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AIR QUALITY IMPACT ASSESSMENT

Martin Creek Quarry Extension Project

5 September 2016

Prepared by

James McMahon

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EXECUTIVE SUMMARY

JM Environments (JME) was commissioned by Buttai Gravel Pty Ltd (the proponent) to prepare an Air Quality Impact Assessment for the Martins Creek Quarry Extension Project (the project). Martins Creek Quarry (the quarry) is an existing hard rock located at Station Street Martins Creek within Dungog Shire Council Local Government Area as shown in Figure 1. The Martins Creek Quarry is currently located within lands identified as Lots 5 and 6 DP242210, Lot 42 DP 815628, Lot 1 DP 1006375 and Lot 1 DP 204377.

The quarry is a high quality hard rock source (Andesite) and was originally developed by the NSW Government in 1914 to supply materials for the North Coast rail line and has continued to supply rail construction materials to present times. Buttai Gravel Pty Ltd took ownership of the quarry from December 2012.

The Martins Creek Quarry Extension Project, which involves:

- extracting up to 1.5 million tonnes of hard rock material per annum;
- expanding into new extraction areas and clearing approximately 36.8 hectares of vegetation;
- increasing the hours of operation for quarrying to 6am – 6pm (Monday to Saturday), processing to 6am - 10pm (Monday to Saturday), mixing and binding to 4:30am - 10pm (Monday to Friday) and 4:30am - 6pm (Saturdays), stockpiling, loading and dispatch of road transport to 5:30am - 7pm (Monday to Saturday) and train loading to 24 hours per day, 7 days per week;
- consolidating existing operations and approvals; and
- rehabilitating the site.

The proposed extension to the extraction area and production of up to 1.5 million tpa has the potential to increase levels of airborne dust principally as a result of:

- vegetation clearing and surface disturbance associated with the extension of the extraction area and waste rock emplacement;
- an increase in the total area of disturbance; and
- increased mobile and fixed plant operation as production reaches the proposed upper limit.
- There would also likely be a small increase in other particulate and gaseous emissions from the increased mobile and fixed plant activity, and associated product transport.

The project is to be assessed as a State Significant Development under Section 78A (8A) of the Environmental Planning and Assessment Act 1979 (EP&A Act). As such, an Environmental Impact Statement (EIS) is required to support the application for project approval. This Air Quality Impact Assessment will form part of the EIS.

The objectives were to:

- assess the current air quality;
- assess potential impacts on the air quality by the extension of the quarry; and
- provide mitigation measures to manage potential impacts on the air by the extension of the quarry

- develop an air dispersion model of the quarry;

In order to achieve the above objectives, the following scope of work was undertaken:

- Review of the Secretary Environmental Assessment Requirements (SEARS);
- Summarise the relevant legislations and guidelines noted in the SEARS-attachment 1;
- Review current air quality monitoring results from the quarry;
- Review of the regional background air quality;
- Development of an air quality dispersion model; and

Preparation of this Air Quality Impact Assessment.

This AQIA has been prepared in accordance with the NSW Environmental Protection Authority's (EPA, formerly Office of Environment and Heritage [OEH]) Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005).

Appropriate background concentrations for the air quality pollutants of concern were obtained from the EPA operated Singleton monitoring station. Comparison was made to the site specific data (which includes contributions from the existing quarry operations) and it was demonstrated that the use of Singleton data represented a suitable and conservative estimation of background air quality.

Estimations of cumulative emissions from proposed quarry activities were performed, using Environment Australia National Pollutant Inventory and US EPA approved emission factors. Suitable mitigation measures were employed which included onsite haul road watering, enclosing of crushers and water spraying of stockpiles.

A dispersion modelling exercise, using the CALPUFF modelling suite and a spatially varying 3-dimensional meteorological input file was performed to assess the transport of emitted pollutants (TSP, PM10 and PM2.5) from the Quarry and to predict the impact upon the twenty-two surrounding receptor locations.

Results of this dispersion modelling exercise indicate that at the receptors; pollutant concentrations and dust deposition levels are predicted to meet criteria levels.

This assessment indicates that the cumulative impact of the proposed quarry extension will comply with the relevant air quality criteria and may operate without significant impact upon the surrounding environment, subject to the continual implementation of the current management practice measures.

A greenhouse gas assessment has been performed for the proposed Project, with direct and indirect emissions of greenhouse gas calculated. It has been shown that the Project is predicted to represent an increase in Scope 1 emissions of 0.0012% per annum on total Australian greenhouse emissions.

It is considered that the proposed quarry extension is suitable in terms of air quality and greenhouse gas emissions.

RECORD OF DISTRIBUTION

No. of copies	Report File Name	Report Status	Date	Distributed to:	Initials
1 pdf	JME4061 Air Quality Impact Assessment	Draft	15 March 2016	Site R&D Portal	SM
1 pdf	JME4061 Air Quality Impact Assessment	Final	14 April 2016	Site R&D Portal	SM
1 pdf	JME4061 Air Quality Impact Assessment	Rev1	19 May 2016	Site R&D Portal	SM
1 pdf	JME4061 Air Quality Impact Assessment	Rev2	5 September 2016	Site R&D Portal	SM

Rev1-Update the proposed staffing numbers

Rev2- Address comments from the Department of Planning

CONTENTS

1 INTRODUCTION

1.1 Project Overview

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1.2 Objectives

The objectives were to:

- assess the current air quality;

- assess potential impacts on the air quality by the extension of the quarry; and
- provide mitigation measures to manage potential impacts on the air by the extension of the quarry
- develop an air dispersion model of the quarry;

1.3 Scope of Work

In order to achieve the above objectives, the following scope of work was undertaken:

- Review of the Secretary Environmental Assessment Requirements (SEARS);
- Summarise the relevant legislations and guidelines noted in the SEARS-attachment 1;
- Review current air quality monitoring results from the quarry;
- Review of the regional background air quality;
- Development of an air quality dispersion model; and
- Preparation of this Air Quality Impact Assessment.

2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Table 1 provides a summary of the Secretary's Environmental Assessment Requirements SEARs while Table 2 provides a summary of the Environmental Assessment Requirements (EARs) provided by other government agencies relating to surface water and groundwater. Tables 1 and 2 also indicate where the specific issues have been addressed within this assessment report.

Table 1: Secretary's Environmental Assessment Requirements

Agency	Requirements relevant to surface water and groundwater	Relevance/issues
Department of Planning and Environment	An assessment of the potential impacts of the development on: • construction and operational impacts, with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10} • dust generation from blasting and processing, as well as diesel emissions and dust generated from the transportation of quarry products; • reasonable and feasible mitigation measures to minimise dust and diesel emissions; and • monitoring and management measures, in particular, real-time air quality monitoring.	Section 10 Section 9.4

Table 2

Agency	**Requirements relevant to surface water and groundwater**	**Relevance/issues**
Dungog Shire Council	Dust from trucks - The issue of dust and other aggregate material being driven onto the roadway and/or falling from trucks after they have left the quarry needs to be addressed within the quarry. This may require the need to have a wash down facility, shaker ramps, etc. to ensure this material does not enter the road network	Wheel wash has been installed

Dungog Shire Council	More detail regarding air quality impacts must be contained in the EIS. However, to ensure that air quality impacts resulting from the development are minimised, the Applicant should be required to: • comply with relevant EPA air quality criteria at all privately owned residences; • implement all practical measures to minimise and/or prevent the emission of dust from the site; and • prepare and implement an air quality monitoring program for the development to demonstrate compliance with relevant EPA air quality criteria. There has also been some comment within the community regarding the impacts of road dust from the high volume of heavy vehicles hauling from the quarry in the village areas of Paterson and Bolwarra. The impact of road dust on human health and property aesthetics should be considered in the EIS. In the past, the operator has also taken measures to address off site dust suppression from heavy vehicles leaving the quarry by engaging a water cart to periodically apply water to Station Street and Grace Avenue. This had the effect of creating a sediment laden runoff to adjoining road drainage systems, potentially discharging to the Paterson River via receiving drainage channels. The continual wetting of the road also impacted on the structural integrity of the road seal and shoulders. Council considers that this initiative was carried out due to concerns over air borne particles discharged directly from heavy vehicles or from the roadway after falling from heavy vehicles leaving the quarry. Council would expect that the issue of dust particles from vehicle movements of this nature be addressed on site without the need for offsite treatment. The EIS should make reference to this component of air quality and consider mitigation and control measures.	Section 10 Practical measures are implemented and are demonstrated to be working by the current air quality monitoring program.
NSW EPA	The EPA's key information requirements for the proposal include an adequate assessment of: 6. Dust impacts associated with the proposal and impacts on nearby sensitive receivers	Section 10

3 LEGISLATION POLICIES AND GUIDELINES

Table 3 contains a review of legislation, polices, plans and guidelines that are potentially relevant to the project. Table 3 also includes either where in this report the relevant are addressed or

Legislation	**Objective/purpose**	**Relevance/issues**
The Protection of the Environment Operations Act 1997 (POEO Act)	The object of the POEO Act is to achieve the protection, restoration and enhancement of the quality of the NSW environment. The Act repealed and consolidated a number of existing Acts to rationalise, simplify and strengthen the regulatory framework for environmental protection in NSW. The activities listed in Schedule 1 to the POEO Act (broadly, activities with potentially significant environmental impacts) require an environmental protection licence (EPL). EPL are issued in respect of scheduled development work (i.e. development of a site that would require a licence), premises based activities and non-premises based activities. Licences can also be issued to regulate water pollution from activities that are not in Schedule 1. Such licences can provide protection against prosecution for water pollution if the licence conditions are complied with. The EPA will issue all licences and are usually subject to conditions. Licences can control the air, noise, water and waste impacts of an activity. Licences are ongoing but subject to review at least once every five years and can be varied, suspended or revoked.	Hard rock quarrying is noted in Schedule 1 of the POEO Act under "Extractive activities". The quarry is currently operating under. The existing quarry is currently operating under EPL licence No. 1378.
Guidelines	**Objective/purpose**	**Location where addressed within this Report**
Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)	This document, the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales ('Approved Methods'), lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in the state. It is referred to in Part 4: Emission of Air Impurities from Activities and Plant in the Protection of the Environment	Used throughout Section 4-10

	Operations (Clean Air) Regulation 2002 (the 'Regulation'). Industry has an obligation to ensure compliance with the requirements specified in the Regulation.	
Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)	This document lists the methods to be used for the sampling and analysis of air pollutants in New South Wales for statutory purposes. The document covers: • pollutant emissions from stationary sources • pollutant emissions from motor vehicles • components in and properties of petroleum products • pollutants in ambient air. This document is referred to in: • the Protection of the Environment Operations (Clean Air) Regulation 2002, Part 4 Emission of Air Impurities from Activities and Plant • the Protection of the Environment Operations (Clean Air) Regulation 2002, Part 5 Motor Vehicles and Motor Vehicle Fuels • the Protection of the Environment Operations (General) Regulation 1998.	Section 9
National Environment Protection (Ambient Air Quality) Measure	The desired environmental outcome of this Measure is ambient air quality that allows for the adequate protection of human health and well-being.	Noted
Coal Mine Particulate Matter Control Best Practice – Site Specific	This guideline provides detail of the process to follow when conducting a site-specific determination of best practice measures to reduce emissions of particulate matter from coal mining activities.	Section 9.3

Determination Guideline (EPA)	Although written specifically for coal mining this document provides guidance in identifying sources and controlling total, PM_{10} and $PM_{2.5}$ dust emissions.	
Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'	To ensure scientific rigueur and consistency in application, the OEH has requested that TRC's Atmospheric Studies Group provide where possible recommended settings for CALMET and CALPUFF in the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW. The OEH have in particular asked for generic guidance on determining the site specific model options and guidance for recommended settings for a range of conditions and model scenarios.	Air modelling using CALPUFF was conducted as per the recommendations of this guideline
National Greenhouse Accounts Factors (Commonwealth)	The National Greenhouse Accounts (NGA) Factors has been prepared by the Department of the Environment and is designed for use by companies and individuals to estimate greenhouse gas emissions.	Section 11

4 EXISTING ENVIRONMENT

The project site is located in the Paterson River Valley which is in a Temperate Climate area with warm to hot wet summers and low winter rainfall with no dry season. The village of Martins Creek, population 341 (2011 census data) adjoins the project site to the south. Fourteen residential properties in the town of Martins Creek are either neighbouring the southern boundary or align the main haulage road route, Station Street (see Figure 2).

The existing quarry operation currently extracts andesite material which is suited to a wide range of uses including production of aggregate and road base material.

The operations at the existing quarry have been assessed as part of this current study. Background air quality data collected near sensitive receptors close to the quarry have been examined. The data collected within the immediate area will contain the effects of operations at the existing quarry and therefore, with the addition of predicted concentrations from the proposed quarry forms the basis of a suitable cumulative air quality assessment.

A number of non-project related residential dwellings are situated in the area surrounding the Project Site. The nearest twenty-two dwellings have been identified as sensitive receptor locations to be taken into account during the air quality assessment.

Properties and residences that were used as assessment locations within the dispersion modelling study for the Project to assess compliance with air quality regulations surrounding the Project Site are shown in Figure 2. These residences were chosen as they were determined to be representative of the air quality environment at different locations surrounding the Project Site. Details relating to each of the assessed properties' locations in relation to the Project Site are provided in Table 4.

Table 4: Identified Sensitive Receptors

Receptor	Lot/DP	Easting	Northing	Receptor	Lot/DP	Easting	Northing
1	3/242210	370284	6397003	12	1/778808	370376	6396940
2	1/37561	370302	6397026	13	1/199194	370401	6396931
3	2/37561	370330	6397062	14	1/193914	370458	6396933
4	4/37561	370338	6397083	15	51/752445	371151	6396900
5	5/37561	370350	6397094	16	21/773220	370972	6397833
6	6/37561	370364	6397114	17	2/1171767	369773	6398078
7	7/37561	370380	6397129	18	8/249257	369571	6397820
8	8/37561	370390	6397148	19	9/249257	369637	6397631
9	9/37561	370404	6397163	20	2/111965	369853	6397380
10	41/815628	370413	6397201	21	1/111965	369819	6397259

Receptor	Lot/DP	Easting	Northing	Receptor	Lot/DP	Easting	Northing
11	1/742731	370352	6396954	22	2/242210	370081	6397086

Figure 2: Location of Sensitive Air Quality Receptors

4.1 Local Sources

The quarry is located in a rural area where activities such as cattle mustering, filling chicken feed silos or cleaning out chickens shed may have short term impacts from time to time in the local area. However these impacts are not considered substantial enough to cause a cumulative impact on the air quality. Vogels Road is a local unsealed road and a 500m long unsealed driveway may cause a cumulative impact on Receptor 15 depending how often these are used by vehicles.

4.2 Regional Sources

Concentrations of particulates can be elevated under certain conditions, such as bushfires or dust storms. Although these events are relatively unusual, they do occur and can result in elevated concentrations of particulates over several days in some instances. These events can be identified through the use of a regional network of air quality monitors.

5 AMBIENT AIR QUALITY CRITERIA

5.1 Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms "dust" and "particulates" are often used interchangeably. The term "particulate matter" refers to a category of airborne particles, typically less than 30 microns (μm) in diameter and ranging down to 0.1 μm and is termed total suspended particulate (TSP).

The annual goal for TSP is given as 90 μg/m^3, as recommended by the National Health and Medical Research Council (NHMRC) at their 92nd session in October 1981. It was developed before the more recent results of epidemiological studies suggested a relationship between health impacts and exposure to concentrations of finer particulate matter. Emissions of particulate matter less than 10 and 2.5 μm in diameter (referred to as PM_{10} and $PM_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The NSW PM_{10} assessment goals as expressed in the Approved Methods are:

- a 24-hour maximum of 50 μg/m^3; and
- an annual average of 30 μg/m^3.

The 24-hour PM10 reporting standard of 50 μg/m is numerically identical to the equivalent National Environment Protection Measure (NEPM) reporting standard except that the NEPM reporting standard allows for five exceedances per year. These NEPM goals were developed by the National Environmental Protection Council (NEPC) in 1998 to be achieved within 10 years of commencement (i.e. by 2008).

In December 2000, the NEPC initiated a review to determine whether a new ambient air quality criterion for $PM_{2.5}$ was required in Australia, and the feasibility of developing such a criterion. The review found that:

- there are health effects associated with these fine particles;
- the health effects observed overseas are supported by Australian studies; and
- fine particle standards have been set in Canada and the USA, and an interim criterion is proposed for New Zealand.

The review concluded that there is sufficient community concern regarding $PM_{2.5}$ to consider it an entity separate from PM_{10}.

As such, in July 2003 a variation to the Ambient Air Quality NEPM was made to extend its coverage to $PM_{2.5}$. This document references the following reporting goals for $PM_{2.5}$:

- a 24-hour average concentration of 25 μg/m^3; and
- an annual average concentration of 8 μg/m^3.

5.2 Nuisance Impacts of Fugitive Emissions

The preceding section is concerned with the health impacts of particulate matter. Nuisance (amenity) impacts also need to be considered, mainly in relation to deposition of dust. In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 grams per square metre per month (g/m^2/month) or when deposited dust levels increase by $2g/m^2$/month from month to month.

Due to proximity of residences in the villages of Paterson and Bolwarra to the main road to be used as a haulage route, the impact of dust from truck movements have been considered.

5.3 Project Air Quality Goals

The air quality goals adopted for this assessment, which conform to current EPA air quality criteria, are summarised in **Table 5**.

Table 5: Current EPA Air Quality Criteria

Pollutant	Averaging Time	Air Quality Goal[a]
PM_{10}	24 hours	$50\mu g/m^3$
	Annual	$30\mu g/m^3$
$PM_{2.5}$	24 hours	$25\mu g/m^3$
	Annual	$8\mu g/m^3$
Dust Deposition	Month	Maximum increment $2g/m^2$/month
	Annual	$4g/m^2$/month

(a) Air quality goals also

5.4 Voluntary Land Acquisition and Mitigation Policy

The '*Voluntary Land Acquisition and Mitigation Policy*', NSW Department of Planning and Environment (DPE 2014) have adopted the criteria in Table 5 to trigger voluntary mitigation and acquisition rights where the Project contributes to exceedances of the mitigation or acquisition criteria. The policy applies to any residence or workplace on privately owned land or more than 25% of any privately owned land, and a dwelling could be built on that land under existing planning controls.

5.5 NOx Emissions

Blasting activities have the potential to cause particulate matter and blast fume emissions. Blast fume emissions comprise of nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is regulated in NSW. NO_2 exposure can cause irritation of the lungs, lower resistance to respiratory infections and contribute to photochemical smog.

NSW EPA has adopted a 1-hour average (246µg/m^3) and an annual average (62µg/m^3) for NO_2 from the National Environment Protection Measure for Ambient Air Quality (Ambient Air NEPM).

6 EXISTING AIR QUALITY ENVIRONMENT

6.1 Martins Creek EPL 1378 Air Monitoring Stations

As part of EPL 1378, Buttai Gravel are required to monitor Ash and Particulates-Deposited Matter at four locations and PM_{10} at one location. An additional 2 dust deposition gauge locations are also monitored by Buttai Gravel. The location of these monitoring stations are shown in Figure 3.

Figure 3: Location of Dust Deposition Gauges (note Location DG1 contains both a dust deposition gauge and a High Volume Air Sampler).

Dust deposition monitoring has been performed at locations DG1, DG2 DG3 and DG4 since January 2013 and is ongoing. PM10 monitoring by High Volume Air Sampler (HVAS) has been performed at location DG1 since January 2013 and is ongoing. Dust deposition monitoring has been performed at locations DG5 and DG 6 from January 2015 and is ongoing.

Monitoring $PM_{2.5}$ is not required under the current EPL1378. Data is available from the EPA's Tapered Element Oscillating Microbalance (TEOM) monitoring locations at Beresfield and Singleton, between approximately 27 km to the south and 42 km to the west of the quarry. While it is recognised that the sources of $PM_{2.5}$ may differ between the quarry and the monitoring stations (which will be dominated by traffic/other urban related or coal mining particulates), it is considered that the $PM_{2.5}$ concentrations recorded at these locations would be a reasonably good representation of the rural location at the quarry. Additionally, even considering the greater distance between the Singleton monitoring station and the quarry when compared with Beresfield, the less urban nature of this monitoring location is considered to better represent the particulate environment at the quarry. Therefore, data from the Singleton station has been selected for assessment purposes.

PM10 monitoring data collected at the quarry was compared to data collected from the Singleton station for the time period January 2013-June 2015 and is summarised in Figure 4

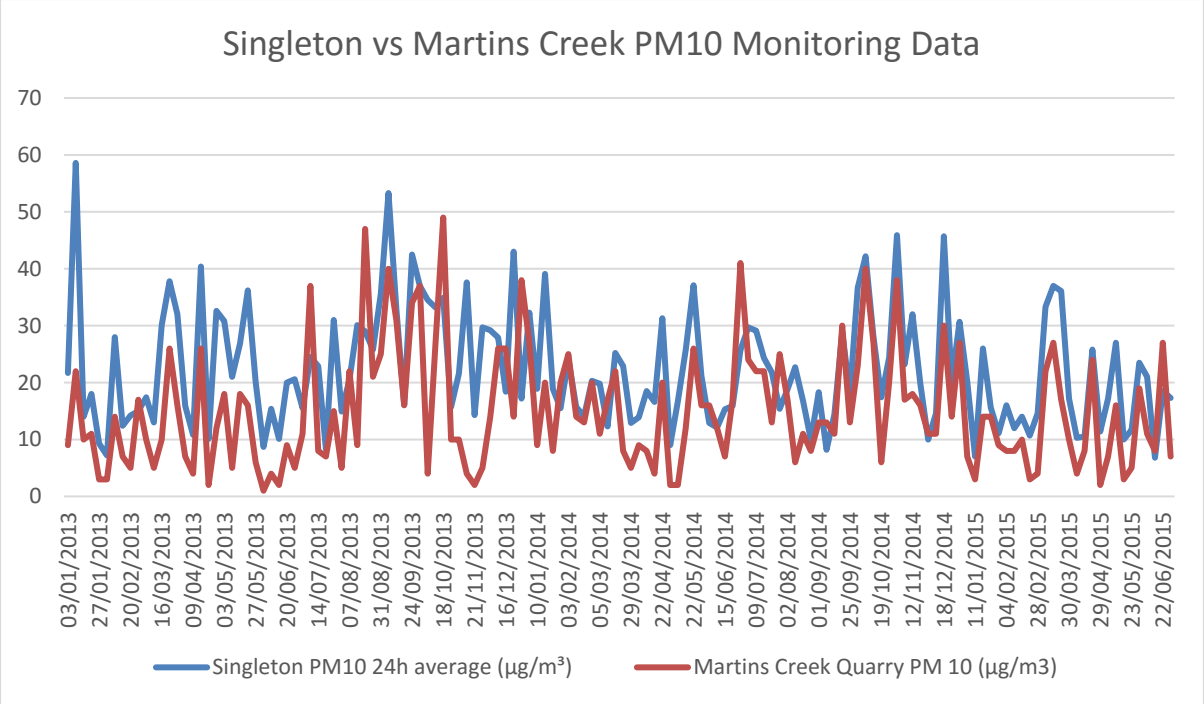


Figure 4: Singleton vs Martin Creek PM_{10} Monitoring Data

Table 5: PM_{10} Monitoring Statistics - Martins Creek and Singleton

Site				**Percentile**		**Max**	**Skewness**	**Kutrosis**
	Mean	Standard Deviation	75th	90th	99th			
	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³		
Martins Creek	15.09	10.25	22	27	44.36	49	0.998	0.702
Singleton	21.4	10.09	26.25	35	54.01	85	1.246	2.656

Skewness is a statistical function that reports how evenly a population is distributed around the mean of that population. A positive skew represents a population that "tails off" towards the upper extents, and a negative skew represents a distribution tailing off towards the lower extents. Skew is dimensionless. The reported skew values of +1.246 (Singleton) and +0.998 (Martins Creek) indicate that the recorded data is typically low, a small number of higher readings (i.e. representative of PM_{10} episodes, with much lower "standard" conditions).

Similarly, Kurtosis quantifies whether the shape of the data distribution matches the Gaussian distribution. A Gaussian distribution has a kurtosis of 0. A flatter distribution has a negative kurtosis and distribution more peaked than a Gaussian distribution has a positive kurtosis. The reported kurtosis values of 0.702 for Martins Creek's data indicate that the distribution of dust readings that approximates a Gaussian distribution.

These statistical functions support the assumption that the site typically experiences low 24-hour PM_{10} concentrations, with sporadic higher readings, which are typical of short-duration PM_{10} episodes.

Buttai Gravel have been monitoring deposited dust at locations DG1, DG2 DG3 and DG4 since January 2013 and locations DG5 and DG 6 from January 2015. A summary of the rolling 12 month averages of the monitoring results for Dust Deposition Gauges DG1-DG4 are presented in Figure 5.

