| Group No. | Members | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | 15 | 16 | 17 | 18 | 19 | 20 | 21 |

```
                22      23      24      25      26      27      28

                29      30
         2      31      32      33      34      35      36      37
                38      39      40      41      42      43      44

                45      46      47      48      49      50      51

                52      53      54      55      56      57      58

                59      60
         3      61      62      63      64      65      66      67
                68      69      70      71      72      73      74

                75      76      77      78      79      80      81

                82      83      84      85      86      87      88

                89      90
 _____________________________________________________________________________

1                ____________________________________________

                   AUSPLUME Input File : Dust concentration

                            SOURCE CHARACTERISTICS

                 ____________________________________________


                   VOLUME SOURCE: 1

   X(m)     Y(m)      Ground Elevation     Height   Hor. spread    Vert. spread
  301104  6261968            1m              2m        20m              2m

              (Constant) emission rate = 1.00E+00 grams/second

        Hourly multiplicative factors will be used with
        this emission factor.

                   Particle  Particle  Particle
                     Mass      Size     Density
                   fraction  (micron)  (g/cm3)
                  _____________________________
                     1.0000       1.0       2.50


                   VOLUME SOURCE: 31

   X(m)     Y(m)      Ground Elevation     Height   Hor. spread    Vert. spread
  301104  6261968            1m              2m        20m              2m

              (Constant) emission rate = 1.00E+00 grams/second

        Hourly multiplicative factors will be used with
        this emission factor.

                   Particle  Particle  Particle
                     Mass      Size     Density
                   fraction  (micron)  (g/cm3)
                  _____________________________
                     1.0000       5.0       2.50


                   VOLUME SOURCE: 61

   X(m)     Y(m)      Ground Elevation     Height   Hor. spread    Vert. spread
  301104  6261968            1m              2m        20m              2m

              (Constant) emission rate = 1.00E+00 grams/second

        Hourly multiplicative factors will be used with
        this emission factor.

                   Particle  Particle  Particle
                     Mass      Size     Density
                   fraction  (micron)  (g/cm3)
```

1.0000 17.3 2.50

1

AUSPLUME Input File : Dust concentration

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
299105.m 299605.m 300105.m 300605.m 301105.m 301605.m 302105.m
302605.m 303105.m

and these y-values (or northings):
6260190.m 6260690.m 6261190.m 6261690.m 6262190.m 6262690.m 6263190.m
6263690.m 6264190.m

DISCRETE RECEPTOR LOCATIONS (in metres)