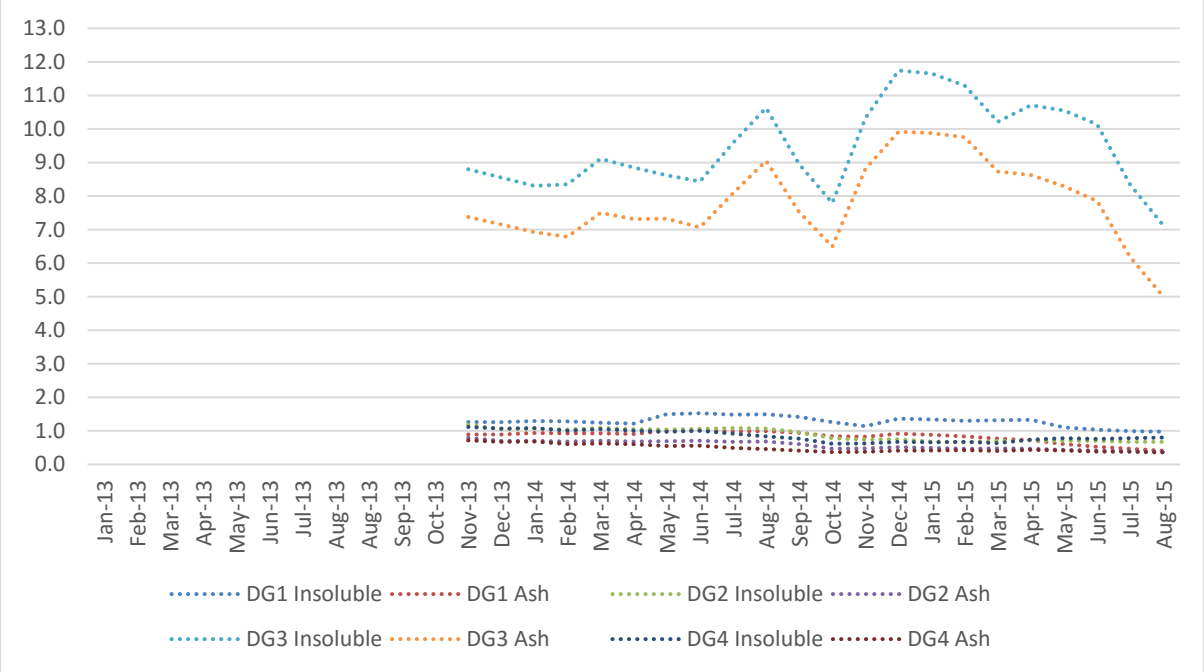


Figure 5: DG1-DG4- Dust Deposition Gauge Rolling 12 Month Rolling Average January 2013-August 2015 (mg/m²/month).

The rolling 12 monthly average for insoluble and ash dust for deposition gauges DG1, 2 and 4 are below the EPA air quality criterion of 4g/m²/month in Table 4. Whereas the rolling yearly average for deposition gauge DG3 is significantly above the EPA criterion and is noted that a significant portion of the deposited matter is made up of ash-able material indicating the source of the dust is more likely to be result of its proximity to cattle paddocks and yards as opposed to the quarrying of hard rock which would result in a higher proportion of non-ash-able deposited dust. Dust Deposition Gauge DG3 is not considered representative of the quarrying activities. Dust Deposition Gauge DG1 had a maximum rolling twelve month average of approximately 1.5g/m²/month in May 2014 which has been selected as the background dust deposition level to assess the cumulative impact of the proposed quarry extension.

6.2 Background Air Quality for the Air Quality Assessment

The background air quality concentrations/levels as presented in Table 6 have been adopted.

Table 6: Background Air Quality Concentrations/Levels

Air Quality Parameter	Concentration / Level	Data Source
$PM_{2.5}$	7.8 µg/m^3	EPA Singleton 2014
PM_{10}	21.0 µg/m^3	EPA Singleton 2014
Dust Deposition	1.5g/m^2/month	DG1 May 2014 (site specific)

7 METEOROLOGICAL DATA

The meteorological data used in dispersion modelling is of fundamental importance as it drives the transport and dispersion of the air pollutants in the atmosphere. The most critical parameters are wind direction, which determines the initial direction of transport of pollutants from their sources; wind speed, which dilutes the plume in the direction of transport and determines the travel time from source to receptor; and atmospheric turbulence, which indicates the dispersive ability of the atmosphere.

The meteorological data was sourced from the Tocal All Weather Station (AWS) (32.64°S, 151.59°N) which is located approximately 9.2 km SSE of the quarry and is approximately 30mAHD. The Tocal AWS commenced recording metrological data in 1967.

7.1 Wind Conditions

The wind strength and direction at Tocal AWS for 2014 is summarised in the wind rose shown in Figure 6.

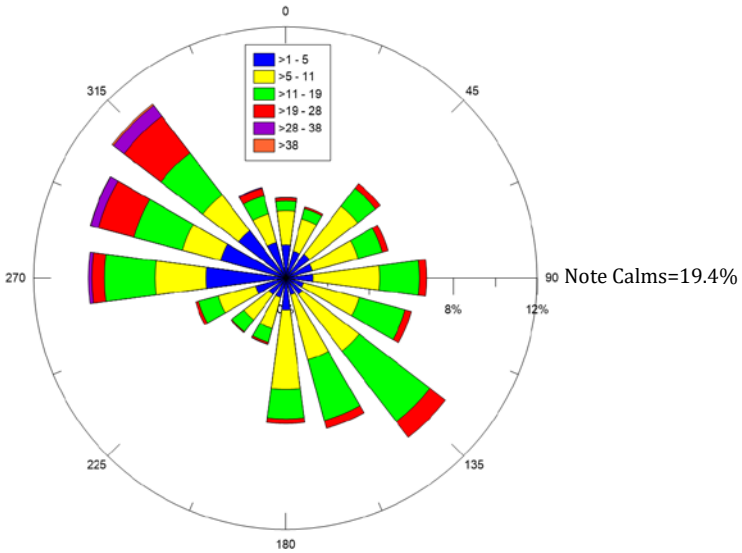


Figure 6: 2014 Wind Rose Generated using data from the Bureau of Meteorology.

Figure 6 indicates that winds experienced at Tocal AWS are dominated by light air (1-5km/h), light breezes (>5-11km/h) and gentle breezes (>11-19km/h) from the west-northwest sector and light breezes and gentle breezes from the south east sector. Calm wind conditions were reported to occur 19.4% of the time throughout 2014.

7.2 Temperature Conditions

From analysis of the recorded historic data at Tocal AWS (1967-2015), the daytime temperature of the may be described as cool to hot, with average air temperatures during the day varying between 17.4°C in winter and 29.8°C in summer. Average air temperatures during the night tend to be cold to mild, varying between 6.2°C in winter and 17.6°C in summer. The mean high (daytime) and mean low (night-time) temperatures form 1967-201f are summarised in Figure 7.

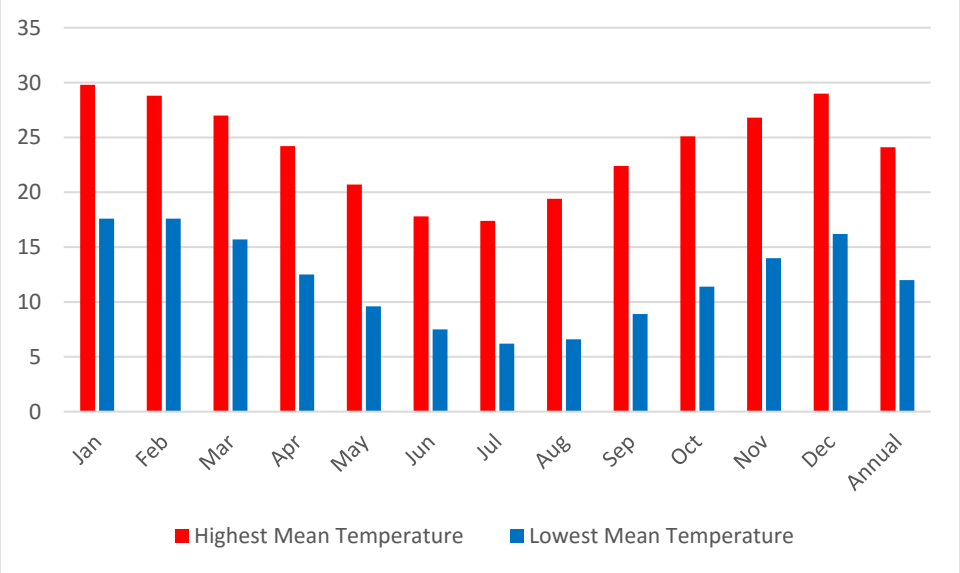


Figure 7: Historical Mean Low and Mean High Monthly Temperatures from Tocal AWS (1967-2015)

7.3 Rainfall

Precipitation is important to air pollution studies it reduces the potential for fugitive dust emissions and represents an effective removal mechanism of atmospheric pollutants. A graph displaying the recorded monthly mean rainfall measured at Tocal AWS between 1967 and 2015 is shown on Figure 8.

Rainfall experienced in the region surrounding the Project Site can be described as low to moderate, with the historic annual average rainfall recorded at Tocal totalling approximately 934.4 mm. Rainfall in the region surrounding the Project Site is typically lower during the winter and spring months with maxima generally experienced during the summer and autumn months.

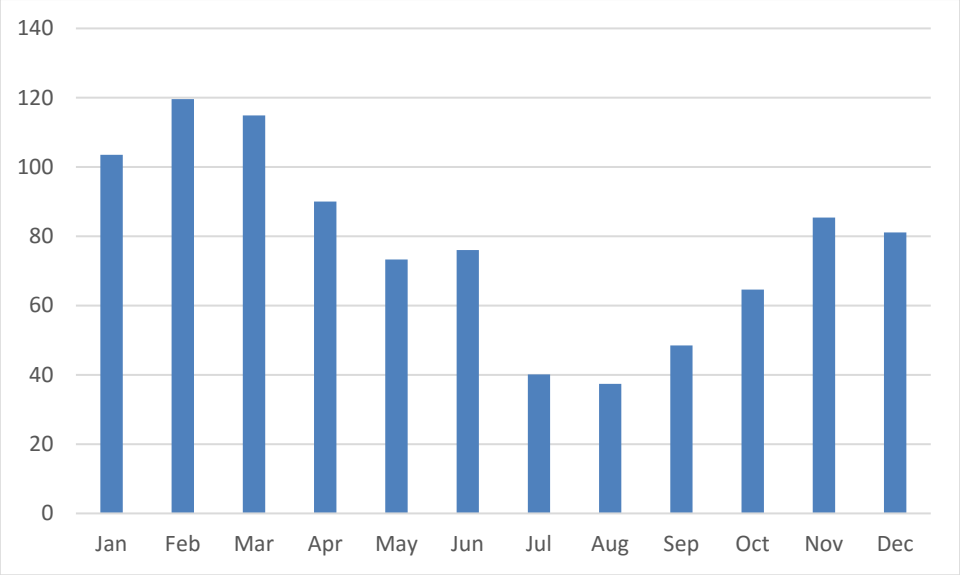


Figure 8: Historical Mean Monthly Rainfall from Tocal AWS (1967-2015)

8 METEROLOGICAL AND DISPERSION MODELLING

8.1 General Modelling Information

CALPUFF (Version 7.2.1) was used for the dispersion modelling in this assessment. The CALApps (Version 2.02 Beta) graphic user interface (GUI) was used to upload the required data into CALPUFF. The CALPUFF modelling system provides a non-steady state modelling approach which evaluates the effects of spatial changes in the meteorological and surface characteristics. CALPUFF modelling system comprises of three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard routinely available meteorological and geophysical databases.

The geophysical model i.e. land use and terrain was developed using digital photography downloaded from Exponent® website (http://www.src.com/calpuff/data).

The CALMET meteorological model consists of a diagnostic wind field module and micrometeorological modules for overwater and overland boundary layers. For this assessment CALMET was run in the "No-Observation Mode" (NOOBS) using gridded numerical (MM5) model output purchased from TRC Solution Pty Ltd (USA). The CALMET ready MM5 data location was a 100km x 100km box centred on 32.549930° S, 151.614893°W. The NOOBS approach using ready prepared three dimensional data files is recommended in the *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia* (March 2011) (Calpuff Guidance) for screening runs due to the benefits of using 3-D meteorological fields, ability to perform dispersion calculations within a non-steady-state framework.

8.2 METEROLOGICAL MODELLING

JME engaged PDS Consultancy Service Pty Ltd (PDS) to compile a 3D meteorological data file for the site. A copy of the PDS Report is attached in Appendix A

8.2.1 Terrain and Landuse Modelling

Global land cover data (Source : GLCC-Australia Pacific) with 900 m resolution was initially used and modified manually to match with real land-use over the area. Three compatible land use

categories were assigned (Built up, unirrigated agriculture and forest). Geophysical data file (GEO.Dat) was prepared based on above data sets (Topography and Land use) running TERREL for topography, CTGPROC for Land-use and MAKEGEO, pre-processors of CALPUFF modelling system.

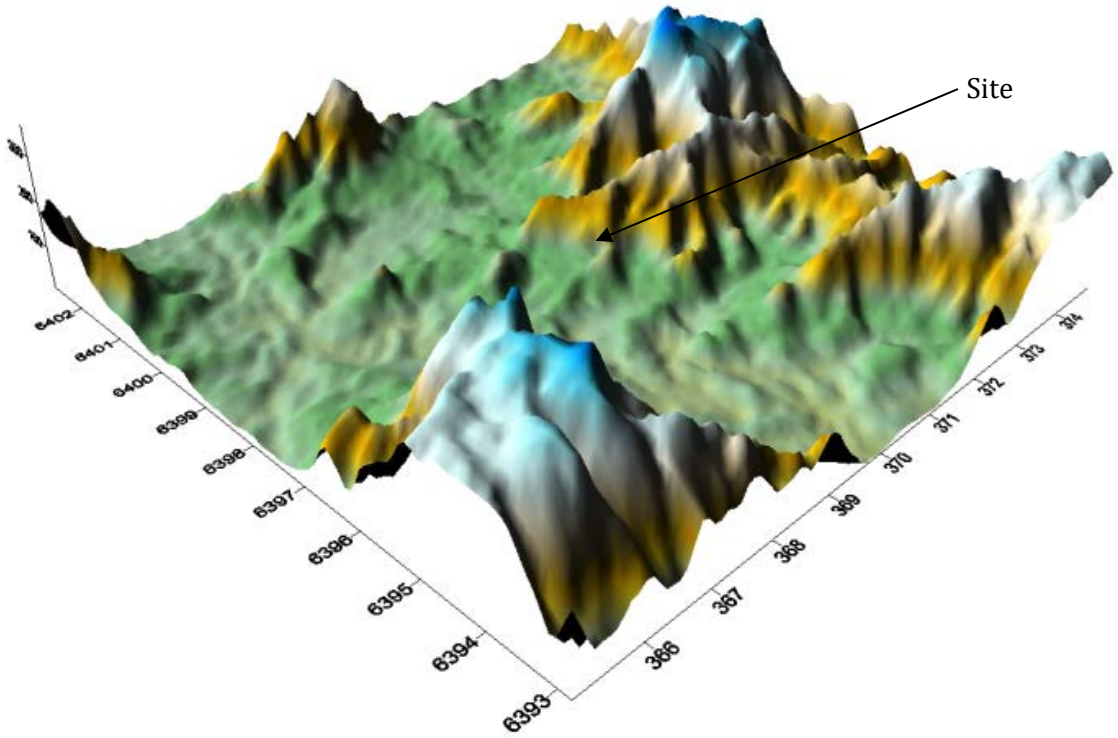


Plate 1: 3D Model of the terrain surrounding site. Note the vertical scale is exaggerated

8.2.2 **Meteorological Domain**

'No Observations" option available in CALMET (The meteorological module of CALPUFF modelling system) was used. CALMET was initialised with 3D data tile prepared running meteorological module of TAPM (CSIRO's The Air Pollution Model). Topography with 90m resolution and land use with ~1 km resolution were used to prepare 3km resolution 3D data tile. This helped resolve topography for some extent even with the met-tile used for initialisation.

Meteorological domain was designed with 10 km by 10 km map extent with 100 m grid resolution. Significant topographic features are also over the domain (to the east of the site). CALPUFF can assess near source impacts. Therefore, the resolution was sufficient to construct detailed 3D meteorology for the intended modelling work.

Eleven vertical faces were setup (0, 20, 40, 80, 160, 320, 640, 1200, 3000, 4000m).

A comparison of wind roses generated by PDS and wind roses generated from data obtained for the Tocal AWS show the modelled and actual data agrees favourably.

9 ATMOSPHERIC DIPERSION MODELLING

9.1 Modelling Scenarios

One modelling scenario was selected to represent the maximum material extraction rate and movement of material, maximum geographical extent of emission sources and maximum quantities of materials processing. A copy of the CALPUFF input file is attached in Appendix B.

9.2 Activity Rates and Material Composition

The parameters used to estimate the emissions rates from various sources are shown in Table 7.

Table 7: Air Quality Contributors

Parameter	Current	Proposed	Comment
Maximum hourly throughput	400t	400t	Using the same equipment for longer hours.
Maximum hourly throughput of overburden	100t	100t	
Moisture content – hard rock	1.5%	1.5%	
Silt content – hard rock	1.5%	1.5%	
Silt Content- - internal/external haul roads	14.1%	14.1%	Source: Emission Control Technologies and Emissions Factors for Unpaved Road Fugitive Emissions (USEPA 1987)
Pit to Processing Plant	1.1km	1.4km	
Western Pit Area	27 Ha	46 Ha	
Eastern Pit Area	0	13 Ha	
Production/Stockpile Area	11 Ha	11 Ha	Production area is not expected to change
Product Transport Trucks	6 on site at a time	12 on site at a time	Current truck movements are based on Table 2-7 of the Martins Creek Traffic and Access Assessment- 10/2/2016 Seca Solution Pty Ltd 2013/2014 traffic averaged over a 15 minute period.
Product Crushers/Screens	6	6	It is anticipated that the number of plant and equipment will remain the same or replaced with more efficient plant and equipment.
Internal Haul Trucks	2	2	It is anticipated that the number of plant and equipment will remain the same or replaced with more efficient plant and equipment.
Dozers/Loaders	6	6	It is anticipated that the number of plant and equipment will remain the

Parameter	Current	Proposed	Comment
			same or replaced with more efficient plant and equipment.
Blasting	1 location at a time	1 location at a time	The site uses typical quarry blast parameters with 89mm bore holes on a 2.8 metre x 3.2 metre burden and spacing usually limited to three rows. The typical Maximum Instantaneous Charge (MIC) is 80 to 100 kilograms initiation using non electric shock tubes.
Blast hole drilling	1 location at a time	1 location at a time	For the purposes of modelling it is assumed that drilling of blast holes is occurring within another section of the quarry.

9.3 Emission Controls

9.3.1 Dust Controls

Dust emission controls have been applied to the sources as identified in Table 24. Specifically, emissions controls have been applied as follows, as per Table 3 of the NPI Emission Estimation Technique for Mining, version 3.1 (DSEWPC 2012):

- Activities occurring in the pit – 50% reduction in TSP emissions, 5% reduction in PM10 and PM2.5 emissions:
    - Drilling;
    - Blasting;
    - Excavator on overburden and product; and,
    - Wind erosion on sources in pit.
- Unpaved haul roads – 50% reduction in PM10 and TSP emissions relating to watering
    - Pit to Overburden Emplacement;
    - Pit to Processing Plant; and
    - Processing Plant to Product Stockpile.
- Product stockpiles– 50% reduction in PM10 and TSP emissions relating to use of water sprays and 30% reduction in PM10 and TSP emissions relating to the use of wind breaks (Note: The noise barriers recommended in Acoustics Assessment NIA Martins Creek Quarry Expansion- 2016 Prepared by RCA Acoustics P/L are considered to be suitable wind breaks).

9.3.2 Blast Fumes

Measures to minimise or avoid imperfect blast will be implemented in accordance with the '*Code of Good Practice: Prevention and Management of Blast Generated NOx gases in Surface Blasting'*, Australian Explosives Industry and Safety Group Inc. 2011) along with the blast fume mitigation measures noted in '*Martins Creek Quarry Extension Project Blasting And Vibration For Inclusion In Eis Report – November 2015'* Peter Bellairs Consulting Pty Ltd.

9.3.3 Diesel Fumes

The NSW Protection of the Environment Operations (Clean Air) Regulation 2010 prescribes requirements for motor vehicle emissions, which will be the main source of diesel fumes for this project. Plant and equipment will be maintained and operated in proper and efficient condition.

Haul roads will be constructed to ensure the most direct routes are taken from the quarry face to production and stockpile areas. This will keep diesel fume to a minimum.

9.4 Emission Inventory

Based on the information presented above a particulate emissions inventory (after the emission controls have been applied) has been compiled for the modelling scenario which is summarised in Table 8 using the Emission Factor Equations from DSEWPC 2012.

Table 8 Emission Inventory

Source	Source Type	TSP Emission (g/s)	PM10 Emission (g/s)	PM2.5 Emission (g/s)
In Pit Loader (x2)	Volume	0.32	0.289	0.043
Overburden Dozer	Volume	23.9	8.193	1.229
Pit to Production Haul Truck (x2)	Volume	0.13	0.053	0.008
Product Transport Trucks (x12)	Volume	0.33	0.099	0.015
Screen and/or Crusher	Volume	0.38	0.015	0.002
Power Rock Drill	Volume	7.48	7.47	1.121
Western Pit	Area	84.4 g/m^2/s	42.2 g/m^2/s	6.3 g/m^2/s
Production	Area	6.3 g/m^2/s	3.2 g/m^2/s	0.5 g/m^2/s
Eastern Pit	Area	21.1 g/m^2/s	10.6 g/m^2/s	1.6 g/m^2/s

10 AIR QUALITY IMPACT ASSESSMENT

10.1 $PM_{2.5}$ 24-hour Average

Table 9 (Appendix C) summarises the results of the dispersion modelling for 24-hour average $PM_{2.5}$ concentrations from the quarry using the emission rates shown in Table 8 at the identified sensitive receptors. The average background concentration is 7.8µg/m^3 as discussed in Section 6.2.

The results presented in Table 9 indicate that cumulative 24-hour average $PM_{2.5}$ concentrations (background plus increment) associated with the quarry are predicted to be below the assessment criterion of 25 µg/m^3 at the receptors modelled.

A contour plot of the incremental 24-hour average $PM_{2.5}$ concentrations attributable to the quarry is presented in Appendix D.

10.2 $PM_{2.5}$ Annual Average

Table 10 (Appendix C) summarises the results of the dispersion modelling for annual average $PM_{2.5}$ concentrations from the quarry using the emission rates shown in Table 8 at the identified sensitive receptors. The average background concentration is 7.8µg/m³ as discussed in Section 6.2.

The results presented in Table 10 indicate that cumulative annual average $PM_{2.5}$ concentrations (background plus increment) associated with the quarry are predicted to be below the assessment criterion of 8 µg/m³ at the receptors modelled.

A contour plot of the incremental annual average $PM_{2.5}$ concentrations attributable to the quarry is presented in Appendix D.

10.3 PM_{10} 24-hour Average

Table 11 (Appendix C) summarises the results of the dispersion modelling for 24-hour average $PM_{2.5}$ concentrations from the quarry using the emission rates shown in Table 8 at the identified sensitive receptors. The average background concentration is 21µg/m³ as discussed in Section 6.2.

The results presented in Table 11 indicate that cumulative 24 hour average PM_{10} concentrations (background plus increment) associated with the quarry are predicted to be below the assessment criterion of 50 µg/m³ at the receptors modelled.

A contour plot of the incremental annual average PM_{10} concentrations attributable to the quarry is presented in Appendix D.

10.4 PM_{10} Annual Average

Table 12 (Appendix C) summarises the results of the dispersion modelling for annual average PM_{10} concentrations from the quarry using the emission rates shown in Table 8 at the identified sensitive receptors. The average background concentration is 21µg/m³ as discussed in Section 6.2.

The results presented in Table 12 indicate that cumulative annual average PM_{10} concentrations (background plus increment) associated with the quarry are predicted to be below the assessment criterion of 30 µg/m³ (annual average) at the receptors modelled.

A contour plot of the incremental annual average PM_{10} concentrations attributable to the quarry is presented in Appendix D.

10.5 TSP Annual Average

Table 13 (Appendix C) summarises the results of the dispersion modelling for annual average TSP concentrations from the quarry using the emission rates shown in Table 8 at the identified sensitive receptors. The average background concentration is 7.8µg/m³ as discussed in Section 6.2.

The results presented in Table 13 indicate that cumulative annual average TSP concentrations (background plus increment) associated with the quarry are predicted to be below the assessment criterion of 90 µg/m³ (annual average) at the receptors modelled.

A contour plot of the incremental annual average TSP concentrations attributable to the quarry is presented in Appendix D.

10.6 Dust Deposition

Table 14 summarises the results of the dispersion modelling for dust deposition from the quarry using the emission rates shown in Table 8 at the identified sensitive receptors. The average background concentration is 1.5g/m^2/month as discussed in Section 6.2.

The results show the average monthly dust deposition predicted at the nearest receptors surrounding the quarry over a one-year time frame. The results presented in Table 28 indicate that the cumulative mean monthly dust deposition (background plus increment) associated with the quarry are predicted to be less than 3.8 g/m^2/month which is below the assessment criterion, at all the nearest non-project related receptors.

A contour plot of the incremental increase in dust deposition is presented in Appendix D. The contour plot is indicative of the levels of dust deposition that could potentially be reached under the conditions modelled.

10.7 Impacts on Vacant Land

There are no privately owned vacant lands predicted to experience an exceedance of the DP&E mitigation or acquisition criteria.

10.8 NOx Emissions

10.8.1 Blasting

NOX emissions from blasting were calculated from a typical production blast of approximately 30,000 tonnes of rock. The initial NO_2 concentration was assumed to be 17ppm (34.9mg/m^3) Based on a Category three blast from the *'Management of oxides of nitrogen in open cut blasting'*, Queensland Guidance Note QGN 20v3, Department of Employment, Economic Development and Innovation 2011. *'NOx Emissions from Blasting in Open Cut Coal Mining in the Hunter Valley*', CDIROS Energy and Technology 2011 reported The NO:NO_2 within the blast exclusion zone to be approximately 27.5:1 and therefore the initial NOx:NO_2 was assumed by JME to be 18.9g NOx:1g NO_2. Based on a 30, 000 tonne production blast and a 10-minute emission release period, emission rate of 0.098gNOx/s was used in the dispersion model.

There were no exceedances of 1 hour average and annual average NO_2 concentrations at the sensitive receptors modelled. The highest modelled 1 hour average concentration was 17µg/m^3 and the highest modelled annual concentration was 0.26µg/m^3 which occurred within the quarry boundary.