| No. | X | Y | ELEVN | HEIGHT | No. | X | Y | ELEVN | HEIGHT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 301012 | 6261826 | 1.0 | 0.0 | 49 | 301472 | 6261263 | 1.0 | 0.0 |
| 2 | 301092 | 6261848 | 1.0 | 0.0 | 50 | 301187 | 6261124 | 1.0 | 0.0 |
| 3 | 301158 | 6261818 | 1.0 | 0.0 | 51 | 300990 | 6261094 | 1.0 | 0.0 |
| 4 | 301180 | 6261774 | 1.0 | 0.0 | 52 | 300778 | 6261116 | 1.0 | 0.0 |
| 5 | 301158 | 6261716 | 1.0 | 0.0 | 53 | 300617 | 6261306 | 1.0 | 0.0 |
| 6 | 301121 | 6261643 | 1.0 | 0.0 | 54 | 300442 | 6261489 | 1.0 | 0.0 |
| 7 | 301063 | 6261614 | 1.0 | 0.0 | 55 | 300478 | 6261760 | 1.0 | 0.0 |
| 8 | 300983 | 6261635 | 1.0 | 0.0 | 56 | 300515 | 6261972 | 1.0 | 0.0 |
| 9 | 300997 | 6261723 | 1.0 | 0.0 | 57 | 300508 | 6261621 | 1.0 | 0.0 |
| 10 | 300946 | 6261826 | 1.0 | 0.0 | 58 | 300559 | 6262294 | 1.0 | 0.0 |
| 11 | 301034 | 6261899 | 1.0 | 0.0 | 59 | 300720 | 6262279 | 1.0 | 0.0 |
| 12 | 301143 | 6261891 | 1.0 | 0.0 | 60 | 300895 | 6262433 | 1.0 | 0.0 |
| 13 | 301231 | 6261848 | 1.0 | 0.0 | 61 | 301224 | 6262498 | 1.0 | 0.0 |
| 14 | 301238 | 6261738 | 1.0 | 0.0 | 62 | 301443 | 6262396 | 1.0 | 0.0 |
| 15 | 301194 | 6261628 | 1.0 | 0.0 | 63 | 301750 | 6262374 | 1.0 | 0.0 |
| 16 | 301078 | 6261548 | 1.0 | 0.0 | 64 | 301903 | 6261994 | 1.0 | 0.0 |
| 17 | 300983 | 6261555 | 1.0 | 0.0 | 65 | 301867 | 6261438 | 1.0 | 0.0 |
| 18 | 300880 | 6261672 | 1.0 | 0.0 | 66 | 301889 | 6261687 | 1.0 | 0.0 |
| 19 | 300844 | 6261789 | 1.0 | 0.0 | 67 | 301852 | 6261175 | 1.0 | 0.0 |
| 20 | 300924 | 6261921 | 1.0 | 0.0 | 68 | 301757 | 6260955 | 1.0 | 0.0 |
| 21 | 301019 | 6262045 | 1.0 | 0.0 | 69 | 301399 | 6260926 | 1.0 | 0.0 |
| 22 | 301180 | 6261994 | 1.0 | 0.0 | 70 | 300880 | 6260897 | 1.0 | 0.0 |
| 23 | 301282 | 6261921 | 1.0 | 0.0 | 71 | 300427 | 6261021 | 1.0 | 0.0 |
| 24 | 301355 | 6261782 | 1.0 | 0.0 | 72 | 300288 | 6261467 | 1.0 | 0.0 |
| 25 | 301319 | 6261650 | 1.0 | 0.0 | 73 | 300332 | 6261928 | 1.0 | 0.0 |
| 26 | 301216 | 6261511 | 1.0 | 0.0 | 74 | 300391 | 6262425 | 1.0 | 0.0 |
| 27 | 301063 | 6261438 | 1.0 | 0.0 | 75 | 300793 | 6262645 | 1.0 | 0.0 |
| 28 | 300880 | 6261489 | 1.0 | 0.0 | 76 | 301231 | 6262813 | 1.0 | 0.0 |
| 29 | 300771 | 6261606 | 1.0 | 0.0 | 77 | 301764 | 6262593 | 1.0 | 0.0 |
| 30 | 300749 | 6261869 | 1.0 | 0.0 | 78 | 302079 | 6262462 | 1.0 | 0.0 |
| 31 | 300851 | 6262038 | 1.0 | 0.0 | 79 | 302363 | 6262411 | 1.0 | 0.0 |
| 32 | 301026 | 6262140 | 1.0 | 0.0 | 80 | 302355 | 6262177 | 1.0 | 0.0 |
| 33 | 301224 | 6262125 | 1.0 | 0.0 | 81 | 302349 | 6261943 | 1.0 | 0.0 |
| 34 | 301355 | 6262038 | 1.0 | 0.0 | 82 | 302327 | 6261511 | 1.0 | 0.0 |
| 35 | 301443 | 6261862 | 1.0 | 0.0 | 83 | 302108 | 6261899 | 1.0 | 0.0 |
| 36 | 301428 | 6261621 | 1.0 | 0.0 | 84 | 302305 | 6260941 | 1.0 | 0.0 |
| 37 | 301370 | 6261453 | 1.0 | 0.0 | 85 | 301319 | 6260502 | 1.0 | 0.0 |
| 38 | 301180 | 6261328 | 1.0 | 0.0 | 86 | 300778 | 6260517 | 1.0 | 0.0 |
| 39 | 300961 | 6261306 | 1.0 | 0.0 | 87 | 299894 | 6261431 | 1.0 | 0.0 |
| 40 | 300778 | 6261409 | 1.0 | 0.0 | 88 | 299887 | 6261869 | 1.0 | 0.0 |
| 41 | 300683 | 6261570 | 1.0 | 0.0 | 89 | 299945 | 6262396 | 1.0 | 0.0 |
| 42 | 300617 | 6261796 | 1.0 | 0.0 | 90 | 300340 | 6263727 | 1.0 | 0.0 |
| 43 | 300668 | 6262045 | 1.0 | 0.0 | 91 | 300347 | 6262966 | 1.0 | 0.0 |
| 44 | 300858 | 6262242 | 1.0 | 0.0 | 92 | 300844 | 6263025 | 1.0 | 0.0 |
| 45 | 301216 | 6262308 | 1.0 | 0.0 | 93 | 301341 | 6263420 | 1.0 | 0.0 |
| 46 | 301494 | 6262177 | 1.0 | 0.0 | 94 | 301836 | 6262944 | 1.0 | 0.0 |
| 47 | 301640 | 6261869 | 1.0 | 0.0 | 95 | 302224 | 6262922 | 1.0 | 0.0 |
| 48 | 301633 | 6261540 | 1.0 | 0.0 | 96 | 302311 | 6263427 | 1.0 | 0.0 |

METEOROLOGICAL DATA : EPA St Marys AUSPLUME Modelling File (Met MANAGER)

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              HOURLY VARIABLE EMISSION FACTOR INFORMATION
              -------------------------------------------

 The input emission rates specfied above will be multiplied by hourly varying
 factors entered via the input file:
 C:\Jobs\RhDC\CHECK3\emiss.src
 For each stack source, hourly values within this file will be added to each
 declared exit velocity (m/sec) and temperature (K).

 Title of input hourly emission factor file is:
 AUSPLUME Variable emissions file (Met MANAGER)

              HOURLY EMISSION FACTOR SOURCE TYPE ALLOCATION
              ---------------------------------------------


 Prefix 1       allocated: 1
 Prefix 2       allocated: 2
 Prefix 3       allocated: 3
 Prefix 4       allocated: 4
 Prefix 5       allocated: 5
 Prefix 6       allocated: 6
 Prefix 7       allocated: 7
 Prefix 8       allocated: 8
 Prefix 9       allocated: 9
 Prefix 10      allocated: 10
 Prefix 11      allocated: 11
 Prefix 12      allocated: 12
 Prefix 13      allocated: 13
 Prefix 14      allocated: 14
 Prefix 15      allocated: 15
 Prefix 16      allocated: 16
 Prefix 17      allocated: 17
 Prefix 18      allocated: 18
 Prefix 19      allocated: 19
 Prefix 20      allocated: 20
 Prefix 21      allocated: 21
 Prefix 22      allocated: 22
 Prefix 23      allocated: 23
 Prefix 24      allocated: 24
 Prefix 25      allocated: 25
 Prefix 26      allocated: 26
 Prefix 27      allocated: 27
 Prefix 28      allocated: 28
 Prefix 29      allocated: 29
 Prefix 30      allocated: 30
 Prefix 31      allocated: 31
 Prefix 32      allocated: 32
 Prefix 33      allocated: 33
 Prefix 34      allocated: 34
 Prefix 35      allocated: 35
 Prefix 36      allocated: 36
 Prefix 37      allocated: 37
 Prefix 38      allocated: 38
 Prefix 39      allocated: 39
 Prefix 40      allocated: 40
 Prefix 41      allocated: 41
 Prefix 42      allocated: 42
 Prefix 43      allocated: 43
 Prefix 44      allocated: 44
 Prefix 45      allocated: 45
 Prefix 46      allocated: 46
 Prefix 47      allocated: 47
 Prefix 48      allocated: 48
 Prefix 49      allocated: 49
 Prefix 50      allocated: 50
 Prefix 51      allocated: 51
 Prefix 52      allocated: 52
 Prefix 53      allocated: 53
 Prefix 54      allocated: 54
 Prefix 55      allocated: 55
 Prefix 56      allocated: 56
 Prefix 57      allocated: 57
 Prefix 58      allocated: 58
 Prefix 59      allocated: 59
 Prefix 60      allocated: 60
 Prefix 61      allocated: 61
 Prefix 62      allocated: 62
 Prefix 63      allocated: 63
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Prefix 64      allocated: 64
Prefix 65      allocated: 65
Prefix 66      allocated: 66
Prefix 67      allocated: 67
Prefix 68      allocated: 68
Prefix 69      allocated: 69
Prefix 70      allocated: 70
Prefix 71      allocated: 71
Prefix 72      allocated: 72
Prefix 73      allocated: 73
Prefix 74      allocated: 74
Prefix 75      allocated: 75
Prefix 76      allocated: 76
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Prefix 79      allocated: 79
Prefix 80      allocated: 80
Prefix 81      allocated: 81
Prefix 82      allocated: 82
Prefix 83      allocated: 83
Prefix 84      allocated: 84
Prefix 85      allocated: 85
Prefix 86      allocated: 86
Prefix 87      allocated: 87
Prefix 88      allocated: 88
Prefix 89      allocated: 89
Prefix 90      allocated: 90
```