10.8.2 Diesel NOx emissions

The primarily fuel source for the vehicle, plant and equipment operating at the Project Site is diesel. Information supplied by the proponent has indicated that 596,800L of diesel were used at the quarry in financial year ending 2014. Further to this it is anticipated that 1,500,000L of diesel per year would be used as a worst case scenario for the quarry extension.

Using the conversion factors from Table 4 of the National Greenhouse Accounts Factors (August 2015) the use of 1,500,00L of diesel in mobile plant would generate approximately 29 tonnes of equivalent CO_2 greenhouse effect of nitrous oxide. Nitrous Oxide has a GWP 265–298 times that of CO_2. Therefore, approximately 97 tonnes of N_2O would potentially be generated. Assuming all the N_2O is converted to NO_2 then approximately 203kg/year on NO_2 could be generated. This equates to an emission 0.015g/s across the mobile plant which is not considered significant.

11 GREENHOUSE GAS ASSESSMENT

11.1 Legislative Framework

11.1.1 The Greenhouse Gas Protocol

The Greenhouse Gas Protocol (GHG Protocol) is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions. A decade-long partnership between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), the GHG Protocol is working with businesses, governments, and environmental groups around the world to build a new generation of credible and effective programs for tackling climate change (http://www.ghgprotocol.org/about-ghgp).

The GHG Protocol comprises two separate but linked standards:

- *GHG Protocol Corporate Accounting and Reporting Standard* (provides a step-by-step guide for companies to use in quantifying and reporting their greenhouse gas emissions).
- *GHG Protocol Project Quantification Standard* (a guide for quantifying reductions from greenhouse gas mitigation projects).

There are three scopes of emissions that are established for greenhouse gas accounting and reporting purposes, defined as follows.

Scope 1 Emissions – Direct GHG Emissions

The GHG Protocol defines Scope 1 emissions as those which result from activities under the Proponent's control or from sources which they own. Scope 1 emissions are principally a result of the following activities.

- Generation of electricity, heat or steam. These emissions result from the combustion of fuels in stationary sources, e.g. boilers, furnaces or turbines.
- Physical or chemical processing. The majority of these emissions result from the manufacture or processing of chemicals and materials e.g. the manufacture of cement, aluminium, adipic acid and ammonia, or waste processing.
- Transportation of materials, products, waste, and employees. These emissions result from the combustion of fuels in company owned/controlled mobile combustion sources (eg trucks, trains, ships, airplanes, buses, and cars).
- Fugitive emissions. These emissions result from intentional or unintentional releases, eg equipment leaks from joints, seals, packing, and gaskets; carbon dioxide and methane emissions from coal mines and venting; hydrofluorocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

Scope 2 Emissions – Electricity indirect GHG Emissions

Scope 2 emissions are those which relate to the generation of purchased electricity consumed in owned or controlled equipment or operations. For many companies, purchased electricity represents one of the largest sources of GHG emissions and the most significant opportunity to reduce these emissions.

Scope 3 Emissions – Other indirect GHG Emissions

The GHG protocol states that Scope 3 reporting is optional and covers all other indirect GHG emissions. Scope 3 emissions are defined as those which do not result from the activities of a company although arise from sources not owned or controlled by the Proponent. Examples of Scope 3 emissions include the extraction and production of purchased materials, transportation of purchased fuels and the use of sold products and services.

The GHG protocol flags the issue that the reporting of Scope 3 emissions may result in the double counting of emissions. A second problem is that as their reporting is optional, comparisons between countries and / or projects may become difficult. The GHG protocol also states that compliance regimes are more likely to focus on the "point of release" of emissions (direct emissions) and / or indirect emissions from the use of electricity. However, for GHG risk management and voluntary reporting, double counting is less important.

11.1.2 National Greenhouse and Energy Reporting Act

The National Greenhouse and Energy Reporting Act (the NGER Act) was passed on 29 September 2007, establishing a mandatory reporting system for company greenhouse gas emissions and energy production and consumption.

The first reporting period under the Act commenced on 1 July 2008.

The NGER Act seeks to provide a national framework for the reporting of greenhouse gas emissions, abatement actions, energy consumption and production by corporations. The data generated under the Act will lay the foundation for Australia's Carbon Pollution Reduction Scheme and assist Australia to meet its relevant international reporting obligations.

From 1 July 2008, corporations are required to register and report for the 2008 – 2009 financial year where they exceed the reporting thresholds. There are two levels of thresholds at which corporations or enterprises are required to apply for registration and report, namely, facility thresholds and corporate thresholds, as follows:

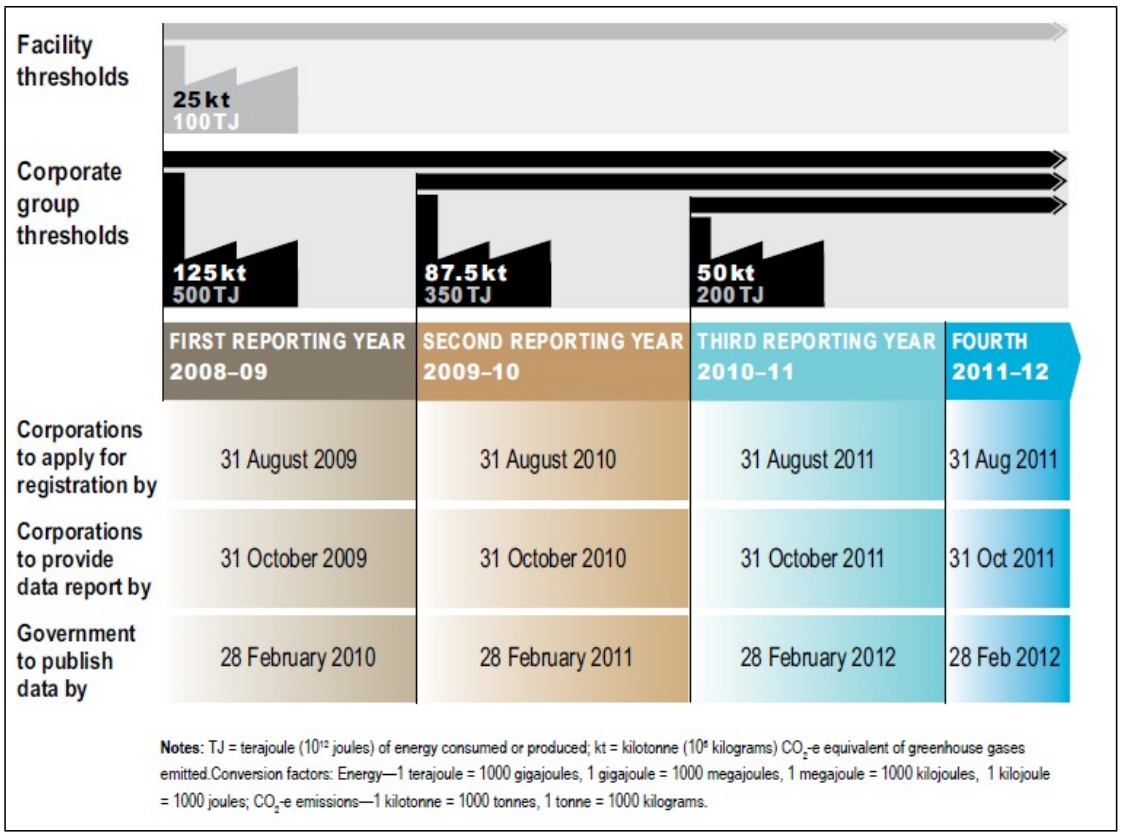
They control a facility that emits 25 kilotonnes (kt) or more of greenhouse gases (CO2 equivalent), or produces or consumes 100 Terajoules (TJ) or more of energy.

Their corporate group emits 125kt or more greenhouse gases (CO2 equivalent), or produces or consumes 500TJ or more of energy.

When a controlling corporation's group meets a facility or corporate threshold, the controlling corporation must apply for registration and report its greenhouse gas emissions and energy data to the Greenhouse and Energy Data Officer.

The corporate group threshold progressively reduced into the second and third reporting year, as outlined in Figure 9.

Figure 9 NGER Reporting Thresholds



Source: NGER Guidelines

The National Greenhouse and Energy Reporting Guidelines have been developed to help corporations understand their obligations. The NGER Guidelines are applicable across industry sectors and cover important concepts under the Act and Regulations, including scheme participation, determining corporate, facility and operational control, registration and reporting obligations. The National Greenhouse and Energy Reporting (Measurement) 2008 provides methods and criteria for calculating greenhouse gas emissions and energy data under the act.

The range of emission sources covered in the Determination include:

- The combustion of fuels for energy
- Fugitive emissions from the extraction of coal
- Oil and gas
- Industrial processes (such as producing cement and steel)
- Waste management

Reporting under the NGER Act is required for Scope 1 emissions and Scope 2 emissions, while reporting of Scope 3 emissions is voluntary. The methods are based on those used for the National Greenhouse Accounts (refer **Section 11.1.3**).

11.1.3 National Greenhouse Accounts (NGA) Factors

The Federal Department of Climate Change (DCC) has prepared the National Greenhouse Accounts (NGA) Factors (August 2015). The NGA Factors are used to estimate greenhouse gas emissions for reporting under various government programs, including the NGERS. The

methods described for calculating emissions listed in the NGA Factors are "Method 1" from the National Greenhouse and Energy Reporting (Measurement) Determination 2008 and the National Greenhouse and Energy Reporting (Measurement) Technical Guidelines 2008 v1.1, which have been designed to support reporting under the NGER Act 2007.

The methods described for deriving emissions in the NGA factors are consistent with international guidelines (such as the GHG Protocol).

11.2 Greenhouse Gas Calculations

For comparative purposes, non-CO2 greenhouse gases are awarded a "CO2-equivalence" based on their contribution to the enhancement of the greenhouse effect. The CO2-equivalence of a gas is calculated using an index called the Global Warming Potential (GWP). The GWPs for a variety of non- CO2 greenhouse gases are contained within the Intergovernmental Panel on Climate Change (IPCC) document Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

The GHG Emissions associated with the proposed Project have been assessed in terms of direct (Scope 1) emission potential, indirect (Scope 2) emission potential and significant upstream/downstream (Scope 3) emission potential.

A summary of the potential project-related GHG emission sources is provided in Table 15.

Table 15 Summary of Potential Project Greenhouse Gas Emissions

Project Component	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
Diesel	Emissions from the combustion of diesel by plant, equipment and transport at the Project Site		Estimated emissions attributable to the extraction, production and transport of diesel consumed at the Project Site
Explosives	Emissions from the explosives used as part of the project.		
Electricity		Emissions from the generation of purchased electricity at the Project Site.	Estimated emissions from the extraction, production and transport of fuel burned for the generation of electricity consumed at the Project Site and the electricity lost in delivery in the transmission and distribution network.
Employee Travel			Emissions from the combustion of petrol consumed by staff travelling to and from the Project Site.
Solid Waste			Emissions from the solid waste sent to landfill

11.2.1 Project Energy Consumption

Scope 1: Direct Emissions

Diesel Usage

Scope 1 GHG emissions attributable to diesel relate to the use of plant and equipment on site.

The primarily fuel source for the vehicle, plant and equipment operating at the Project Site is diesel. Information supplied by the proponent has indicated that 596,800L of diesel were used at the quarry in financial year ending 2014. Further to this it is anticipated that 1,500,000L of diesel per year would be used as a worst case scenario for the quarry extension.

Annual Scope 1 emissions of CO_2 and other GHG from the combustion of 1,500,000L of diesel have been estimated using emission factors contained in Table 4 of the NGA Factors. The calculated Scope 1 diesel combustion related emissions for operations at the Project Site are:

- CO_2 - 4000 t CO_2-e/year;
- CH_4 – 12t CO_2-e/year; and
- N_20 – 29t CO_2-e/year

Explosives

The use of explosives in quarrying leads to the release of greenhouse gases. The activity level is the mass of explosives (in tonnes).

The current edition of NGA Factors (DCC, 2010) does not include emission factors for CO_2-e resulting from the use of ANFO or emulsion explosives. However, an emission factor of 0.17 t CO2-e per tonne of explosive (t CO_2- e/t explosive) has been sourced from the February 2008 edition of the NGA Factors for use in this assessment.

Information supplied by the proponent has indicated that 14.4 t (300kg times 48 blasts) of explosives will be used each year for the Project. Therefore 2.448t of CO_2-e/year will be generated from blasting.

Scope 2: Indirect Emissions

Scope 2 GHG emissions associated with the Project relate to the consumption of purchased electricity. The NGA Factors provides Scope 2 emission factors for the consumption of purchased electricity by each state of Australia.

State emission factors are used because electricity flows between states are significantly constrained by the capacity of the inter-state interconnectors and in some cases there are no interconnections. The emission factor for Scope 2 (0.90 kg CO_2-e/kWh as per Table 5 of the NGA Factors) covers emissions from fuel combustion at power stations associated with the consumption of purchased electricity in New South Wales.

Information supplied by the proponent has indicated that the electricity consumption to power plant and equipment is 1,787,082.04 kWh per annum. Hence Annual Scope 2 emissions of CO2-equivalent (CO2-e) from the consumption of purchased electricity for operations at the quarry in 2014 was 1,608t CO_2-e/year.

Scope 3: Other Indirect Emissions

Employee Travel and Product Distribution

GHG emissions associated with the travel of employees to and from the Project Site need to be calculated and accounted for under Scope 3 emissions. Information supplied by the proponent has indicated that the number of employee vehicle movements per day is 26 in and 26 out, resulting in 18,980 vehicle movements per year in total. It is assumed that the employees live

locally and travel approximately 10 km from the Project Site and the fuel efficiency is approximately 10L/100km. Therefore, staff travelling to and from work are estimated to use 18.98kL petrol/year. It is predicted that the staff levels may raise to 36 resulting in an additional 10 movements into and 10 movements out of the quarry per day or 7,300 additional vehicle movements per year. This equates to an additional 7.3kL petrol/year.

Currently, the majority of quarry product deliveries are made to the Newcastle area which is approximately 56km from the quarry. 46,153 laden truck movements and 46,153 empty truck movements (SECA2016) are required to move 1,500,000tpa which equates to approximately 5,200,000 truck km/year. The Australia Bureau of Statistics estimated the average fuel efficiency for articulated trucks to be 56.9L/100km in 2014. Therefore, it is estimated that 2,900kL of diesel will be used to distribute the quarry product to market.

The annual emissions of CO2 and other GHG from this source have been estimated using Table 4 of the NGA Factors. It has been assumed that an energy content of 34.2 GJ/kL for petrol is applicable for employee travel and 38.6GL/kL for diesel used in product distribution. The Scope 3 emission factor for liquid fuel consumption (5.3 kg CO_2-e/GJ, as per Table 39 of the NGA Factors) has been applied to calculate total GHG emissions. Staff travel to and from the quarry will produce approximately 3.4t CO_2-e/year and product distribution by truck will produce approximately 600t CO_2-e/year.

Extraction, Production and Transport of Fuel Burned for the Generation of Electricity and Electricity Consumed in the Transmission and Distribution System

The NGA Factors provides Scope 3 emission factors for the consumption of purchased electricity by each state. State emission factors are used because electricity flows between states are significantly constrained by the capacity of the inter-state interconnectors and in some cases there are no interconnections.

The NSW Scope 3 emission factor (0.17 kg CO2-e/kWh) covers both the emissions from the extraction, production and transport of fuels used in the production of the purchased electricity (i.e. fugitive emissions and stationary and mobile fuel combustion emissions) and also the emissions associated with the electricity lost in transmission and distribution on route to the customer.

Annual Scope 3 emissions of CO2-equivalent from the consumption of purchased electricity for operations at the Project Site was estimated to be 304t CO_2-e/year.

Extraction, Production and Transport of Diesel Consumed at the Project

Scope 3 GHG emissions attributable to diesel used onsite at the Project Site relate to its extraction, production and transport. These emissions are associated with the diesel consumed by plant and equipment.

The annual emissions of CO2 and other GHG from this source have been estimated using Table 4 of the NGA Factors. It has been assumed that an energy content of 38.6 GJ/kL for diesel is applicable. The Scope 3 emission factor for liquid fuel consumption (5.3 kg CO2-e/GJ, as per Table 38 of the NGA Factors) has been applied to calculate total GHG emissions.

The calculated Scope 3 diesel combustion related emissions were estimated to be 307t CO_2-e/year.

Solid Waste to Landfill

Scope 3 GHG emissions attributable to waste produced at the Project Site relate to its extraction, production and transport. These emissions are associated with the diesel consumed by plant and equipment.

Information supplied by the proponent has indicated that 144 m^3 per annum of solid waste is sent to landfill. It is assumed that the solid waste from the quarry is inert (eg rocks and concrete) and will thus produce 0 t of CO_2-e emissions per year

11.3 Greenhouse Gas Emissions Summary

Calculated Scope 1, Scope 2 and Scope 3 emissions of GHG resulting from the emissions sources outlined above are:

- Scope 1 - ~4043 t CO_2-e/year
- Scope 2 - ~1608 t CO_2-e/year; and
- Scope 3 - ~ 1,214 t CO_2-e/year

A comparison of the annual Scope 1 GHG emissions from the Project against published net total GHG emissions for NSW and Australia during 2008 has also been conducted. Net emissions of 164.7 Mt CO2-e and 581.9 Mt CO2-e were reported for 2008 for NSW and Australia respectively by the DCC (2010b). Scope 1 emissions from the Project would represent approximately 0.004% of total NSW 2008 emissions and approximately 0.0012 % of total Australian 2008 emissions.

It is clear from the values presented in the preceding sections that the principal source of GHG emissions at the Project is the onsite combustion of diesel fuel by plant and equipment although the totals are relatively small when compared to NSW and Australian emissions totals.

11.4 Greenhouse Gas Minimisation Recommendations

The following list details some methods that could assist in the reduction of GHG emissions from operations at the Project Site.

Relating to Diesel Consumption:

- Minimise the use of haul trucks by overland conveyors where possible. Trade-off is increased electricity consumption;
- Optimisation of incline/decline of haul routes to reduce transport distances from extraction area;
- Reduce vehicle idling time;
- Maintain optimum tyre pressure; and
- Consider the use of alternative fuels, such as biodiesel, for mobile plant.

Regarding Electricity Consumption:

- Consider the use of renewable energy technologies, such as wind, solar or biomass for externally-sourced electricity;
- Installation of most efficient crusher and other processing plant technology available should be a priority;
- Close regulation of the daily operation of lighting; and

- Implement solar-powered lighting about site where possible.

12 CONCLUSIONS

This AQIA has been prepared in accordance with the NSW Environmental Protection Authority's (EPA, formerly Office of Environment and Heritage [OEH]) Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005).

Appropriate background concentrations for the air quality pollutants of concern were obtained from the EPA operated Singleton monitoring station. Comparison was made to the site specific data (which includes contributions from the existing quarry operations) and it was demonstrated that the use of Singleton data represented a suitable and conservative estimation of background air quality.

Estimations of cumulative emissions from proposed quarry activities were performed, using Environment Australia National Pollutant Inventory and US EPA approved emission factors. Suitable mitigation measures were employed which included onsite haul road watering, enclosing of crushers and water spraying of stockpiles.

A dispersion modelling exercise, using the CALPUFF modelling suite and a spatially varying 3-dimensional meteorological input file was performed to assess the transport of emitted pollutants (TSP, PM10 and PM2.5) from the Quarry and to predict the impact upon the twenty-two surrounding receptor locations.

Results of this dispersion modelling exercise indicate that at the receptors; pollutant concentrations and dust deposition levels are predicted to meet criteria levels.

This assessment indicates that the cumulative impact of the proposed quarry extension will comply with the relevant air quality criteria and may operate without significant impact upon the surrounding environment, subject to the continual implementation of the current management practice measures.

A greenhouse gas assessment has been performed for the proposed Project, with direct and indirect emissions of greenhouse gas calculated. It has been shown that the Project is predicted to represent an increase in Scope 1 emissions of 0.0012% per annum on total Australian greenhouse emissions.

It is considered that the proposed quarry extension is suitable in terms of air quality and greenhouse gas emissions.

Figures

Notes: 1) Google Earth 2) Subject Site	N	Client **Buttai Gravel**	PROJECT:	JME4061	DESIGNED:	JMc	FIGURE TITLE: **Project Location Plan**
			DWG #:	1	DRAWN:	JMc	
			REVISION:	1	STATUS:	NFC	
		PROJECT TITLE: **Martins Creek Quarry Extension**	SCALE:	NTS			
			DATE:	14/04/2016			FIGURE NUMBER: **1**

ENVIRONMENTS

Appendix A

PDS Consultancy CALMET Report

Three Dimensional (3D) Meteorological data file for CALPUFF

Martins Creek-2012

This file was exclusively compiled for **J M Environmental** Pty Ltd By pDs Consultancy Service.

pDs Consultancy
@1999-2016

Introduction

Non steady state PUFF model such as CALPUFF (Californian PUFF model) require meteorological data, preferably hourly average for the entire modelling domain which is in question. Meteorological domain should usually bigger than the computational domain which is intended to use for dispersion modelling. There are several recommended options available to construct 3D meteorological data files. Selection of the suitable option is depending on the data availability.

pDs Consultancy has been engaged by **J M Environmental Pty Ltd** to compile an 3D meteorological data file for a remote site at **Martins Creek** in New South Wales using the year 2012.

CONSTRUCTION OF GEOPHYSICAL DATA FILE :

Topography and land used over the area were examined and topography data with 90m resolution was used (Source :SRTM3-Global data). Map showing topography in 3D was prepared and preliminary QA/QC was done comparing it with Google maps.

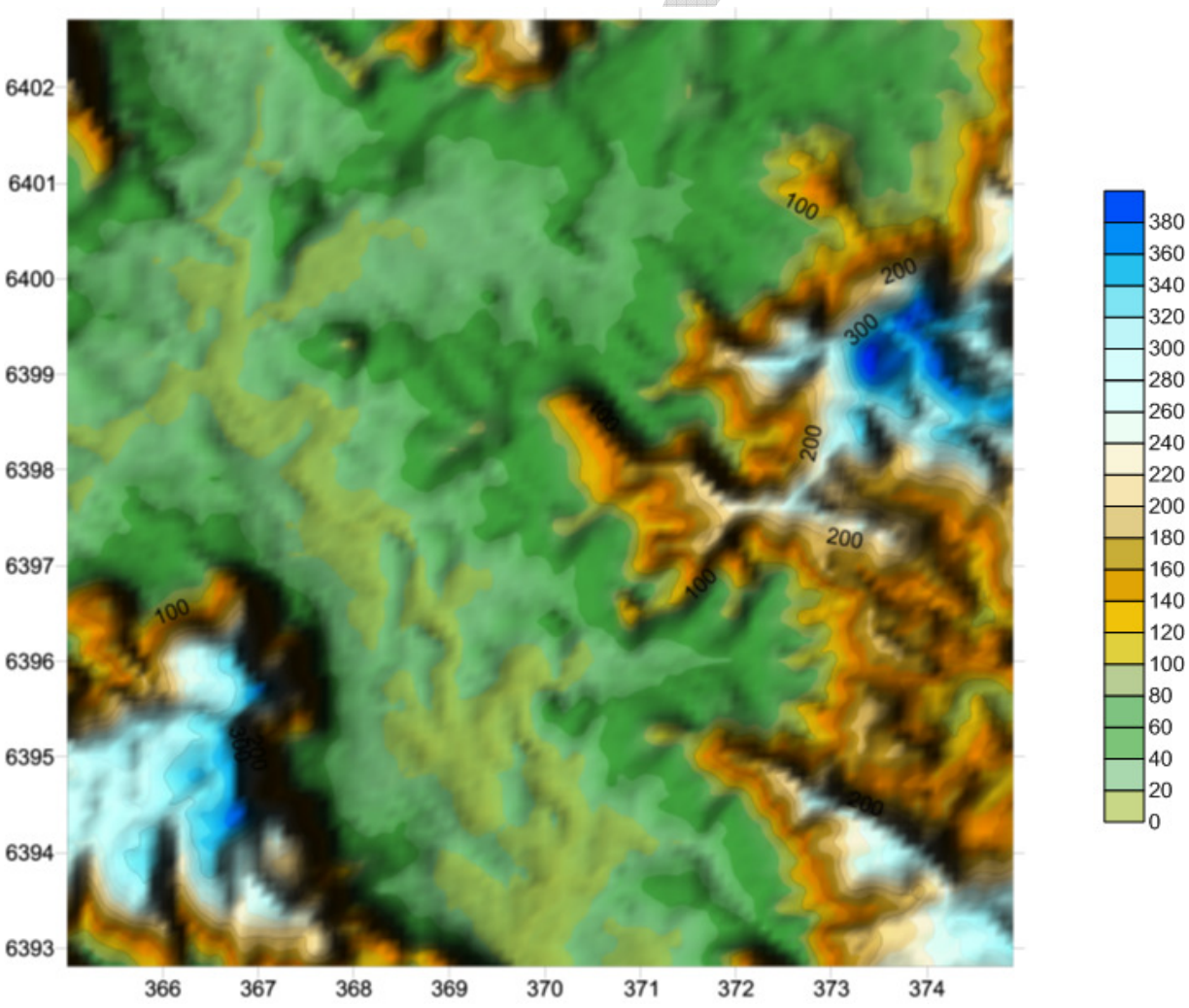
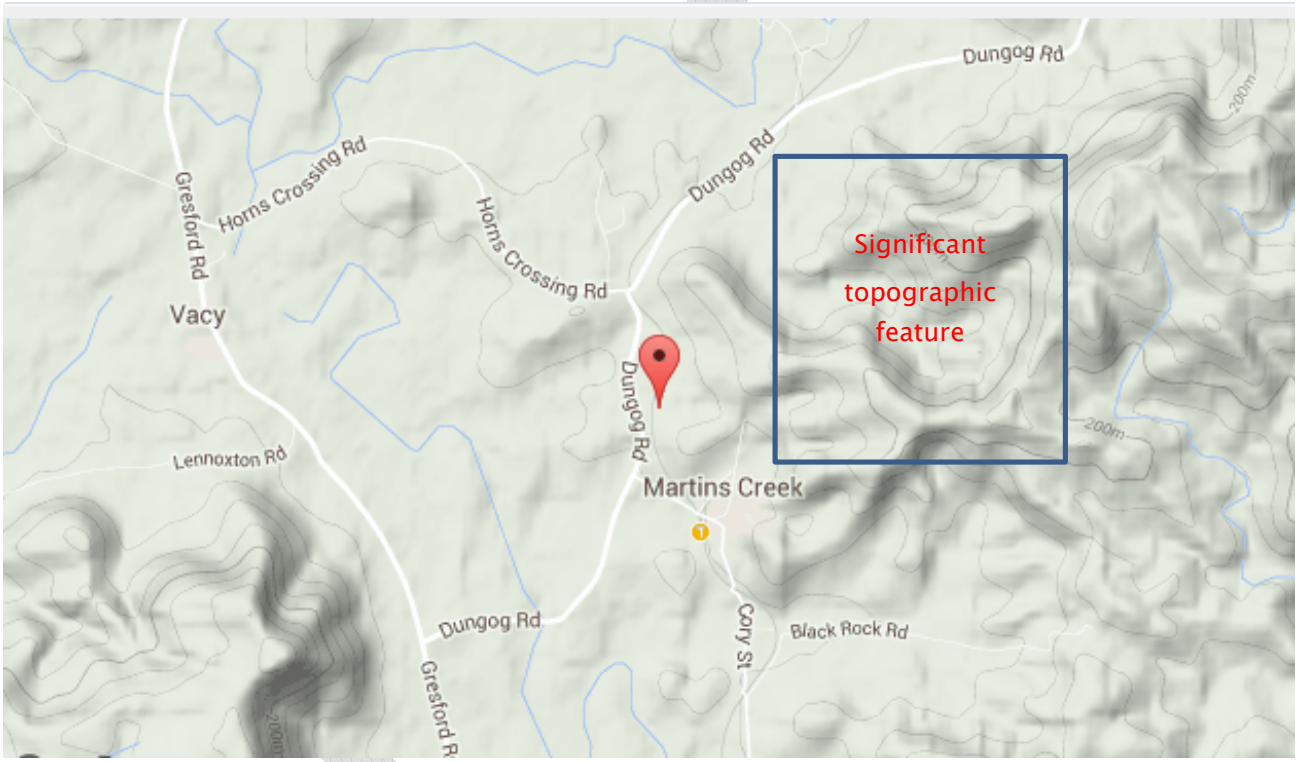
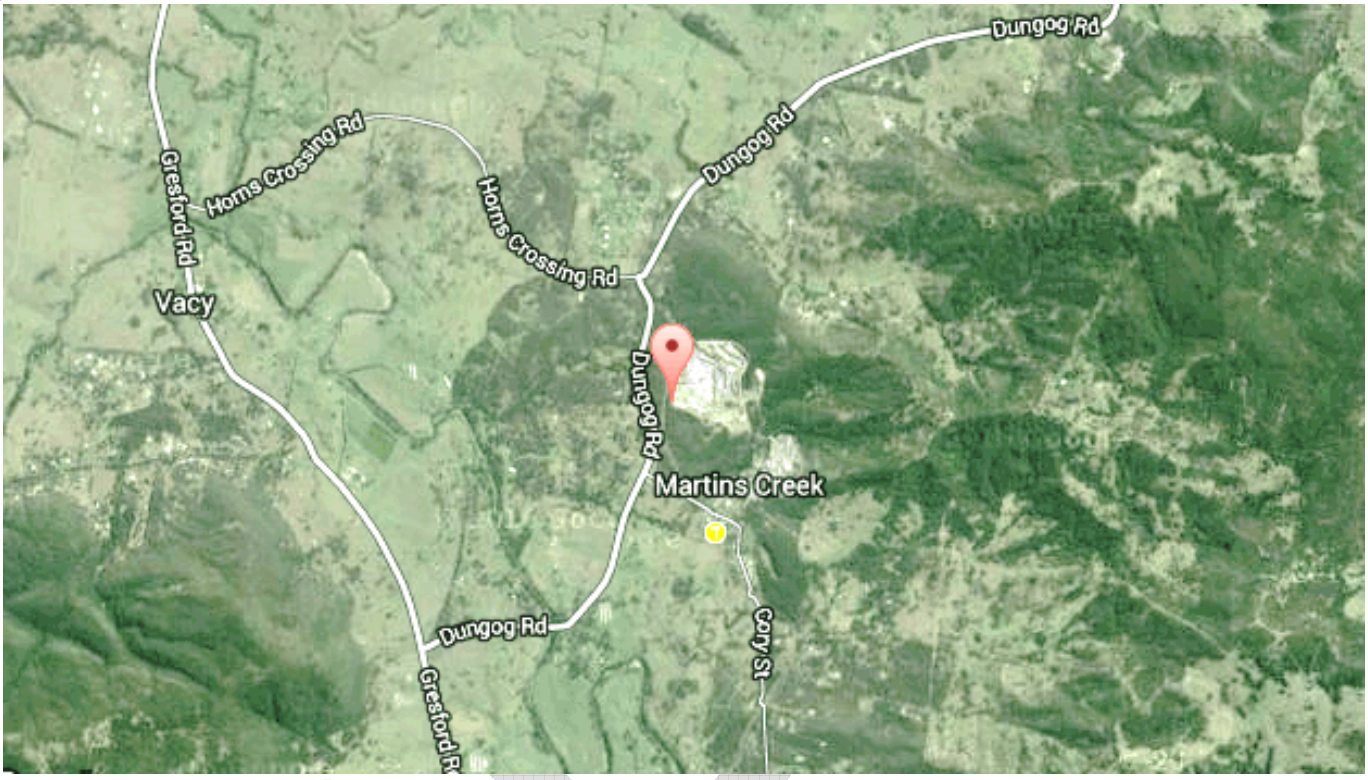


FIGURE 1: TOPOGRAPHY OVER THE METEOROLOGICAL DOMAIN

Global land cover data (Source :GLCC-Australia Pacific) with 900 m resolution was initially used and modified manually to match with real land-use over the area. Three compatible land use categories were assigned (Built up, unirrigated agriculture and).

FIGURE 2: LAND USE OVER THE METEOROLOGICAL DOMAIN





Shrub Land and Mid-dense forest found to be the significant land use over the domain.

Geophysical data file (GEO.Dat) was prepared based on above data sets (Topography and Land use) running TERREL for topography, CTGPROC for Land-use and MAKEGEO, pre-processors of CALPUFF modelling system.

Land Use Categories

The default CALMET land use scheme is based on the U.S. Geological Survey (USGS) land use classification system. The USGS primary land use categories are shown below. Two Level I USGS categories (water and wetlands) are subdivided into subcategories. The default land use classification scheme contains 14 land use types. Note that a negative value of land use is used as a flag to indicate irrigated land. If the land is irrigated, it is assumed that the vegetation is not moisture stressed.

Default Land Use Type	Description	Surface Roughness (m)	Albedo	Bowen Ratio	Soil Heat Flux Parameter	Anthro. Heat Flux	Leaf Area Index
10	Urban or Built-up Land	1.0	0.18	1.5	.25	0.0	0.2
20	Agricultural Land - Unirrigated	0.25	0.15	1.0	.15	0.0	3.0
-20	Agricultural Land - Irrigated	0.25	0.15	0.5	.15	0.0	3.0
30	Rangeland	0.05	0.25	1.0	.15	0.0	0.5
40	Forest Land	1.0	0.10	1.0	.15	0.0	7.0
50	Water	0.001	0.10	0.0	1.0	0.0	0.0
51	Small Water Body	0.001	0.10	0.0	1.0	0.0	0.0
55	Large Water Body	0.001	0.10	0.0	1.0	0.0	0.0
60	Wetland	1.0	0.10	0.5	.25	0.0	2.0
61	Forested Wetland	1.0	0.1	0.5	0.25	0.0	2.0
62	Nonforested Wetland	0.2	0.1	0.1	0.25	0.0	1.0
70	Barren Land	0.05	0.30	1.0	.15	0.0	0.05
80	Tundra	0.20	0.30	0.5	.15	0.0	0.0
90	Perennial Snow or Ice	0.20	0.70	0.5	.15	0.0	0.0

INPUT METEOROLOGY

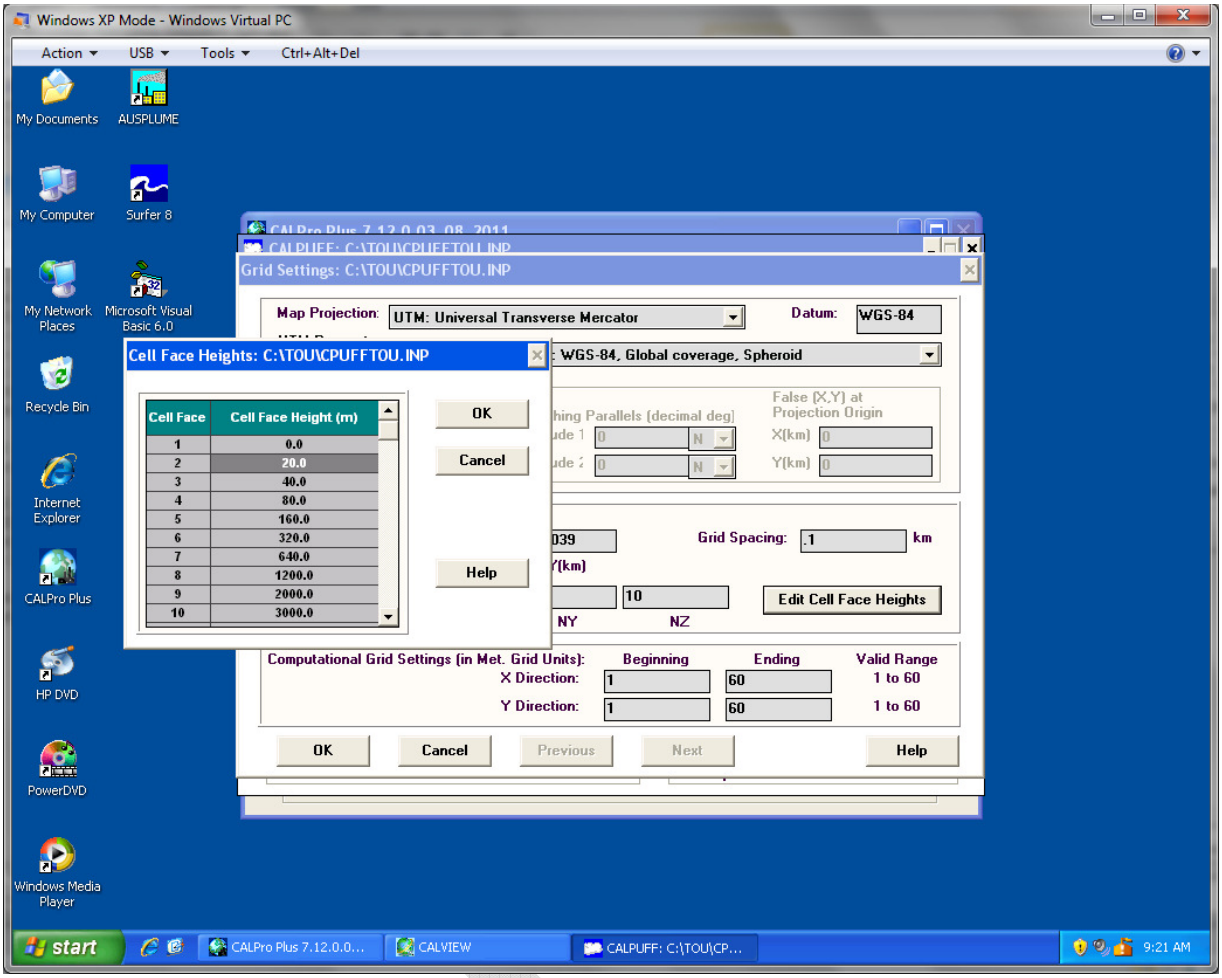
There were no meteorological data sources within 50 KM radius of the intended modelling domain. Therefore 'No Observations" option available in CALMET- The meteorological module of CALPUFF modelling system was used. CALMET was initialised with 3D data tile prepared running meteorological module of TAPM (CISIRO's **T**he **A**ir **P**ollution **M**odel). Topography with 90m resolution and land use with ~1 Km resolution were used to prepare 3KM resolution 3D data tile. This will help resolve topography for some extent even with the met-tile used for initialisation.

METEOROLOGICAL DOMAIN:

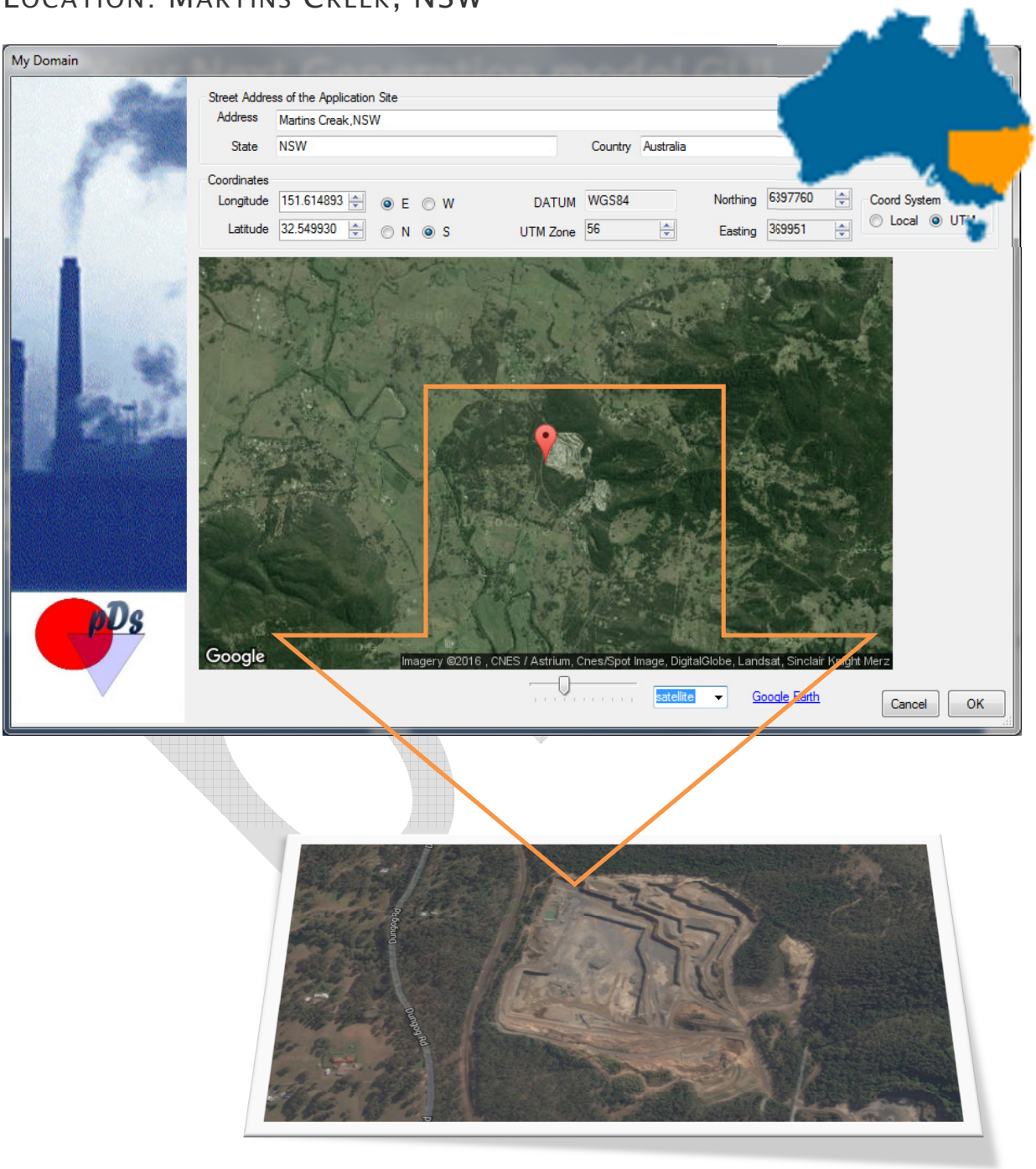
Meteorological domain was designed with 10 KM by 10 KM map extent with 100 m grid resolution. Significant topographic features are also over the domain (See Figures 1 and 2). CALPUFF is intended to run to determine near source impacts. This resolution is good enough to construct detailed 3D meteorology for the intended modelling work.

VERTICAL STRUCTURE

Eleven cell faeces were set up with 0,20,40,80,160,320……,4000m. Predictions were done at 10,30,60 etc..

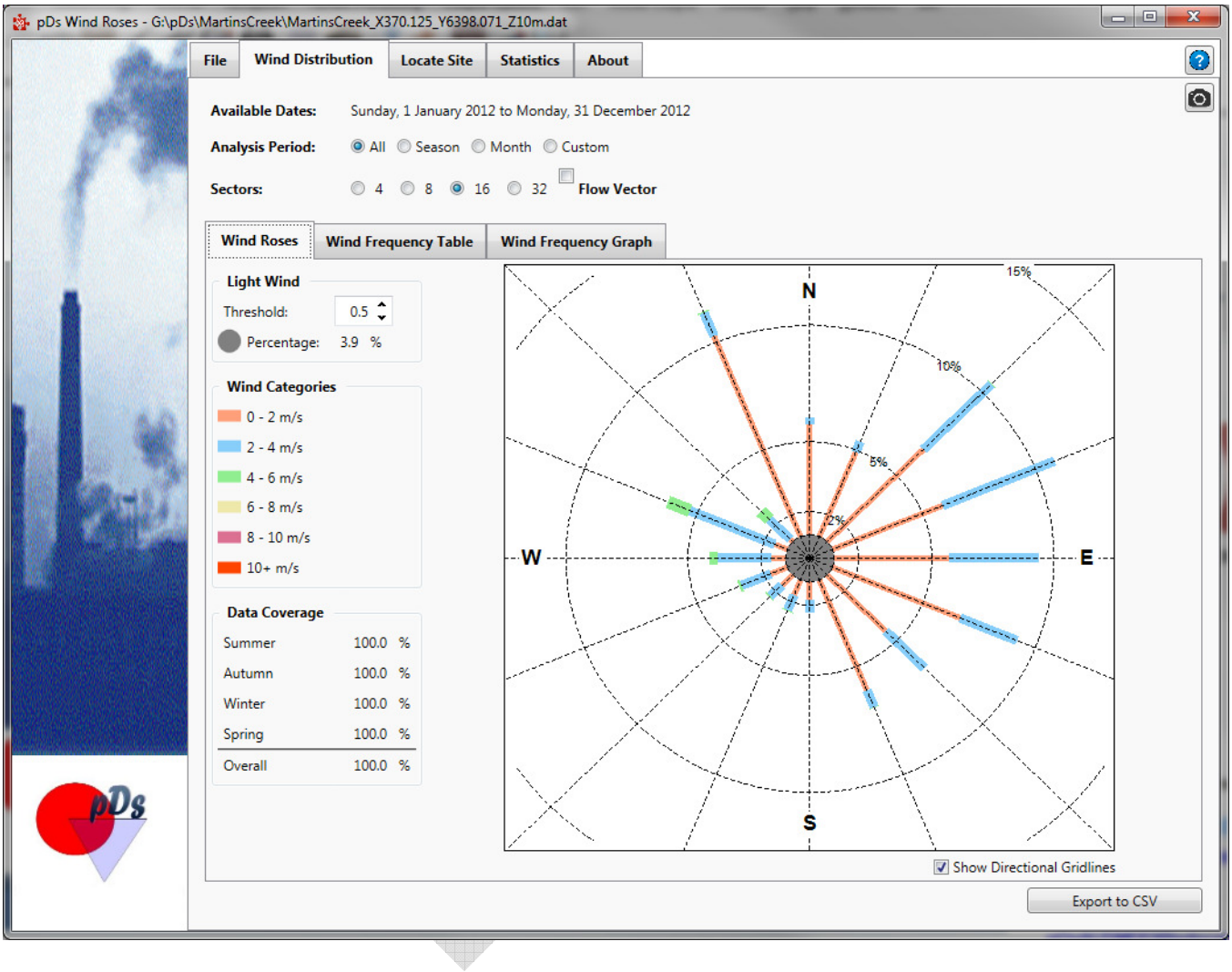


LOCATION: MARTINS CREEK, NSW

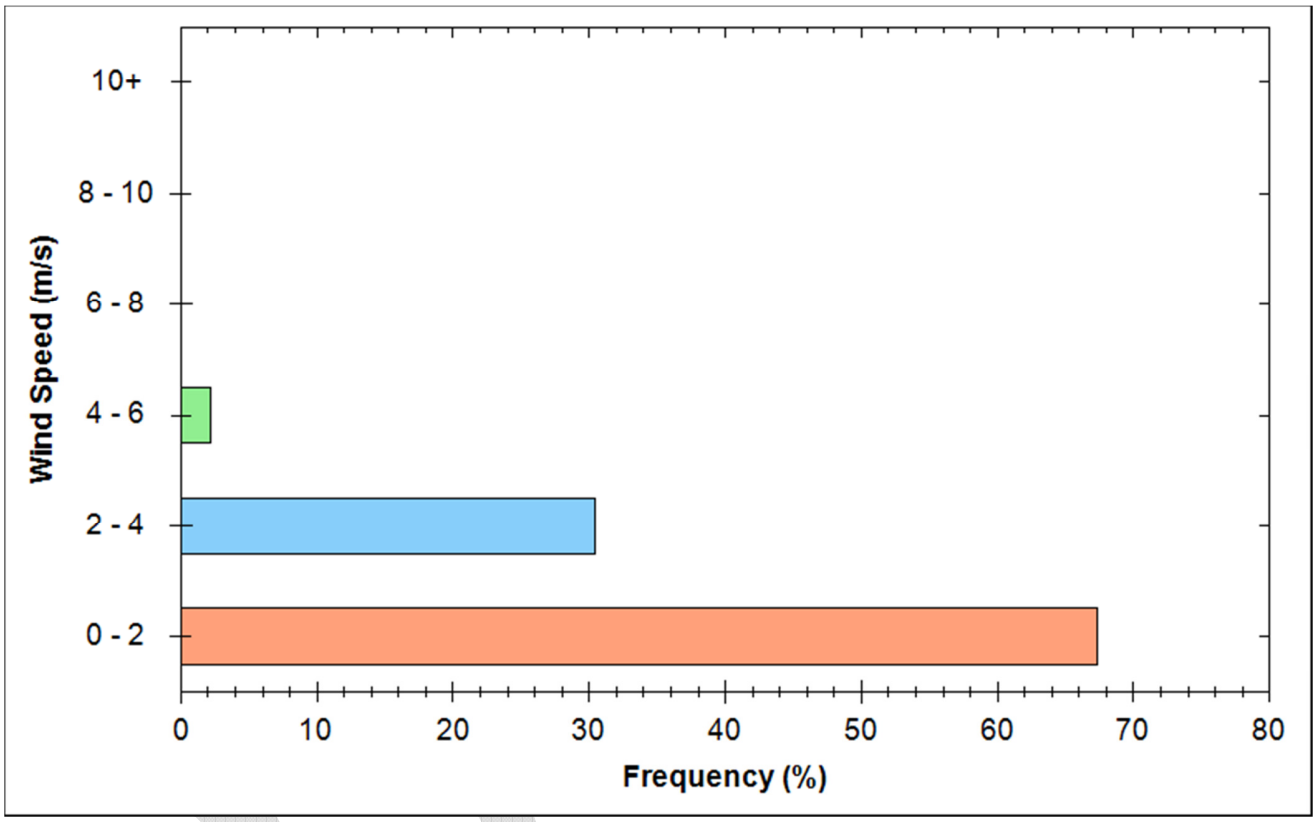


ANALYSIS OF THE SIMULATED DATA EXTRACTED FOR THE SITE IN QUESTION.

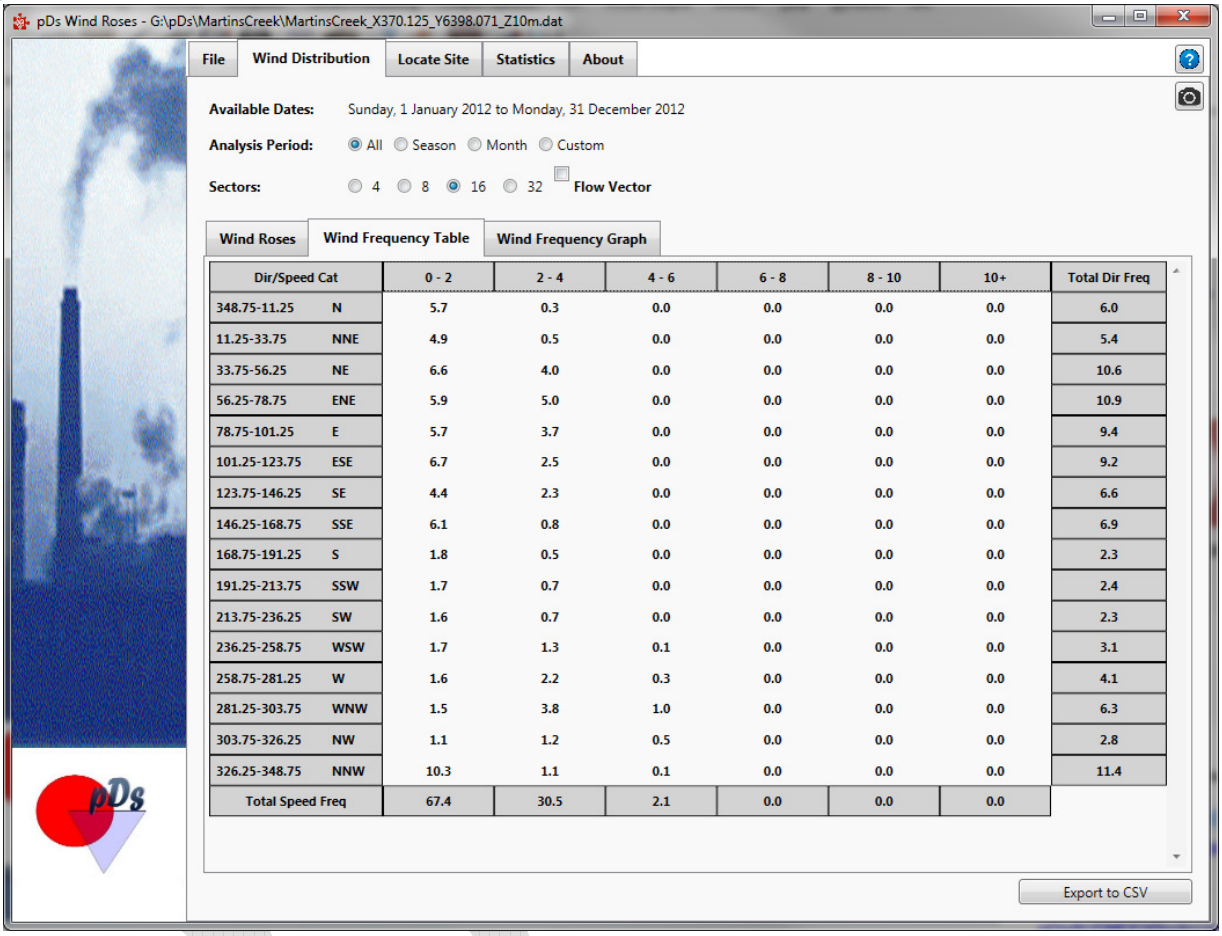
ANNUAL WINDROSES



ANNUAL WIND SPEED FREQUENCY

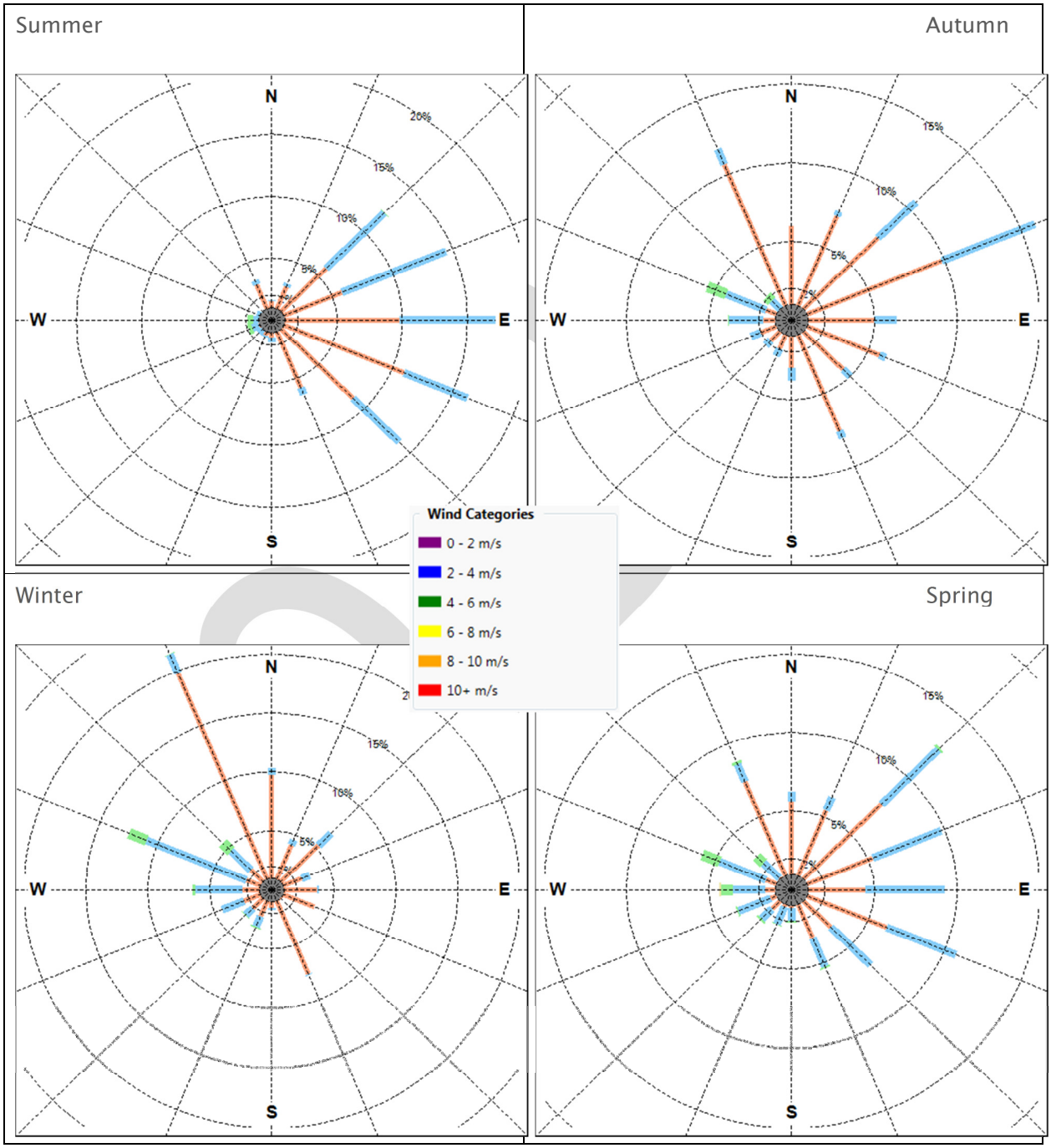


More light winds represent remote country region with topographic influence.



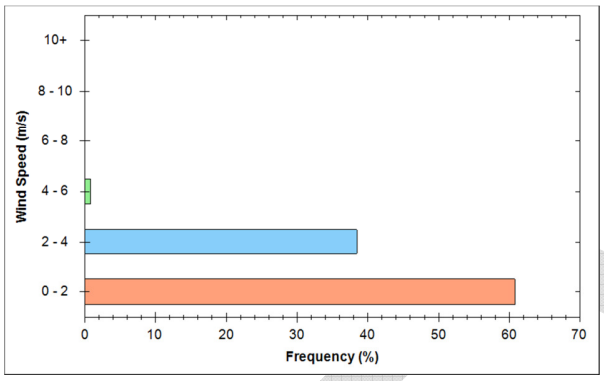
Dir/Speed Cat		0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10+	Total Dir Freq
348.75-11.25	N	5.7	0.3	0.0	0.0	0.0	0.0	6.0
11.25-33.75	NNE	4.9	0.5	0.0	0.0	0.0	0.0	5.4
33.75-56.25	NE	6.6	4.0	0.0	0.0	0.0	0.0	10.6
56.25-78.75	ENE	5.9	5.0	0.0	0.0	0.0	0.0	10.9
78.75-101.25	E	5.7	3.7	0.0	0.0	0.0	0.0	9.4
101.25-123.75	ESE	6.7	2.5	0.0	0.0	0.0	0.0	9.2
123.75-146.25	SE	4.4	2.3	0.0	0.0	0.0	0.0	6.6
146.25-168.75	SSE	6.1	0.8	0.0	0.0	0.0	0.0	6.9
168.75-191.25	S	1.8	0.5	0.0	0.0	0.0	0.0	2.3
191.25-213.75	SSW	1.7	0.7	0.0	0.0	0.0	0.0	2.4
213.75-236.25	SW	1.6	0.7	0.0	0.0	0.0	0.0	2.3
236.25-258.75	WSW	1.7	1.3	0.1	0.0	0.0	0.0	3.1
258.75-281.25	W	1.6	2.2	0.3	0.0	0.0	0.0	4.1
281.25-303.75	WNW	1.5	3.8	1.0	0.0	0.0	0.0	6.3
303.75-326.25	NW	1.1	1.2	0.5	0.0	0.0	0.0	2.8
326.25-348.75	NNW	10.3	1.1	0.1	0.0	0.0	0.0	11.4
Total Speed Freq		67.4	30.5	2.1	0.0	0.0	0.0	

SEASONAL WINDROSES

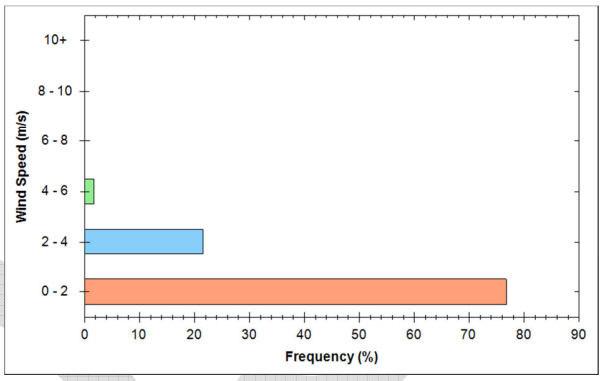


SEASONAL WIND SPEED FREQUENCY

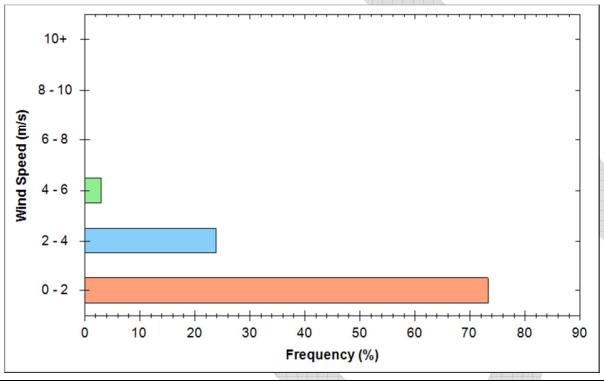
Summer



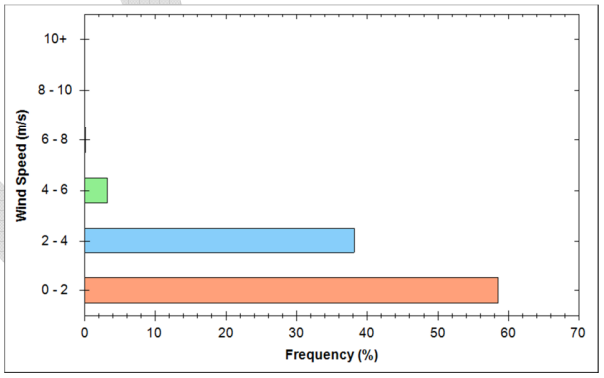
Autumn



Winter



Spring



LIGHT WINDS ARE EVIDENT OVER ALL SEASONS.

DATA

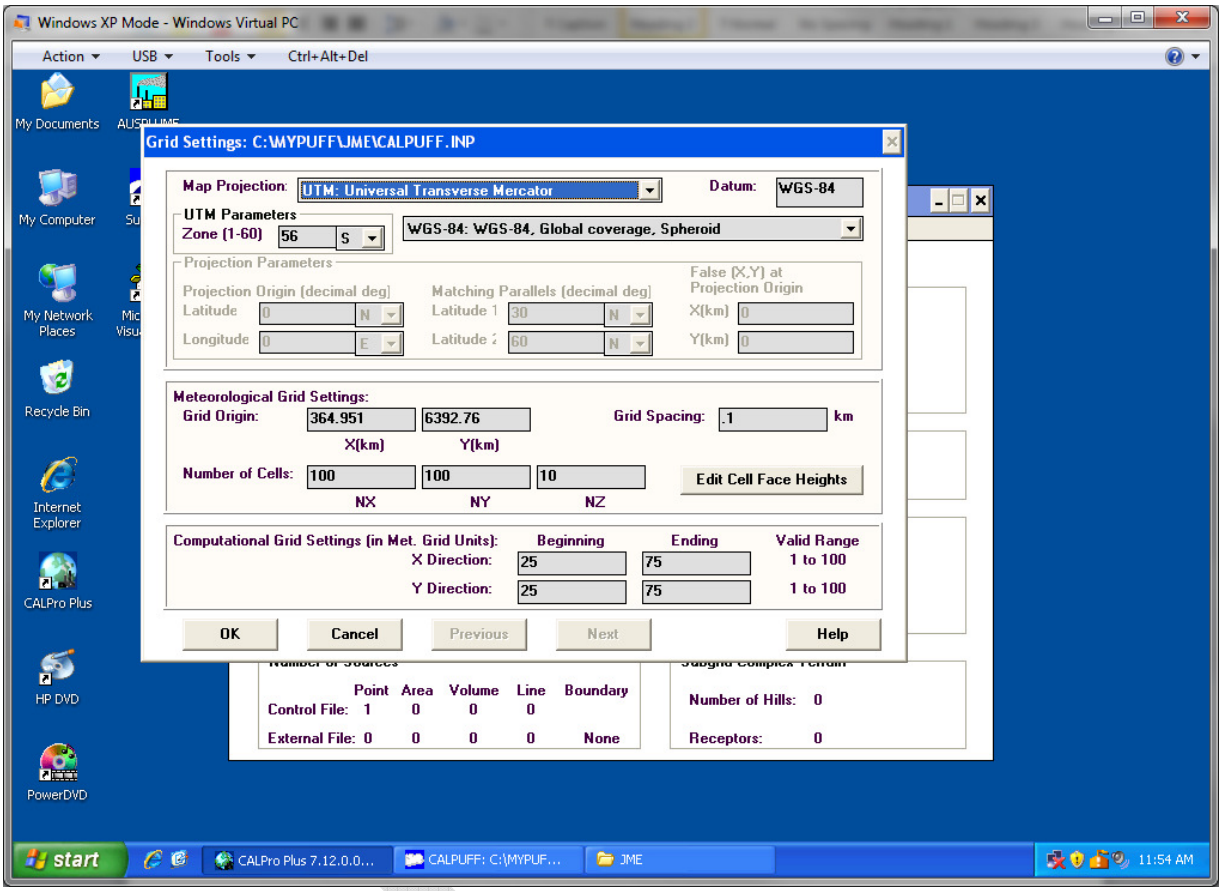
Data Source

- Global Synoptic data for 2012 in .glo format, Source :CSIRO
- GLCC (Australia Pacific ~900m)
- Google Earth/Mapping
- SRTM3
- pDsAUSMOD Software

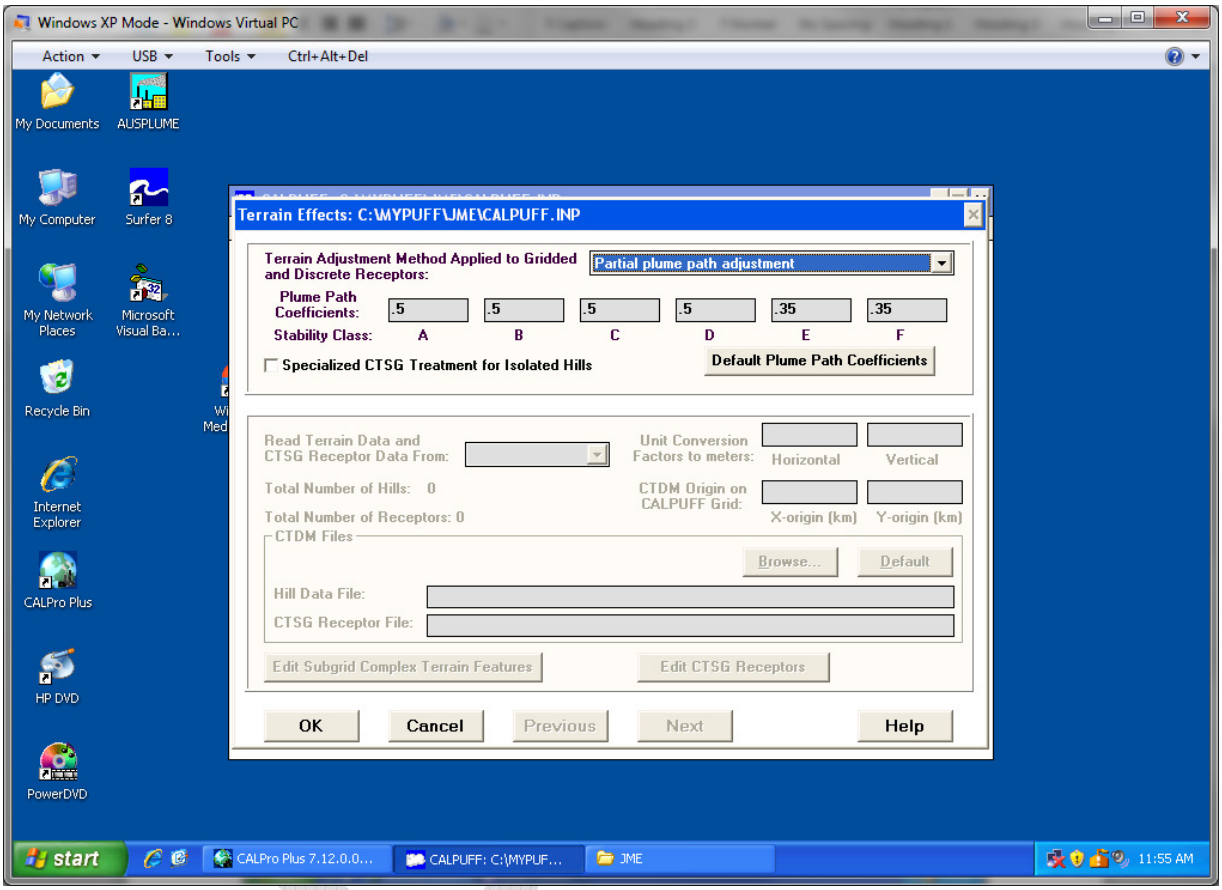
APPENDIX A

SAMPLE CALPUFF SETUP

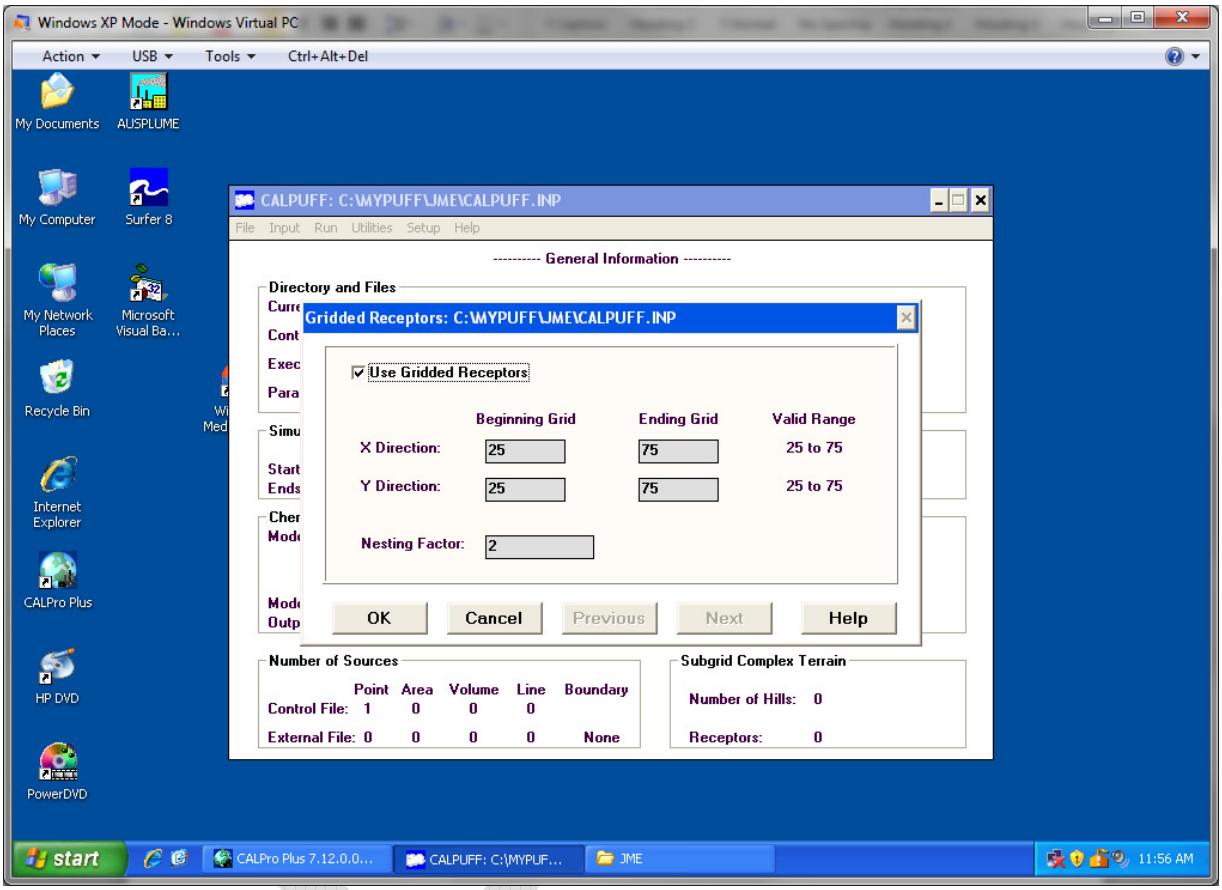
Computational Grid



Terrain Effect



Receptor settings



Turbulence based dispersion is recommended but it is up to the client and the authority.

DISCLAIMER

Compilation of input meteorological data file for CALPUFF was done under the supervision of qualified and experienced meteorologists. Although all due care has been taken, we cannot give any warranty, nor accept any liability (except that required by law) in relation to the information given, its completeness or its applicability to a particular problem. These data and other material are supplied on the condition that you agree to indemnify us and hold us harmless from and against all liability, losses, claims, proceedings, damages, costs and expenses, directly or indirectly relating to, or arising from the use of or reliance on the data and material which we have supplied.

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BIBLIOGRAPHY

Appendix B

Calpuff Input File

```
CALPUFF.INP     2.0             File version record



---------------- Run title (3 lines) ------------------------------------------
   MODEL:  Version 6
SOFTWARE:  CALApps v2.02 Beta - December 12, 2014
--------------------------------------------------------------------------------

                    CALPUFF MODEL CONTROL FILE
                    --------------------------

--------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type           File Name
------------  ----           ---------
CALMET.DAT    input    ! METDAT = Z:\Job Folder\JME4061 - Daracon Martins
Creek\Air data\Modelling\Original\CALMET.DAT !
    or
ISCMET.DAT    input    * ISCDAT =             *
    or
PLMMET.DAT    input    * PLMDAT =             *
    or
PROFILE.DAT   input    * PRFDAT =             *
SURFACE.DAT   input    * SFCDAT =             *
RESTARTB.DAT  input    * RSTARTB=             *
--------------------------------------------------------------------------------
-
CALPUFF.LST   output   ! PUFLST = calpuff.lst !
CONC.DAT      output   ! CONDAT = calpuff.con !
DFLX.DAT      output   ! DFDAT = calpuff.dry !
WFLX.DAT      output   ! WFDAT = calpuff.wet !

VISB.DAT      output   * VISDAT = calpuff.vis *
TK2D.DAT      output   * T2DDAT = calpuff.t2d *
RHO2D.DAT     output   * RHODAT = calpuff.rho *
RESTARTE.DAT  output   * RSTARTE=             *
--------------------------------------------------------------------------------
-
Emission Files
--------------
PTEMARB.DAT   input    * PTDAT  =             *
VOLEMARB.DAT  input    * VOLDAT =             *
BAEMARB.DAT   input    * ARDAT  =             *
LNEMARB.DAT   input    * LNDAT  =             *
--------------------------------------------------------------------------------
-
Other Files
-----------
```

```
OZONE.DAT     input    * OZDAT  =             *
VD.DAT        input    * VDDAT  =             *
CHEM.DAT      input    * CHEMDAT=             *
AUX           input    * AUXEXT =             *
(Extension added to METDAT filename(s) for files
 with auxiliary 2D and 3D data)
H2O2.DAT      input    * H2O2DAT=             *
NH3Z.DAT      input    * NH3ZDAT=             *
HILL.DAT      input    * HILDAT=             *
HILLRCT.DAT   input    * RCTDAT=             *
COASTLN.DAT   input    * CSTDAT=             *
FLUXBDY.DAT   input    * BDYDAT=             *
BCON.DAT      input    * BCNDAT=             *
DEBUG.DAT     output   * DEBUG =             *
MASSFLX.DAT   output   * FLXDAT=             *
MASSBAL.DAT   output   * BALDAT=             *
FOG.DAT       output   * FOGDAT=             *
RISE.DAT      output   * RISDAT=             *
------------------------------------------------------------------------------
-
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = T !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 132 characters in length


Provision for multiple input files
----------------------------------

     Number of Modeling Domains (NMETDOM)
                                     Default: 1       ! NMETDOM = 1 !

     Number of CALMET.DAT files for run (NMETDAT)
                                     Default: 1       ! NMETDAT = 1 !

     Number of POINT source files (PTEMARB.DAT)
     with time-varying data (NPTDAT)
                                     Default: 0       ! NPTDAT = 0 !

     Number of BUOYANT AREA source files (BAEMARB.DAT)
     with time-varying data (NARDAT)
                                     Default: 0       ! NARDAT = 0 !

     Number of VOLUME source files (VOLEMARB.DAT)
     with time-varying data (NVOLDAT)
                                     Default: 0       ! NVOLDAT = 0 !

     Note: Only one LINE source file is allowed (see LNEMARB in Input Group: 0)

!END!
```

```
-------------
Subgroup (0a)
-------------

  Provide a name for each CALMET domain if NMETDOM > 1
  Enter NMETDOM lines.
                                    a,b
Default Name              Domain Name
------------              ------------
 none                   * DOMAIN1=     *   *END*
 none                   * DOMAIN2=     *   *END*
 none                   * DOMAIN3=     *   *END*


  The following CALMET.DAT filenames are processed in sequence
  if NMETDAT > 1

  Enter NMETDAT lines, 1 line for each file name.

                                      a,c,d
Default Name  Type           File Name
------------  ----           ---------
 none         input    * METDAT=  *    *END*
 none         input    * METDAT1=  *    *END*
 none         input    * METDAT2=  *    *END*
 none         input    * METDAT3=  *    *END*

-------------
    a
     The name for each CALMET domain and each CALMET.DAT file is treated
     as a separate input subgroup and therefore must end with an input
     group terminator.
    b
     Use DOMAIN1= to assign the name for the outermost CALMET domain.
     Use DOMAIN2= to assign the name for the next inner CALMET domain.
     Use DOMAIN3= to assign the name for the next inner CALMET domain, etc.
      ------------------------------------------------------------------
      |   When inner domains with equal resolution (grid-cell size)     |
      |   overlap, the data from the FIRST such domain in the list will  |
      |   be used if all other criteria for choosing the controlling     |
      |   grid domain are inconclusive.                                  |
      ------------------------------------------------------------------
    c
     Use METDAT1= to assign the file names for the outermost CALMET domain.
     Use METDAT2= to assign the file names for the next inner CALMET domain.
     Use METDAT3= to assign the file names for the next inner CALMET domain,
etc.
    d
     The filenames for each domain must be provided in sequential order

-------------
Subgroup (0b)
```

```
-------------

  The following PTEMARB.DAT filenames are processed if NPTDAT>1
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * PTDAT=     *   *END*

  Note: If NPTDAT=1, the PTEMARB.DAT filename is entered above in Input Group
0.
        Otherwise, NPTDAT files are entered here in Subgroup (0b).


-------------
Subgroup (0c)
-------------

  The following BAEMARB.DAT filenames are processed if NARDAT>1
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * ARDAT=     *   *END*

  Note: If NARDAT=1, the BAEMARB.DAT filename is entered above in Input Group
0.
        Otherwise, NARDAT files are entered here in Subgroup (0c).


-------------
Subgroup (0d)
-------------

  The following VOLEMARB.DAT filenames are processed if NVOLDAT>1
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * VOLDAT=     *   *END*

  Note: If NVOLDAT=1, the VOLEMARB.DAT filename is entered above in Input Group
0.
        Otherwise, NVOLDAT files are entered here in Subgroup (0d).


-------------------------------------------------------------------------------
-

INPUT GROUP: 1 -- General run control parameters
--------------
```

```
Option to run all periods found
in the met. file     (METRUN)   Default: 0       ! METRUN = 1 !

     METRUN = 0 - Run period explicitly defined below
     METRUN = 1 - Run all periods in met. file

 Starting date:    Year   (IBYR)  --    No default   ! IBYR = 2011 !
                   Month  (IBMO)  --    No default   ! IBMO = 1 !
                   Day    (IBDY)  --    No default   ! IBDY = 1 !
 Starting time:    Hour   (IBHR)  --    No default   ! IBHR = 0 !
                   Minute (IBMIN) --    No default   ! IBMIN = 0 !
                   Second (IBSEC) --    No default   ! IBSEC = 0 !

 Ending date:      Year   (IEYR)  --    No default   ! IEYR = 2012 !
                   Month  (IEMO)  --    No default   ! IEMO = 1 !
                   Day    (IEDY)  --    No default   ! IEDY = 1 !
 Ending time:      Hour   (IEHR)  --    No default   ! IEHR = 0 !
                   Minute (IEMIN) --    No default   ! IEMIN = 0 !
                   Second (IESEC) --    No default   ! IESEC = 0 !

 (These are only used if METRUN = 0)

 Base time zone:          (ABTZ)  --    No default   ! ABTZ = UTC+1000 !
  (character*8)
 The modeling domain may span multiple time zones.  ABTZ defines the
 base time zone used for the entire simulation.  This must match the
 base time zone of the meteorological data.
 Examples:
     Greenwich Mean Time (GMT) = UTC+0000
     EST                       = UTC-0500
     CST                       = UTC-0600
     MST                       = UTC-0700
     PST                       = UTC-0800
     Los Angeles, USA          = UTC-0800
     New York, USA             = UTC-0500
     Santiago, Chile           = UTC-0400
     UK                        = UTC+0000
     Western Europe            = UTC+0100
     Rome, Italy               = UTC+0100
     Cape Town, S.Africa       = UTC+0200
     Sydney, Australia         = UTC+1000

 Length of modeling time-step (seconds)
 Equal to update period in the primary
 meteorological data files, or an
 integer fraction of it (1/2, 1/3 ...)
 Must be no larger than 1 hour
 (NSECDT)                       Default:3600     ! NSECDT = 3600 !
                                Units: seconds

 Number of chemical species (NSPEC)
                                Default: 5       ! NSPEC = 3 !
```

```
Number of chemical species
to be emitted  (NSE)            Default: 3       ! NSE = 3 !

Flag to stop run after
SETUP phase (ITEST)             Default: 2       ! ITEST = 2 !
(Used to allow checking
of the model inputs, files, etc.)
      ITEST = 1 - STOPS program after SETUP phase
      ITEST = 2 - Continues with execution of program
                  after SETUP

Restart Configuration:

   Control flag (MRESTART)      Default: 0       ! MRESTART = 0 !

      0 = Do not read or write a restart file
      1 = Read a restart file at the beginning of
          the run
      2 = Write a restart file during run
      3 = Read a restart file at beginning of run
          and write a restart file during run

   Number of periods in Restart
   output cycle (NRESPD)        Default: 0       ! NRESPD = 0 !

      0 = File written only at last period
     >0 = File updated every NRESPD periods

Meteorological Data Format (METFM)
                                Default: 1       ! METFM = 1 !

      METFM = 1 - CALMET binary file (CALMET.MET)
      METFM = 2 - ISC ASCII file (ISCMET.MET)
      METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
      METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                  surface parameters file (SURFACE.DAT)
      METFM = 5 - AERMET tower file (PROFILE.DAT) and
                  surface parameters file (SURFACE.DAT)

Meteorological Profile Data Format (MPRFFM)
       (used only for METFM = 1, 2, 3)
                                Default: 1       ! MPRFFM = 1 !

      MPRFFM = 1 - CTDM plus tower file (PROFILE.DAT)
      MPRFFM = 2 - AERMET tower file (PROFILE.DAT)

PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
Averaging Time (minutes) (AVET)
                                Default: 60.0    ! AVET = 60. !
PG Averaging Time (minutes) (PGTIME)
                                Default: 60.0    ! PGTIME = 60. !
```

```
     Output units for binary concentration and flux files
     written in Dataset v2.2 or later formats
     (IOUTU)                         Default: 1       ! IOUTU = 1 !
         1 = mass      -  g/m3 (conc) or g/m2/s (dep)
         2 = odour     -  odour_units (conc)
         3 = radiation -  Bq/m3 (conc) or Bq/m2/s (dep)


     Output Dataset format for binary concentration
     and flux files (e.g., CONC.DAT)
     (IOVERS)                        Default: 2       ! IOVERS = 2 !
         1 = Dataset Version 2.1
         2 = Dataset Version 2.2


!END!


------------------------------------------------------------------------------

INPUT GROUP: 2 -- Technical options
--------------


     Vertical distribution used in the
     near field (MGAUSS)                  Default: 1     ! MGAUSS = 1 !
        0 = uniform
        1 = Gaussian

     Terrain adjustment method
     (MCTADJ)                             Default: 3     ! MCTADJ = 3 !
        0 = no adjustment
        1 = ISC-type of terrain adjustment
        2 = simple, CALPUFF-type of terrain
            adjustment
        3 = partial plume path adjustment

     Subgrid-scale complex terrain
     flag (MCTSG)                         Default: 0     ! MCTSG = 0 !
        0 = not modeled
        1 = modeled

     Near-field puffs modeled as
     elongated slugs? (MSLUG)             Default: 0     ! MSLUG = 0 !
        0 = no
        1 = yes (slug model used)

     Transitional plume rise modeled?
     (MTRANS)                             Default: 1     ! MTRANS = 1 !
        0 = no  (i.e., final rise only)
```

```
   1 = yes (i.e., transitional rise computed)

Stack tip downwash? (MTIP)            Default: 1     ! MTIP = 1 !
   0 = no  (i.e., no stack tip downwash)
   1 = yes (i.e., use stack tip downwash)

Method used to compute plume rise for
point sources not subject to building
downwash? (MRISE)                     Default: 1     ! MRISE = 1 !
   1 = Briggs plume rise
   2 = Numerical plume rise

Method used to simulate building
downwash? (MBDW)                      Default: 1     ! MBDW = 1 !
   1 = ISC method
   2 = PRIME method

Vertical wind shear modeled above
stack top (modified Briggs plume rise)?
(MSHEAR)                              Default: 0     ! MSHEAR = 0 !
   0 = no  (i.e., vertical wind shear not modeled)
   1 = yes (i.e., vertical wind shear modeled)

Puff splitting allowed? (MSPLIT)      Default: 0     ! MSPLIT = 0 !
   0 = no (i.e., puffs not split)
   1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM)       Default: 1     ! MCHEM = 0 !
   0 = chemical transformation not
       modeled
   1 = transformation rates computed
       internally (MESOPUFF II scheme)
   2 = user-specified transformation
       rates used
   3 = transformation rates computed
       internally (RIVAD/ARM3 scheme)
   4 = secondary organic aerosol formation
       computed (MESOPUFF II scheme for OH)
   5 = user-specified half-life with or
       without transfer to child species
   6 = transformation rates computed
       internally (Updated RIVAD scheme with
       ISORROPIA equilibrium)
   7 = transformation rates computed
       internally (Updated RIVAD scheme with
       ISORROPIA equilibrium and CalTech SOA)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 6, or 7)        Default: 0     ! MAQCHEM = 0 !
   0 = aqueous phase transformation
       not modeled
   1 = transformation rates and wet
```

```
       scavenging coefficients adjusted
       for in-cloud aqueous phase reactions
       (adapted from RADM cloud model
        implementation in CMAQ/SCICHEM)

Liquid Water Content flag (MLWC)
(Used only if MAQCHEM = 1)            Default: 1     ! MLWC = 1 !
   0 = water content estimated from cloud cover
       and presence of precipitation
   1 = gridded cloud water data read from CALMET
       water content output files (filenames are
       the CALMET.DAT names PLUS the extension
       AUXEXT provided in Input Group 0)

Wet removal modeled ? (MWET)          Default: 1     ! MWET = 1 !
   0 = no
   1 = yes

Dry deposition modeled ? (MDRY)       Default: 1     ! MDRY = 1 !
   0 = no
   1 = yes
   (dry deposition method specified
    for each species in Input Group 3)


Gravitational settling (plume tilt)
modeled ? (MTILT)                     Default: 0     ! MTILT = 0 !
   0 = no
   1 = yes
   (puff center falls at the gravitational
    settling velocity for 1 particle species)

Restrictions:
    - MDRY  = 1
    - NSPEC = 1  (must be particle species as well)
    - sg    = 0  GEOMETRIC STANDARD DEVIATION in Group 8 is
                 set to zero for a single particle diameter

Method used to compute dispersion
coefficients (MDISP)                  Default: 3     ! MDISP = 2 !

   1 = dispersion coefficients computed from measured values
       of turbulence, sigma v, sigma w
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.
   5 = CTDM sigmas used for stable and neutral conditions.
```

```
       For unstable conditions, sigmas are computed as in
       MDISP = 3, described above.  MDISP = 5 assumes that
       measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
(Used only if MDISP = 1 or 5)         Default: 3     ! MTURBVW = 3 !
   1 = use sigma-v or sigma-theta measurements
       from PROFILE.DAT to compute sigma-y
       (valid for METFM = 1, 2, 3, 4, 5)
   2 = use sigma-w measurements
       from PROFILE.DAT to compute sigma-z
       (valid for METFM = 1, 2, 3, 4, 5)
   3 = use both sigma-(v/theta) and sigma-w
       from PROFILE.DAT to compute sigma-y and sigma-z
       (valid for METFM = 1, 2, 3, 4, 5)
   4 = use sigma-theta measurements
       from PLMMET.DAT to compute sigma-y
       (valid only if METFM = 3)

Back-up method used to compute dispersion
when measured turbulence data are
missing (MDISP2)                      Default: 3     ! MDISP2 = 3 !
(used only if MDISP = 1 or 5)
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.

[DIAGNOSTIC FEATURE]
Method used for Lagrangian timescale for Sigma-y
(used only if MDISP=1,2 or MDISP2=1,2)
(MTAULY)                              Default: 0     ! MTAULY = 0 !
   0 = Draxler default 617.284 (s)
   1 = Computed as Lag. Length / (.75 q) -- after SCIPUFF
  10 < Direct user input (s)             -- e.g., 306.9


[DIAGNOSTIC FEATURE]
Method used for Advective-Decay timescale for Turbulence
(used only if MDISP=2 or MDISP2=2)
(MTAUADV)                             Default: 0     ! MTAUADV = 0 !
   0 = No turbulence advection
   1 = Computed (OPTION NOT IMPLEMENTED)
  10 < Direct user input (s)   -- e.g., 800


Method used to compute turbulence sigma-v &
sigma-w using micrometeorological variables
```

```
(Used only if MDISP = 2 or MDISP2 = 2)
(MCTURB)                              Default: 1     ! MCTURB = 1 !
   1 = Standard CALPUFF subroutines
   2 = AERMOD subroutines

PG sigma-y,z adj. for roughness?      Default: 0     ! MROUGH = 0 !
(MROUGH)
   0 = no
   1 = yes

Partial plume penetration of          Default: 1     ! MPARTL = 1 !
elevated inversion modeled for
point sources?
(MPARTL)
   0 = no
   1 = yes

Partial plume penetration of          Default: 1     ! MPARTLBA = 1 !
elevated inversion modeled for
buoyant area sources?
(MPARTLBA)
   0 = no
   1 = yes

Strength of temperature inversion     Default: 0     ! MTINV = 0 !
provided in PROFILE.DAT extended records?
(MTINV)
   0 = no (computed from measured/default gradients)
   1 = yes

PDF used for dispersion under convective conditions?
                                      Default: 0     ! MPDF = 0 !
(MPDF)
   0 = no
   1 = yes

Sub-Grid TIBL module used for shore line?
                                      Default: 0     ! MSGTIBL = 0 !
(MSGTIBL)
   0 = no
   1 = yes

Boundary conditions (concentration) modeled?
                                      Default: 0     ! MBCON = 0 !
(MBCON)
   0 = no
   1 = yes, using formatted BCON.DAT file
   2 = yes, using unformatted CONC.DAT file

Note:  MBCON > 0 requires that the last species modeled
       be 'BCON'.  Mass is placed in species BCON when
       generating boundary condition puffs so that clean
```

```
       air entering the modeling domain can be simulated
       in the same way as polluted air.  Specify zero
       emission of species BCON for all regular sources.

Individual source contributions saved?
                                        Default: 0     ! MSOURCE = 0 !
(MSOURCE)
   0 = no
   1 = yes


Analyses of fogging and icing impacts due to emissions from
arrays of mechanically-forced cooling towers can be performed
using CALPUFF in conjunction with a cooling tower emissions
processor (CTEMISS) and its associated postprocessors.  Hourly
emissions of water vapor and temperature from each cooling tower
cell are computed for the current cell configuration and ambient
conditions by CTEMISS. CALPUFF models the dispersion of these
emissions and provides cloud information in a specialized format
for further analysis. Output to FOG.DAT is provided in either
'plume mode' or 'receptor mode' format.

Configure for FOG Model output?
                                        Default: 0     ! MFOG = 0 !
(MFOG)
   0 = no
   1 = yes  - report results in PLUME Mode format
   2 = yes  - report results in RECEPTOR Mode format


Test options specified to see if
they conform to regulatory
values? (MREG)                          Default: 1     ! MREG = 0 !

   0 = NO checks are made
   1 = Technical options must conform to USEPA
       Long Range Transport (LRT) guidance
                  METFM    1 or 2
                  AVET     60. (min)
                  PGTIME   60. (min)
                  MGAUSS   1
                  MCTADJ   3
                  MTRANS   1
                  MTIP     1
                  MRISE    1
                  MCHEM    1 or 3 (if modeling SOx, NOx)
                  MWET     1
                  MDRY     1
                  MDISP    2 or 3
                  MPDF     0 if MDISP=3
                           1 if MDISP=2
                  MROUGH   0
```

```
                    MPARTL   1
                    MPARTLBA 0
                    SYTDEP   550. (m)
                    MHFTSZ   0
                    SVMIN    0.5 (m/s)


!END!


--------------------------------------------------------------------------------

INPUT GROUP: 3a, 3b -- Species list
-------------------

------------
Subgroup (3a)
------------

  The following species are modeled:
! CSPEC = PM10 !         !END!
! CSPEC = PM2.5 !         !END!
! CSPEC = TSP !         !END!

                                                          Dry
OUTPUT GROUP
    SPECIES          MODELED          EMITTED       DEPOSITED
NUMBER
     NAME         (0=NO, 1=YES)    (0=NO, 1=YES)    (0=NO,
(0=NONE,
   (Limit: 12                                        1=COMPUTED-GAS
1=1st CGRUP,
    Characters                                       2=COMPUTED-PARTICLE
2=2nd CGRUP,
    in length)                                       3=USER-SPECIFIED)     3=
etc.)
!        PM10=       1,               1,           ,                  0   !
!       PM2.5=       1,               1,           0,                  0   !
!         TSP=       1,               1,           0,                  0   !

!END!

  Note:  The last species in (3a) must be 'BCON' when using the
         boundary condition option (MBCON > 0).  Species BCON should
         typically be modeled as inert (no chem transformation or
         removal).


-------------
Subgroup (3b)
-------------
  The following names are used for Species-Groups in which results
```

```
  for certain species are combined (added) prior to output.  The
  CGRUP name will be used as the species name in output files.
  Use this feature to model specific particle-size distributions
  by treating each size-range as a separate species.
  Order must be consistent with 3(a) above.
```

```
INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                    Default: UTM    ! PMAP = UTM !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                   Default=0.0     ! FEAST = 0.000 !
     (FNORTH)                  Default=0.0     ! FNORTH = 0.000 !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                  No Default      ! IUTMZN = 56 !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                  Default: N      ! UTMHEM = S !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                   No Default      ! RLAT0 = 0N !
     (RLON0)                   No Default      ! RLON0 = 0E !

         TTM :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         LCC :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         PS  :  RLON0 identifies central (grid N/S) meridian of projection
```

```
               RLAT0 selected for convenience
          EM  :  RLON0 identifies central meridian of projection
                 RLAT0 is REPLACED by 0.0N (Equator)
          LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
                 RLAT0 identifies latitude of tangent-point of mapping plane

     Matching parallel(s) of latitude (decimal degrees) for projection
     (Used only if PMAP= LCC or PS)
     (XLAT1)                    No Default      ! XLAT1 = 0N !
     (XLAT2)                    No Default      ! XLAT2 = 0N !

          LCC :  Projection cone slices through Earth's surface at XLAT1 and
XLAT2
          PS  :  Projection plane slices through Earth at XLAT1
                 (XLAT2 is not used)

     ----------
     Note:  Latitudes and longitudes should be positive, and include a
            letter N,S,E, or W indicating north or south latitude, and
            east or west longitude.  For example,
            35.9  N Latitude  =  35.9N
            118.7 E Longitude = 118.7E


     Datum-region
     ------------

     The Datum-Region for the coordinates is identified by a character
     string.  Many mapping products currently available use the model of the
     Earth known as the World Geodetic System 1984 (WGS-84).  Other local
     models may be in use, and their selection in CALMET will make its output
     consistent with local mapping products.  The list of Datum-Regions with
     official transformation parameters is provided by the National Imagery and
     Mapping Agency (NIMA).

     NIMA Datum - Regions(Examples)

-------------------------------------------------------------------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

     Datum-region for output coordinates
     (DATUM)                    Default: WGS-84    ! DATUM = WGS-84 !


METEOROLOGICAL Grid:

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate
```

```
          No. X grid cells (NX)      No default     ! NX = 100 !
          No. Y grid cells (NY)      No default     ! NY = 100 !
       No. vertical layers (NZ)      No default     ! NZ = 10 !

         Grid spacing (DGRIDKM)      No default     ! DGRIDKM = 0.1 !
                                     Units: km

              Cell face heights
                  (ZFACE(nz+1))      No defaults
                                     Units: m
 ! ZFACE = 0,20,40,80,160,320,640,1200,2000,3000,4000 !

          Reference Coordinates
         of SOUTHWEST corner of
               grid cell(1, 1):

          X coordinate (XORIGKM)     No default     ! XORIGKM = 364.951 !
          Y coordinate (YORIGKM)     No default     ! YORIGKM = 6392.76 !
                                    Units: km
```

COMPUTATIONAL Grid:

The computational grid is identical to or a subset of the MET. grid. The lower left (LL) corner of the computational grid is at grid point (IBCOMP, JBCOMP) of the MET. grid. The upper right (UR) corner of the computational grid is at grid point (IECOMP, JECOMP) of the MET. grid. The grid spacing of the computational grid is the same as the MET. grid.

```
   X index of LL corner (IBCOMP)      No default     ! IBCOMP = 35 !
             (1 <= IBCOMP <= NX)

   Y index of LL corner (JBCOMP)      No default     ! JBCOMP = 35 !
             (1 <= JBCOMP <= NY)


   X index of UR corner (IECOMP)      No default     ! IECOMP = 65 !
             (1 <= IECOMP <= NX)

   Y index of UR corner (JECOMP)      No default     ! JECOMP = 65 !
             (1 <= JECOMP <= NY)
```

SAMPLING Grid (GRIDDED RECEPTORS):

The lower left (LL) corner of the sampling grid is at grid point (IBSAMP, JBSAMP) of the MET. grid. The upper right (UR) corner of the sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid. The sampling grid must be identical to or a subset of the computational grid. It may be a nested grid inside the computational grid.

```
     The grid spacing of the sampling grid is DGRIDKM/MESHDN.

        Logical flag indicating if gridded
        receptors are used (LSAMP)          Default: T     ! LSAMP = T !
        (T=yes, F=no)

        X index of LL corner (IBSAMP)       No default     ! IBSAMP = 35 !
         (IBCOMP <= IBSAMP <= IECOMP)

        Y index of LL corner (JBSAMP)       No default     ! JBSAMP = 35 !
         (JBCOMP <= JBSAMP <= JECOMP)


        X index of UR corner (IESAMP)       No default     ! IESAMP = 65 !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)       No default     ! JESAMP = 65 !
         (JBCOMP <= JESAMP <= JECOMP)


       Nesting factor of the sampling
        grid (MESHDN)                       Default: 1     ! MESHDN = 1 !
        (MESHDN is an integer >= 1)

!END!


--------------------------------------------------------------------------------


INPUT GROUP: 5 -- Output Options
--------------
                                          *                         *
     FILE                        DEFAULT VALUE             VALUE THIS RUN
     ----                        -------------             --------------

   Concentrations (ICON)               1                   ! ICON = 1 !
   Dry Fluxes (IDRY)                   1                   ! IDRY = 1 !
   Wet Fluxes (IWET)                   1                   ! IWET = 1 !
   2D Temperature (IT2D)               0                   ! IT2D = 0 !
   2D Density (IRHO)                   0                   ! IRHO = 0 !
   Relative Humidity (IVIS)            1                   ! IVIS = 0 !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                            Default: T         ! LCOMPRS = T !

   *
    0 = Do not create file, 1 = create file
```

```
QA PLOT FILE OUTPUT OPTION:

   Create a standard series of output files (e.g.
   locations of sources, receptors, grids ...)
   suitable for plotting?
   (IQAPLOT)                    Default: 1         ! IQAPLOT = 1 !
     0 = no
     1 = yes

DIAGNOSTIC PUFF-TRACKING OUTPUT OPTION:

   Puff locations and properties reported to
   PFTRAK.DAT file for postprocessing?
   (IPFTRAK)                    Default: 0         ! IPFTRAK = 0 !
     0 = no
     1 = yes, update puff output at end of each timestep
     2 = yes, update puff output at end of each sampling step

DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

   Mass flux across specified boundaries
   for selected species reported?
   (IMFLX)                      Default: 0         ! IMFLX = 0 !
     0 = no
     1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
              are specified in Input Group 0)

   Mass balance for each species
   reported?
   (IMBAL)                      Default: 0         ! IMBAL = 0 !
     0 = no
     1 = yes (MASSBAL.DAT filename is
          specified in Input Group 0)


NUMERICAL RISE OUTPUT OPTION:

   Create a file with plume properties for each rise
   increment, for each model timestep?
   This applies to sources modeled with numerical rise
   and is limited to ONE source in the run.
   (INRISE)                     Default: 0         ! INRISE = 0 !
     0 = no
     1 = yes (RISE.DAT filename is
              specified in Input Group 0)


LINE PRINTER OUTPUT OPTIONS:

   Print concentrations (ICPRT)    Default: 0      ! ICPRT = 1 !
   Print dry fluxes (IDPRT)        Default: 0      ! IDPRT = 0 !
   Print wet fluxes (IWPRT)        Default: 0      ! IWPRT = 0 !
```

```
       (0 = Do not print, 1 = Print)

       Concentration print interval
       (ICFRQ) in timesteps            Default: 1         ! ICFRQ = 1 !
       Dry flux print interval
       (IDFRQ) in timesteps            Default: 1         ! IDFRQ = 1 !
       Wet flux print interval
       (IWFRQ) in timesteps            Default: 1         ! IWFRQ = 1 !

       Units for Line Printer Output
       (IPRTU)                         Default: 1         ! IPRTU = 3 !
                     for              for
                Concentration    Deposition
           1 =       g/m**3          g/m**2/s
           2 =      mg/m**3         mg/m**2/s
           3 =      ug/m**3         ug/m**2/s
           4 =      ng/m**3         ng/m**2/s
           5 =     Odour Units

       Messages tracking progress of run
       written to the screen ?
       (IMESG)                         Default: 2         ! IMESG = 2 !
         0 = no
         1 = yes (advection step, puff ID)
         2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)


     SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

                  ---- CONCENTRATIONS ----   ------ DRY FLUXES ------   ------
WET FLUXES ------   -- MASS FLUX --
   SPECIES
   /GROUP        PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   PRINTED?
 SAVED ON DISK?   SAVED ON DISK?
   -------       ------------------------   ------------------------
-----------------------   ---------------
!         PM10=   0,           1,           0,           1,           0,
   1,           0   !
!        PM2.5=   0,           1,           0,           1,           0,
   1,           0   !
!          TSP=   0,           1,           0,           1,           0,
   1,           0   !
  Note:  Species BCON (for MBCON > 0) does not need to be saved on disk.


     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                                Default: F     ! LDEBUG = F !

       First puff to track
       (IPFDEB)                                Default: 1     ! IPFDEB = 1 !
```

```
       Number of puffs to track
       (NPFDEB)                                Default: 1     ! NPFDEB = 1 !

       Met. period to start output
       (NN1)                                   Default: 1     ! NN1 = 1 !

       Met. period to end output
       (NN2)                                   Default: 10    ! NN2 = 10 !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs
-------------------------

---------------
Subgroup (6a)
---------------
       Number of terrain features (NHILL)      Default: 0     ! NHILL = 0 !

       Number of special complex terrain
       receptors  (NCTREC)                     Default: 0     ! NCTREC = 0 !

       Terrain and CTSG Receptor data for
       CTSG hills input in CTDM format ?
       (MHILL)                                 No Default     ! MHILL = 2 !
       1 = Hill and Receptor data created
           by CTDM processors & read from
           HILL.DAT and HILLRCT.DAT files
       2 = Hill data created by OPTHILL &
           input below in Subgroup (6b);
           Receptor data in Subgroup (6c)

       Factor to convert horizontal dimensions  Default: 1.0   ! XHILL2M = 1.0
!
       to meters (MHILL=1)

       Factor to convert vertical dimensions    Default: 1.0   ! ZHILL2M = 1.0
!
       to meters (MHILL=1)

       X-origin of CTDM system relative to      No Default     ! XCTDMKM = 0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

       Y-origin of CTDM system relative to      No Default     ! YCTDMKM = 0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !
```

Subgroup (6b)
---

1 **
HILL information

HILL NO.	XC (km)	YC (km)	THETAH (deg.)	ZGRID (m)	RELIEF (m)	EXPO 1 (m)	EXPO 2 (m)	SCALE 1 (m)	SCALE 2 (m)	AMAX1 (m)	AMAX2 (m)

Subgroup (6c)

COMPLEX TERRAIN RECEPTOR INFORMATION

XRCT (km)	YRCT (km)	ZRCT (m)	XHH

1
Description of Complex Terrain Variables:
XC, YC = Coordinates of center of hill
THETAH = Orientation of major axis of hill (clockwise from North)
ZGRID = Height of the 0 of the grid above mean sea level
RELIEF = Height of the crest of the hill above the grid elevation
EXPO 1 = Hill-shape exponent for the major axis
EXPO 2 = Hill-shape exponent for the major axis
SCALE 1 = Horizontal length scale along the major axis
SCALE 2 = Horizontal length scale along the minor axis
AMAX = Maximum allowed axis length for the major axis
BMAX = Maximum allowed axis length for the major axis

XRCT, YRCT = Coordinates of the complex terrain receptors
ZRCT = Height of the ground (MSL) at the complex terrain Receptor
XHH = Hill number associated with each complex terrain receptor (NOTE: MUST BE ENTERED AS A REAL NUMBER)

**
NOTE: DATA for each hill and CTSG receptor are treated as a separate input subgroup and therefore must end with an input group

terminator.

INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases

---

SPECIES NAME	DIFFUSIVITY (cm**2/s)	ALPHA STAR	REACTIVITY	MESOPHYLL RESISTANCE (s/cm)	HENRY'S LAW COEFFICIENT (dimensionless)

!END!

INPUT GROUP: 8 -- Size parameters for dry deposition of particles

---

For SINGLE SPECIES, the mean and standard deviation are used to compute a deposition velocity for NINT (see group 9) size-ranges, and these are then averaged to obtain a mean deposition velocity.

For GROUPED SPECIES, the size distribution should be explicitly specified (by the 'species' in the group), and the standard deviation for each should be entered as 0. The model will then use the deposition velocity for the stated mean diameter.

SPECIES NAME	GEOMETRIC MASS MEAN DIAMETER (microns)	GEOMETRIC STANDARD DEVIATION (microns)

!END!

INPUT GROUP: 9 -- Miscellaneous dry deposition parameters

Reference cuticle resistance (s/cm)
(RCUTR) Default: 30 ! RCUTR = 30.0 !

```
     Reference ground resistance  (s/cm)
     (RGR)                        Default: 10    ! RGR = 10.0 !
     Reference pollutant reactivity
     (REACTR)                     Default: 8     ! REACTR = 8.0 !

     Number of particle-size intervals used to
     evaluate effective particle deposition velocity
     (NINT)                       Default: 9     ! NINT = 9 !

     Vegetation state in unirrigated areas
     (IVEG)                       Default: 1     ! IVEG = 1 !
        IVEG=1 for active and unstressed vegetation
        IVEG=2 for active and stressed vegetation
        IVEG=3 for inactive vegetation

!END!


--------------------------------------------------------------------------------


INPUT GROUP: 10 -- Wet Deposition Parameters
---------------

                      Scavenging Coefficient -- Units: (sec)**(-1)

       Pollutant      Liquid Precip.       Frozen Precip.
       ---------      --------------       --------------

!        PM10 =      1.0E-04,     3.0E-05 !
!       PM2.5 =      1.0E-04,     3.0E-05 !
!         TSP =      1.0E-04,     3.0E-05 !

!END!


--------------------------------------------------------------------------------


INPUT GROUP: 11a, 11b -- Chemistry Parameters
---------------------

---------------
Subgroup (11a)
---------------

     Several parameters are needed for one or more of the chemical
transformation
     mechanisms.  Those used for each mechanism are:
                                      M                 B
                                      A  B  R  R  R     C  B        N
                                 B    V  C  N  N  N  M  K  C  O     D
```

Mechanism (MCHEM)	MOZ	CKNH3	MAVGNH3	GRNITE1	KRNITE2	ITRATE	ITRDEP	IHONO	H2O2	KPMF	FRACN	VCNX	ECAY
0 None	.	.	.	.	.	.	.	.	.	.	.	.	.
1 MESOPUFF II	X	X	.	.	X	X	X	X	.	.	.	.	.
2 User Rates	.	.	.	.	.	.	.	.	.	.	.	.	.
3 RIVAD	X	X	.	.	X	.	.	.	.	.	.	.	.
4 SOA	X	X	.	.	.	.	.	.	.	.	X	X	X	.
5 Radioactive Decay	.	.	.	.	.	.	.	.	.	.	.	.	.	X
6 RIVAD/ISORRPIA	X	X	X	X	X	X	.	.	X	X	.	.	.	.
7 RIVAD/ISORRPIA/SOA	X	X	X	X	X	X	.	.	X	X	X	X	.	.

Ozone data input option (MOZ) Default: 1 ! MOZ = 1 !
(Used only if MCHEM = 1, 3, 4, 6, or 7)
0 = use a monthly background ozone value
1 = read hourly ozone concentrations from
the OZONE.DAT data file

Monthly ozone concentrations in ppb (BCKO3)
(Used only if MCHEM = 1,3,4,6, or 7 and either
MOZ = 0, or
MOZ = 1 and all hourly O3 data missing)
Default: 12*80.
! BCKO3 = 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00 !

Ammonia data option (MNH3) Default: 0 ! MNH3 = 0 !
(Used only if MCHEM = 6 or 7)
0 = use monthly background ammonia values (BCKNH3) - no vertical variation
1 = read monthly background ammonia values for each layer from
the NH3Z.DAT data file

Ammonia vertical averaging option (MAVGNH3)
(Used only if MCHEM = 6 or 7, and MNH3 = 1)
0 = use NH3 at puff center height (no averaging is done)
1 = average NH3 values over vertical extent of puff
Default: 1 ! MAVGNH3 = 1 !

Monthly ammonia concentrations in ppb (BCKNH3)
(Used only if MCHEM = 1 or 3, or
if MCHEM = 6 or 7, and MNH3 = 0)
Default: 12*10.
! BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00 !

Nighttime SO2 loss rate in %/hour (RNITE1)
(Used only if MCHEM = 1, 6 or 7)
This rate is used only at night for MCHEM=1

```
     and is added to the computed rate both day
     and night for MCHEM=6,7 (heterogeneous reactions)
                                     Default: 0.2          ! RNITE1 = .2 !

     Nighttime NOx loss rate in %/hour (RNITE2)
     (Used only if MCHEM = 1)
                                     Default: 2.0          ! RNITE2 = 2.0 !

     Nighttime HNO3 formation rate in %/hour (RNITE3)
     (Used only if MCHEM = 1)
                                     Default: 2.0          ! RNITE3 = 2.0 !

     H2O2 data input option (MH2O2)    Default: 1          ! MH2O2 = 1 !
     (Used only if MCHEM = 6 or 7, and MAQCHEM = 1)
        0 = use a monthly background H2O2 value
        1 = read hourly H2O2 concentrations from
            the H2O2.DAT data file

     Monthly H2O2 concentrations in ppb (BCKH2O2)
     (Used only if MQACHEM = 1 and either
        MH2O2 = 0 or
        MH2O2 = 1 and all hourly H2O2 data missing)
                                     Default: 12*1.
     ! BCKH2O2 =   1.00,  1.00,  1.00,  1.00,  1.00,  1.00,  1.00,  1.00,
1.00,  1.00,  1.00,  1.00 !


 --- Data for SECONDARY ORGANIC AEROSOL (SOA) Options
     (used only if MCHEM = 4 or 7)

     The MCHEM = 4 SOA module uses monthly values of:
          Fine particulate concentration in ug/m^3 (BCKPMF)
          Organic fraction of fine particulate     (OFRAC)
          VOC / NOX ratio (after reaction)         (VCNX)

     The MCHEM = 7 SOA module uses monthly values of:
          Fine particulate concentration in ug/m^3 (BCKPMF)
          Organic fraction of fine particulate     (OFRAC)

     These characterize the air mass when computing
     the formation of SOA from VOC emissions.
     Typical values for several distinct air mass types are:

        Month    1    2    3    4    5    6    7    8    9   10   11   12
                Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

     Clean Continental
        BCKPMF   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.
        OFRAC  .15  .15  .20  .20  .20  .20  .20  .20  .20  .20  .20  .15
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

     Clean Marine (surface)
```

```
        BCKPMF  .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5
        OFRAC  .25  .25  .30  .30  .30  .30  .30  .30  .30  .30  .30  .25
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

     Urban - low biogenic (controls present)
        BCKPMF  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.
        OFRAC  .20  .20  .25  .25  .25  .25  .25  .25  .20  .20  .20  .20
        VCNX     4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.

     Urban - high biogenic (controls present)
        BCKPMF  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.
        OFRAC  .25  .25  .30  .30  .30  .55  .55  .55  .35  .35  .35  .25
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

     Regional Plume
        BCKPMF  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.
        OFRAC  .20  .20  .25  .35  .25  .40  .40  .40  .30  .30  .30  .20
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

     Urban - no controls present
        BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100.
        OFRAC  .30  .30  .35  .35  .35  .55  .55  .55  .35  .35  .35  .30
        VCNX     2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.

     Default: Clean Continental
     ! BCKPMF =   1.00,  1.00,  1.00,  1.00,  1.00,  1.00,  1.00,  1.00,  1.00,
 1.00,  1.00,  1.00 !
     !  OFRAC =   0.15,  0.15,  0.20,  0.20,  0.20,  0.20,  0.20,  0.20,  0.20,
 0.20,  0.20,  0.15 !
     !   VCNX =  50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00,
50.00, 50.00, 50.00 !

 --- End Data for SECONDARY ORGANIC AEROSOL (SOA) Option


     Number of half-life decay specification blocks provided in Subgroup 11b
     (Used only if MCHEM = 5)
     (NDECAY)                                    Default: 0      ! NDECAY = 0 !

!END!


--------------
Subgroup (11b)
--------------

     Each species modeled may be assigned a decay half-life (sec), and the
associated
     mass lost may be assigned to one or more other modeled species using a
mass yield
     factor. This information is used only for MCHEM=5.
```

```
     Provide NDECAY blocks assigning the half-life for a parent species and
mass yield
     factors for each child species (if any) produced by the decay.
     Set HALF_LIFE=0.0 for NO decay (infinite half-life).


                              a            b
        SPECIES      Half-Life   Mass Yield
         NAME          (sec)       Factor
        -------      ---------   ----------
     *   SPEC1   =    3600.,        -1.0   *    (Parent)
     *   SPEC2   =     -1.0,         0.0   *    (Child)
   *END*
--------
    a
     Specify a half life that is greater than or equal to zero for 1 parent
species
     in each block, and set the yield factor for this species to -1
    b
     Specify a yield factor that is greater than or equal to zero for 1 or more
child
     species in each block, and set the half-life for each of these species to
-1

     NOTE: Assignments in each block are treated as a separate input
           subgroup and therefore must end with an input group terminator.
           If NDECAY=0, no assignments and input group terminators should
appear.

------------------------------------------------------------------------------


INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters
--------------

     Horizontal size of puff (m) beyond which
     time-dependent dispersion equations (Heffter)
     are used to determine sigma-y and
     sigma-z (SYTDEP)                          Default: 550.   ! SYTDEP =
5.5E02 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                  Default: 0      ! MHFTSZ = 0 !

     Stability class used to determine plume
     growth rates for puffs above the boundary
     layer (JSUP)                              Default: 5      ! JSUP = 5 !

     Vertical dispersion constant for stable
     conditions (k1 in Eqn. 2.7-3)  (CONK1)    Default: 0.01   ! CONK1 = .01 !
```

```
     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
     (CONK2)                                  Default: 0.1    ! CONK2 = .1 !

     Factor for determining Transition-point from
     Schulman-Scire to Huber-Snyder Building Downwash
     scheme (SS used for Hs < Hb + TBD * HL)
     (TBD)                                    Default: 0.5    ! TBD = .5 !
        TBD < 0   ==> always use Huber-Snyder
        TBD = 1.5 ==> always use Schulman-Scire
        TBD = 0.5 ==> ISC Transition-point

     Range of land use categories for which
     urban dispersion is assumed
     (IURB1, IURB2)                           Default: 10     ! IURB1 = 10 !
                                                       19     ! IURB2 = 19 !

     Site characterization parameters for single-point Met data files ---------
     (needed for METFM = 2,3,4,5)

        Land use category for modeling domain
        (ILANDUIN)                            Default: 20     ! ILANDUIN = 20
!

        Roughness length (m) for modeling domain
        (Z0IN)                                Default: 0.25   ! Z0IN = .25 !

        Leaf area index for modeling domain
        (XLAIIN)                              Default: 3.0    ! XLAIIN = 3.0
!

        Elevation above sea level (m)
        (ELEVIN)                              Default: 0.0    ! ELEVIN = .0 !

        Latitude (degrees) for met location
        (XLATIN)                              Default: -999.  ! XLATIN =
-999. !

        Longitude (degrees) for met location
        (XLONIN)                              Default: -999.  ! XLONIN =
-999. !

     Specialized information for interpreting single-point Met data files -----

        Anemometer height (m) (Used only if METFM = 2,3)
        (ANEMHT)                              Default: 10.    ! ANEMHT = 10.0
!

        Form of lateral turbulance data in PROFILE.DAT file
        (Used only if METFM = 4,5 or MTURBVW = 1 or 3)
        (ISIGMAV)                             Default: 1      ! ISIGMAV = 1 !
            0 = read sigma-theta
```

```
            1 = read sigma-v

         Choice of mixing heights (Used only if METFM = 4)
         (IMIXCTDM)                              Default: 0      ! IMIXCTDM = 0
!
            0 = read PREDICTED mixing heights
            1 = read OBSERVED mixing heights

      Maximum length of a slug (met. grid units)
      (XMXLEN)                                   Default: 1.0    ! XMXLEN = 1.0
!

      Maximum travel distance of a puff/slug (in
      grid units) during one sampling step
      (XSAMLEN)                                  Default: 1.0    ! XSAMLEN = 1.0
!

      Maximum Number of slugs/puffs release from
      one source during one time step
      (MXNEW)                                    Default: 99     ! MXNEW = 99 !

      Maximum Number of sampling steps for
      one puff/slug during one time step
      (MXSAM)                                    Default: 99     ! MXSAM = 99 !

      Number of iterations used when computing
      the transport wind for a sampling step
      that includes gradual rise (for CALMET
      and PROFILE winds)
      (NCOUNT)                                   Default: 2      ! NCOUNT = 2 !

      Minimum sigma y for a new puff/slug (m)
      (SYMIN)                                    Default: 1.0    ! SYMIN = 1.0 !

      Minimum sigma z for a new puff/slug (m)
      (SZMIN)                                    Default: 1.0    ! SZMIN = 1.0 !

      Maximum sigma z (m) allowed to avoid
      numerical problem in calculating virtual
      time or distance.  Cap should be large
      enough to have no influence on normal events.
      Enter a negative cap to disable.
      (SZCAP_M)                                  Default: 5.0e06 ! SZCAP_M =
5.0E06 !

      Default minimum turbulence velocities sigma-v and sigma-w
      for each stability class over land and over water (m/s)
      (SVMIN(12) and SWMIN(12))

                      ----------  LAND  ----------       ---------  WATER
----------
         Stab Class :  A    B    C    D    E    F         A    B    C    D    E
```

```
  F
                     ---  ---  ---  ---  ---  ---       ---  ---  ---  ---  ---
 ---
     Default SVMIN : .50, .50, .50, .50, .50, .50,      .37, .37, .37, .37,
.37, .37
     Default SWMIN : .20, .12, .08, .06, .03, .016,     .20, .12, .08, .06,
.03, .016

           !  SVMIN =  0.500, 0.500, 0.500, 0.500, 0.500, 0.500, 0.370, 0.370,
0.370, 0.370, 0.370, 0.370 !
           !  SWMIN =  0.200, 0.120, 0.080, 0.060, 0.030, 0.016, 0.200, 0.120,
0.080, 0.060, 0.030, 0.016 !

     Divergence criterion for dw/dz across puff
     used to initiate adjustment for horizontal
     convergence (1/s)
     Partial adjustment starts at CDIV(1), and
     full adjustment is reached at CDIV(2)
     (CDIV(2))                                     Default: 0.0,0.0  !   CDIV =
 .0,    .0 !

     Search radius (number of cells) for nearest
     land and water cells used in the subgrid
     TIBL module
     (NLUTIBL)                                     Default: 4      ! NLUTIBL = 4 !

     Minimum wind speed (m/s) allowed for
     non-calm conditions. Also used as minimum
     speed returned when using power-law
     extrapolation toward surface
     (WSCALM)                                      Default: 0.5    ! WSCALM = .5 !

     Maximum mixing height (m)
     (XMAXZI)                                      Default: 3000.  ! XMAXZI =
3000.0 !

     Minimum mixing height (m)
     (XMINZI)                                      Default: 50.    ! XMINZI = 20.0
!

     Default wind speed classes --
     5 upper bounds (m/s) are entered;
     the 6th class has no upper limit
     (WSCAT(5))                       Default   :
                                      ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8
(10.8+)

                                Wind Speed Class :  1     2     3     4     5
                                                   ---   ---   ---   ---   ---
                                         !  WSCAT =   1.54,  3.09,  5.14,  8.23,
10.80 !
```

```
     Default wind speed profile power-law
     exponents for stabilities 1-6
     (PLX0(6))                       Default   : ISC RURAL values
                                     ISC RURAL : .07, .07, .10, .15, .35, .55
                                     ISC URBAN : .15, .15, .20, .25, .30, .30

                                Stability Class :  A     B     C     D     E
F
                                                   ---   ---   ---   ---   ---
---
                                        !   PLX0 =   0.07,  0.07,  0.10,  0.15,
 0.35,  0.55 !

     Default potential temperature gradient
     for stable classes E, F (degK/m)
     (PTG0(2))                       Default: 0.020, 0.035
                                        !   PTG0 =  0.020, 0.035 !

     Default plume path coefficients for
     each stability class (used when option
     for partial plume height terrain adjustment
     is selected -- MCTADJ=3)
     (PPC(6))                   Stability Class :  A     B     C     D     E
F
                                   Default  PPC : .50,  .50,  .50,  .50,  .35,
.35
                                                   ---   ---   ---   ---   ---
---
                                        !    PPC =   0.50,  0.50,  0.50,  0.50,
 0.35,  0.35 !

     Slug-to-puff transition criterion factor
     equal to sigma-y/length of slug
     (SL2PF)                            Default: 10.        ! SL2PF = 10.0 !

     Puff-splitting control variables ------------------------

       VERTICAL SPLIT
       --------------

       Number of puffs that result every time a puff
       is split - nsplit=2 means that 1 puff splits
       into 2
       (NSPLIT)                         Default:   3        ! NSPLIT = 3 !

       Time(s) of a day when split puffs are eligible to
       be split once again; this is typically set once
       per day, around sunset before nocturnal shear develops.
       24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
       0=do not re-split    1=eligible for re-split
       (IRESPLIT(24))                   Default:  Hour 17 = 1
       ! IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !
```

```
       Split is allowed only if last hour's mixing
       height (m) exceeds a minimum value
       (ZISPLIT)                        Default: 100.       ! ZISPLIT =
100.0 !

       Split is allowed only if ratio of last hour's
       mixing ht to the maximum mixing ht experienced
       by the puff is less than a maximum value (this
       postpones a split until a nocturnal layer develops)
       (ROLDMAX)                        Default: 0.25       ! ROLDMAX = 0.25
!


       HORIZONTAL SPLIT
       ----------------

       Number of puffs that result every time a puff
       is split - nsplith=5 means that 1 puff splits
       into 5
       (NSPLITH)                        Default:   5        ! NSPLITH = 5 !

       Minimum sigma-y (Grid Cells Units) of puff
       before it may be split
       (SYSPLITH)                       Default:  1.0       ! SYSPLITH = 1.0
!

       Minimum puff elongation rate (SYSPLITH/hr) due to
       wind shear, before it may be split
       (SHSPLITH)                       Default:  2.        ! SHSPLITH = 2.0
!

       Minimum concentration (g/m^3) of each
       species in puff before it may be split
       Enter array of NSPEC values; if a single value is
       entered, it will be used for ALL species
       (CNSPLITH)                       Default:  1.0E-07   ! CNSPLITH =
1.0E-07 !

     Integration control variables ------------------------

       Fractional convergence criterion for numerical SLUG
       sampling integration
       (EPSSLUG)                        Default:   1.0e-04  ! EPSSLUG =
1.0E-04 !

       Fractional convergence criterion for numerical AREA
       source integration
       (EPSAREA)                        Default:   1.0e-06  ! EPSAREA =
1.0E-06 !

       Trajectory step-length (m) used for numerical rise
```

```
       integration
       (DSRISE)                          Default:   1.0      ! DSRISE = 1.0 !

       Boundary Condition (BC) Puff control variables ----------------------

       Minimum height (m) to which BC puffs are mixed as they are emitted
       (MBCON=2 ONLY).  Actual height is reset to the current mixing height
       at the release point if greater than this minimum.
       (HTMINBC)                         Default:   500.     ! HTMINBC =
500.0 !

       Search radius (km) about a receptor for sampling nearest BC puff.
       BC puffs are typically emitted with a spacing of one grid cell
       length, so the search radius should be greater than DGRIDKM.
       (RSAMPBC)                         Default:   10.      ! RSAMPBC = 10.0
!

       Near-Surface depletion adjustment to concentration profile used when
       sampling BC puffs?
       (MDEPBC)                          Default:   1        ! MDEPBC = 1 !
          0 = Concentration is NOT adjusted for depletion
          1 = Adjust Concentration for depletion

!END!


--------------------------------------------------------------------------------


INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------

---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  ! NPT1 = 0 !

     Units used for point source
     emissions below                (IPTU)  Default: 1  ! IPTU = 1 !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
```

```
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  ! NSPT1 = 0 !

     Number of point sources with
     variable emission parameters
     provided in external file      (NPT2)  No default  ! NPT2 = 0 !

     (If NPT2 > 0, these point
     source emissions are read from
     the file: PTEMARB.DAT)

!END!

---------------
Subgroup (13b)
---------------
                                      a
          POINT SOURCE: CONSTANT DATA
          ---------------------------
                                                                        b
         c
  Source       X         Y       Stack    Base     Stack    Exit  Exit    Bldg.
 Emission
   No.     Coordinate Coordinate Height Elevation Diameter  Vel.  Temp.   Dwash
  Rates
              (km)      (km)       (m)      (m)       (m)  (m/s) (deg. K)

  ------   ---------- ---------- ------  ------   -------- ----- -------- -----
--------

--------
```

a
Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.

SRCNAM is a 12-character name for a source
(No default)
X is an array holding the source data listed by the column headings
(No default)
SIGYZI is an array holding the initial sigma-y and sigma-z (m)
(Default: 0.,0.)
FMFAC is a vertical momentum flux factor (0. or 1.0) used to represent
the effect of rain-caps or other physical configurations that
reduce momentum rise associated with the actual exit velocity.
(Default: 1.0 -- full momentum used)
ZPLTFM is the platform height (m) for sources influenced by an isolated
structure that has a significant open area between the surface
and the bulk of the structure, such as an offshore oil platform.
The Base Elevation is that of the surface (ground or ocean),
and the Stack Height is the release height above the Base (not

above the platform). Building heights entered in Subgroup 13c must be those of the buildings on the platform, measured from the platform deck. ZPLTFM is used only with MBDW=1 (ISC downwash method) for sources with building downwash. (Default: 0.0)

b
0. = No building downwash modeled
1. = Downwash modeled for buildings resting on the surface
2. = Downwash modeled for buildings raised above the surface (ZPLTFM > 0.)
NOTE: must be entered as a REAL number (i.e., with decimal point)

c
An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by IPTU (e.g. 1 for g/s).

Subgroup (13c)

BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH

Source a
No. Effective building height, width, length and X/Y offset (in meters) every 10 degrees. LENGTH, XBADJ, and YBADJ are only needed for MBDW=2 (PRIME downwash option)

```
   1 * SRCNAM = STK1 *
   1 * HEIGHT =    16.00,   16.00,   16.00,   16.00,   16.00,   16.00,
                   16.00,   16.00,   16.00,   16.00,   16.00,   16.00,
                   16.00,   16.00,   16.00,   16.00,   16.00,   16.00,
                   16.00,   16.00,   16.00,   16.00,   16.00,   16.00,
                   16.00,   16.00,   35.00,   35.00,   35.00,   16.00,
                   16.00,   16.00,   16.00,   16.00,   16.00,   16.00 *
   1 *  WIDTH =   148.62,  128.00,  173.25,  213.24,  246.75,  289.75,
                  330.06,  360.34,  379.67,  387.46,  393.50,  401.68,
                  397.66,  381.55,  353.84,  315.39,  267.35,  211.19,
                  148.62,  128.00,  173.25,  213.24,  246.75,  289.75,
                  330.06,  360.34,   39.66,   39.49,   39.94,  401.68,
                  397.66,  381.55,  353.84,  315.39,  267.35,  211.19 *
   1 * LENGTH =   387.46,  393.50,  401.68,  397.66,  381.55,  353.84,
                  315.39,  267.35,  211.19,  148.62,  128.00,  173.25,
                  213.24,  246.75,  289.75,  330.06,  360.34,  379.67,
                  387.46,  393.50,  401.68,  397.66,  381.55,  353.84,
                  315.39,  267.35,   18.37,   11.88,   11.21,  173.25,
                  213.24,  246.75,  289.75,  330.06,  360.34,  379.67 *
   1 *  XBADJ =  -291.24, -280.58, -273.10, -257.31, -233.71, -203.01,
                 -166.14, -124.22,  -78.53,  -30.45,   -0.69,   -0.42,
                   -0.14,    0.15,  -16.56,  -38.87,  -60.01,  -79.32,
                  -96.22, -112.92, -128.59, -140.34, -147.83, -150.83,
```

```
                -149.25, -143.13, -183.53, -183.90, -181.79, -172.83,
                -213.10, -246.90, -273.19, -291.18, -300.33, -300.35 *
   1 *  YBADJ =   -43.86,  -63.31,  -86.20, -106.48, -123.52, -128.31,
                -126.15, -120.16, -110.52,  -97.51,  -83.83,  -72.25,
                 -58.49,  -42.94,  -26.09,   -8.44,    9.46,   27.07,
                  43.86,   63.31,   86.20,  106.48,  123.52,  128.31,
                 126.15,  120.16,   36.30,    5.49,  -25.74,   72.26,
                  58.49,   42.94,   26.09,    8.44,   -9.46,  -27.07 *
*END*
--------
```

a
Building height, width, length, and X/Y offset from the source are treated as a separate input subgroup for each source and therefore must end with an input group terminator. The X/Y offset is the position, relative to the stack, of the center of the upwind face of the projected building, with the x-axis pointing along the flow direction.

Subgroup (13d)

---

a

POINT SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission rates given in 13b. Factors entered multiply the rates in 13b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

- 0 = Constant
- 1 = Diurnal cycle (24 scaling factors: hours 1-24)
- 2 = Monthly cycle (12 scaling factors: months 1-12)
- 3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
- 4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12
- 5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40,

---
a
Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.

INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters

Subgroup (14a)

Number of polygon area sources with
parameters specified below (NAR1) No default ! NAR1 = 3 !

Units used for area source
emissions below (IARU) Default: 1 ! IARU = 1 !
1 = g/m**2/s
2 = kg/m**2/hr
3 = lb/m**2/hr
4 = tons/m**2/yr
5 = Odour Unit * m/s (vol. flux/m**2 of odour compound)
6 = Odour Unit * m/min
7 = metric tons/m**2/yr
8 = Bq/m**2/s (Bq = becquerel = disintegrations/s)
9 = GBq/m**2/yr

Number of source-species
combinations with variable
emissions scaling factors
provided below in (14d) (NSAR1) Default: 0 ! NSAR1 = 0 !

Number of buoyant polygon area sources
with variable location and emission
parameters (NAR2) No default ! NAR2 = 0 !
(If NAR2 > 0, ALL parameter data for
these sources are read from the file: BAEMARB.DAT)

!END!

Subgroup (14b)

AREA SOURCE: CONSTANT DATA

Source No.	Effect. Height (m)	Base Elevation (m)	Initial Sigma z (m)	Emission Rates [b]
1 ! SRCNAM = West Pit (ha) !				
1 ! X = 0, 53, , 6.388890E-005, 6.388890E-006, 0.000127778 !				
!END!				
2 ! SRCNAM = Production !				
2 ! X = 0, 62, , 1.527780E-005, 1.527780E-006, 3.055560E-005 !				
!END!				
3 ! SRCNAM = East Pit !				
3 ! X = 0, 53, , 1.805560E-005, 1.805560E-006, 3.611110E-005 !				
!END!				

---

[a] Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

[b] An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by IARU (e.g. 1 for g/m**2/s).

Subgroup (14c)

COORDINATES (km) FOR EACH VERTEX(4) OF EACH POLYGON

Source No. [a]	Ordered list of X followed by list of Y, grouped by source
1 ! SRCNAM = West Pit (ha) !	
1 ! XVERT = 369.975, 370.007, 370.302, 370.595 !	
1 ! YVERT = 6397.746, 6398.317, 6398.332, 6397.559 !	
!END!	
2 ! SRCNAM = Production !	
2 ! XVERT = 370.474, 370.704, 370.908, 370.832 !	
2 ! YVERT = 6397.158, 6397.5, 6397.493, 6397.09 !	
!END!	
3 ! SRCNAM = East Pit !	
3 ! XVERT = 370.595, 370.65, 371.03, 370.971 !	
3 ! YVERT = 6397.559, 6397.903, 6397.803, 6397.464 !	

!END!

---
a
Data for each source are treated as a separate input subgroup
and therefore must end with an input group terminator.

Subgroup (14d)
---

a
AREA SOURCE: VARIABLE EMISSIONS DATA

Use this subgroup to describe temporal variations in the emission rates given in 14b. Factors entered multiply the rates in 14b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

0 =	Constant	
1 =	Diurnal cycle	(24 scaling factors: hours 1-24)
2 =	Monthly cycle	(12 scaling factors: months 1-12)
3 =	Hour & Season	(4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
4 =	Speed & Stab.	(6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12
5 =	Temperature	(12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)

---
a
Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters

Subgroup (15a)

```
     Number of buoyant line sources
     with variable location and emission
     parameters (NLN2)                              No default  ! NLN2 = 0 !

     (If NLN2 > 0, ALL parameter data for
      these sources are read from the file: LNEMARB.DAT)

     Number of buoyant line sources (NLINES)        No default   ! NLINES = 0 !

     Units used for line source
     emissions below               (ILNU)           Default: 1  ! ILNU = 1 !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)        (NSLN1) Default: 0  ! NSLN1 = 0 !

     Maximum number of segments used to model
     each line (MXNSEG)                             Default: 7   ! MXNSEG = 7 !

     The following variables are required only if NLINES > 0.  They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which                Default: 6   ! NLRISE = 6 !
        transitional rise is computed

        Average building length (XL)                No default   ! XL = .0 !
                                                    (in meters)

        Average building height (HBL)               No default   ! HBL = .0 !
                                                    (in meters)

        Average building width (WBL)                No default   ! WBL = .0 !
                                                    (in meters)

        Average line source width (WML)             No default   ! WML = .0 !
                                                    (in meters)

        Average separation between buildings (DXL)  No default   ! DXL = .0 !
                                                    (in meters)
```

```
        Average buoyancy parameter (FPRIMEL)        No default   ! FPRIMEL = .0
!
                                                    (in m**4/s**3)

!END!
```

Subgroup (15b)

BUOYANT LINE SOURCE: CONSTANT DATA

Source No.	Beg. X Coordinate (km)	Beg. Y Coordinate (km)	End. X Coordinate (km)	End. Y Coordinate (km)	Release Height (m)	Base Elevation (m)	Emission Rates [a]

---

[a] Data for each source are treated as a separate input subgroup and therefore must end with an input group terminator.

[b] An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by ILNTU (e.g. 1 for g/s).

Subgroup (15c)

BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA [a]

Use this subgroup to describe temporal variations in the emission rates given in 15b. Factors entered multiply the rates in 15b. Skip sources here that have constant emissions.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

- 0 = Constant
- 1 = Diurnal cycle (24 scaling factors: hours 1-24)
- 2 = Monthly cycle (12 scaling factors: months 1-12)
- 3 = Hour & Season (4 groups of 24 hourly scaling factors,

```
                                Calpuff.inp
                                  where first group is DEC-JAN-FEB)
          4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                   first group is Stability Class A,
                                   and the speed classes have upper
                                   bounds (m/s) defined in Group 12
          5 =       Temperature   (12 scaling factors, where temperature
                                   classes have upper bounds (C) of:
                                   0, 5, 10, 15, 20, 25, 30, 35, 40,
                                   45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


------------------------------------------------------------------------------


INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters
---------------------------

---------------
Subgroup (16a)
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  ! NVL1 = 28 !

     Units used for volume source
     emissions below in 16b       (IVLU)     Default: 1  ! IVLU = 1 !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (16c)      (NSVL1)    Default: 0  ! NSVL1 = 0 !

     Number of volume sources with
     variable location and emission
     parameters                   (NVL2)     No default  ! NVL2 = 0 !
```

(If NVL2 > 0, ALL parameter data for
these sources are read from the VOLEMARB.DAT file(s))

!END!

Subgroup (16b)
---

a

VOLUME SOURCE: CONSTANT DATA
---

b

Source No.	X Coordinate (km)	Y Coordinate (km)	Effect. Height (m)	Base Elevation (m)	Initial Sigma y (m)	Initial Sigma z (m)	Emission Rates
1	! SRCNAM = TT1 !						
1	! X = 370.013	6397.598	68	0	, ,	0.000725	0.023611111, 0.00725 !

!END!

2	! SRCNAM = TT2 !						
2	! X = 370.149	6397.559	80	0	, ,	0.000725	0.023611111, 0.00725 !

!END!

3	! SRCNAM = TT3 !						
3	! X = 370.167	6397.481	86	0	, ,	0.000725	0.023611111, 0.00725 !

!END!

4	! SRCNAM = TT4 !						
4	! X = 370.229	6397.454	87	0	, ,	0.000725	0.023611111, 0.00725 !

!END!

5	! SRCNAM = TT5 !						
5	! X = 370.314	6397.455	86	0	, ,	0.000725	0.023611111, 0.00725 !

!END!

6	! SRCNAM = TT6 !						
6	! X = 370.413	6397.451	80	0	, ,	0.000725	0.023611111, 0.00725 !

```
!END!

   7 ! SRCNAM = TT7 !
   7 ! X = 370.488, 6397.435, 70, 0, , , 0.000725, 0.023611111, 0.00725 !


!END!

   8 ! SRCNAM = TT8 !
   8 ! X = 370.586, 6397.38, 65, 0, , , 0.000725, 0.023611111, 0.00725 !


!END!

   9 ! SRCNAM = TT9 !
   9 ! X = 370.569, 6397.198, 55, 0, , , 0.000725, 0.023611111, 0.00725 !


!END!

  10 ! SRCNAM = TT10 !
  10 ! X = 370.65, 6397.23, 61, 0, , , 0.000725, 0.023611111, 0.00725 !


!END!

  11 ! SRCNAM = HT1 !
  11 ! X = 370.312, 6397.698, 71, 0, , , 0.001277778, 0.041805556, 0.012777778
!


!END!

  12 ! SRCNAM = HT2 !
  12 ! X = 370.474, 6397.752, 84, 0, , , 0.001277778, 0.041805556, 0.012777778
!


!END!

  13 ! SRCNAM = SPL1 !
  13 ! X = 370.788, 6397.419, 64, 0, , , 0.028275694, 0.663333333, 0.282756944
!


!END!

  14 ! SRCNAM = SPL2 !
  14 ! X = 370.588, 6397.091, 60, 0, , , 0.028275694, 0.663333333, 0.282756944
!
```

```
!END!

  15 ! SRCNAM = PML !
  15 ! X = 370.794, 6397.14, 75, 0, , , 0.028275694, 0.663333333, 0.282756944 !


!END!

  16 ! SRCNAM = TL !
  16 ! X = 370.696, 6397.264, 62, 0, , , 0.028275694, 0.663333333, 0.282756944
!


!END!

  17 ! SRCNAM = QFL !
  17 ! X = 370.194, 6398.045, 72, 0, , , 0.028275694, 0.663333333, 0.282756944
!


!END!

  18 ! SRCNAM = PRD !
  18 ! X = 370.371, 6397.935, 88, 0, , , 0.004090278, 0.040972222, 0.040902778
!


!END!

  19 ! SRCNAM = TT11 !
  19 ! X = 370.706, 6397.254, 61, 0, , , 0.000725, 0.023611111, 0.00725 !


!END!

  20 ! SRCNAM = TT12 !
  20 ! X = 370.65, 6397.153, 64, 0, , , 0.000725, 0.023611111, 0.00725 !


!END!

  21 ! SRCNAM = D10 !
  21 ! X = 370.149, 6397.959, 66, 0, , , 0.009341667, 0.347222222, 0.093416667
!


!END!

  22 ! SRCNAM = JJC !
  22 ! X = 370.77, 6397.376, 63, 0, , , 0.012333333, 0.308333333, 0.123333333 !
```

```
!END!

  23 ! SRCNAM = SB&C !
  23 ! X = 370.697, 6397.305, 61, 3, , , 0.012333333, 0.308333333, 0.123333333
!


!END!

  24 ! SRCNAM = 48RC !
  24 ! X = 370.732, 6397.333, 61, 3, , , 0.006166667, 1.541666667, 0.061666667
!


!END!

  25 ! SRCNAM = CRC !
  25 ! X = 370.665, 6397.268, 61, 3, , , 0.006166667, 1.541666667, 0.061666667
!


!END!

  26 ! SRCNAM = PS !
  26 ! X = 370.753, 6397.347, 62, 3, , , 0.006166667, 1.541666667, 0.061666667
!


!END!

  27 ! SRCNAM = PM !
  27 ! X = 370.757, 6397.114, 73, 3, , , 0, 0, 0 !


!END!

  28 ! SRCNAM = MJC !
  28 ! X = 370.312, 6397.874, 74, 3, , , 0.006166667, 1.541666667, 0.061666667
!


!END!


--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
```

An emission rate must be entered for every pollutant modeled. Enter emission rate of zero for secondary pollutants that are modeled, but not emitted. Units are specified by IVLU (e.g. 1 for g/s).

Subgroup (16c)

VOLUME SOURCE: VARIABLE EMISSIONS DATA[a]

Use this subgroup to describe temporal variations in the emission rates given in 16b. Factors entered multiply the rates in 16b. Skip sources here that have constant emissions. For more elaborate variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

IVARY determines the type of variation, and is source-specific:
(IVARY) Default: 0

- 0 = Constant
- 1 = Diurnal cycle (24 scaling factors: hours 1-24)
- 2 = Monthly cycle (12 scaling factors: months 1-12)
- 3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB)
- 4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the speed classes have upper bounds (m/s) defined in Group 12
- 5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)

---

[a] Data for each species are treated as a separate input subgroup and therefore must end with an input group terminator.

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information

---

Subgroup (17a)

Number of non-gridded receptors (NREC) No default ! NREC = 22 !

!END!

Subgroup (17b)
---

a

NON-GRIDDED (DISCRETE) RECEPTOR DATA

Receptor No.		X Coordinate (km)	Y Coordinate (km)	Ground Elevation (m)	Height Above Ground (m) b	
1	! X =	370.283,	6397.003,	39,	0!	!END!
2	! X =	370.301,	6397.025,	40,	0!	!END!
3	! X =	370.329,	6397.061,	41,	0!	!END!
4	! X =	370.337,	6397.082,	42,	0!	!END!
5	! X =	370.349,	6397.094,	42,	0!	!END!
6	! X =	370.364,	6397.114,	44,	0!	!END!
7	! X =	370.379,	6397.128,	45,	0!	!END!
8	! X =	370.389,	6397.147,	46,	0!	!END!
9	! X =	370.404,	6397.162,	47,	0!	!END!
10	! X =	370.413,	6397.201,	48,	0!	!END!
11	! X =	370.352,	6396.953,	43,	0!	!END!
12	! X =	370.375,	6396.940,	43,	0!	!END!
13	! X =	370.400,	6396.931,	44,	0!	!END!
14	! X =	370.458,	6396.933,	46,	0!	!END!
15	! X =	371.15,	6396.899,	80,	0!	!END!
16	! X =	370.971,	6397.833,	113,	0!	!END!
17	! X =	369.773,	6398.077,	52,	0!	!END!
18	! X =	369.57,	6397.820,	50,	0!	!END!
19	! X =	369.636,	6397.630,	53,	0!	!END!
20	! X =	369.852,	6397.380,	49,	0!	!END!
21	! X =	369.819,	6397.259,	44,	0!	!END!
22	! X =	370.080,	6397.085,	42,	0!	!END!

---

a
Data for each receptor are treated as a separate input subgroup and therefore must end with an input group terminator.

b
Receptor height above ground is optional. If no value is entered, the receptor is placed on the ground.

Appendix C

Summary Tables from Dispersion Modelling

Table 9 Maximum predicted 24-hour $PM_{2.5}$ Concentration at Sensitive Receptors

Receptor	Maximum Increment	Background	Maximum Cumulative	Assessment Criterion
1	0	7.8	7.74	25
2	0.00	7.8	7.80	25
3	0.05	7.8	7.85	25
4	0.05	7.8	7.85	25
5	0.03	7.8	7.83	25
6	0.05	7.8	7.85	25
7	0.06	7.8	7.86	25
8	0.06	7.8	7.86	25
9	0.10	7.8	7.90	25
10	0.15	7.8	7.95	25
11	0.28	7.8	8.08	25
12	0.36	7.8	8.16	25
13	0.43	7.8	8.23	25
14	0.58	7.8	8.38	25
15	0	7.8	7.59	25
16	0.44	7.8	8.24	25
17	1.08	7.8	8.88	25
18	0.43	7.8	8.23	25
19	0.35	7.8	8.15	25
20	0.26	7.8	8.06	25
21	0	7.8	7.77	25
22	0	7.8	7.54	25

Table 10 Maximum predicted Annual $PM_{2.5}$ Concentration at Sensitive Receptors

Receptor	Maximum Increment	Background	Maximum Cumulative	Assessment Criterion
1	0.81	7.8	6.99	8
2	0.80	7.8	7.00	8
3	0.78	7.8	7.02	8
4	0.77	7.8	7.03	8
5	0.76	7.8	7.04	8
6	0.74	7.8	7.06	8
7	0.72	7.8	7.08	8
8	0.71	7.8	7.09	8
9	0.69	7.8	7.11	8
10	0.67	7.8	7.13	8
11	0.78	7.8	7.02	8
12	0.78	7.8	7.02	8
13	0.77	7.8	7.03	8
14	0.76	7.8	7.04	8
15	0.88	7.8	6.92	8
16	0.43	7.8	7.37	8
17	0.44	7.8	7.36	8
18	0.71	7.8	7.09	8
19	0.70	7.8	7.10	8
20	0.71	7.8	7.09	8
21	0.78	7.8	7.02	8
22	0.82	7.8	6.98	8

Table 11 Maximum predicted 24-hour PM_{10} Concentration at Sensitive Receptors

Receptor	Maximum Increment	Background	Maximum Cumulative	Assessment Criterion
1	4.44	21	25.44	50
2	4.60	21	25.60	50
3	4.80	21	25.80	50
4	5.08	21	26.08	50
5	5.14	21	26.14	50
6	5.57	21	26.57	50
7	5.81	21	26.81	50
8	6.10	21	27.10	50
9	6.36	21	27.36	50
10	6.82	21	27.82	50
11	4.45	21	25.45	50
12	4.37	21	25.37	50
13	4.40	21	25.40	50
14	4.54	21	25.54	50
15	2.37	21	23.37	50
16	11.14	21	32.14	50
17	19.70	21	40.70	50
18	13.27	21	34.27	50
19	12.83	21	33.83	50
20	10.88	21	31.88	50
21	8.06	21	29.06	50
22	5.74	21	26.74	50

Table 12 Maximum predicted Annual PM_{10} Concentration at Sensitive Receptors

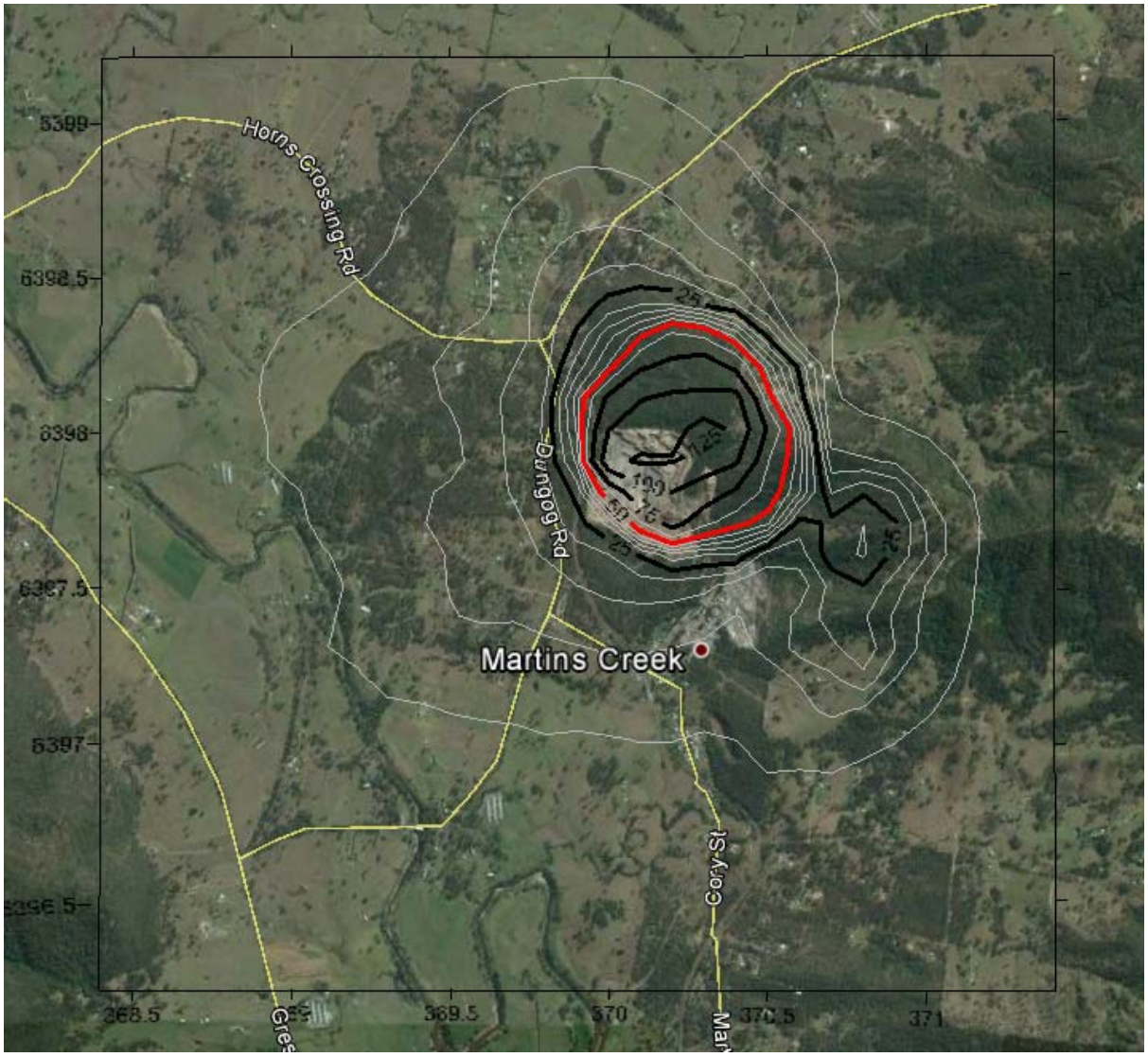
Receptor	Maximum Increment	Background	Maximum Cumulative	Assessment Criterion
1	1.07	21	22.07	30
2	1.13	21	22.13	30
3	1.24	21	22.24	30
4	1.31	21	22.31	30
5	1.35	21	22.35	30
6	1.45	21	22.45	30
7	1.53	21	22.53	30
8	1.62	21	22.62	30
9	1.71	21	22.71	30
10	1.87	21	22.87	30
11	1.06	21	22.06	30
12	1.05	21	22.05	30
13	1.06	21	22.06	30
14	1.12	21	22.12	30
15	0.41	21	21.41	30
16	5.13	21	26.13	30
17	5.10	21	26.10	30
18	2.48	21	23.48	30
19	2.46	21	23.46	30
20	2.17	21	23.17	30
21	1.64	21	22.64	30
22	1.24	21	22.24	30

Table 13 Maximum predicted maximum monthly TSP Deposition at Sensitive Receptors

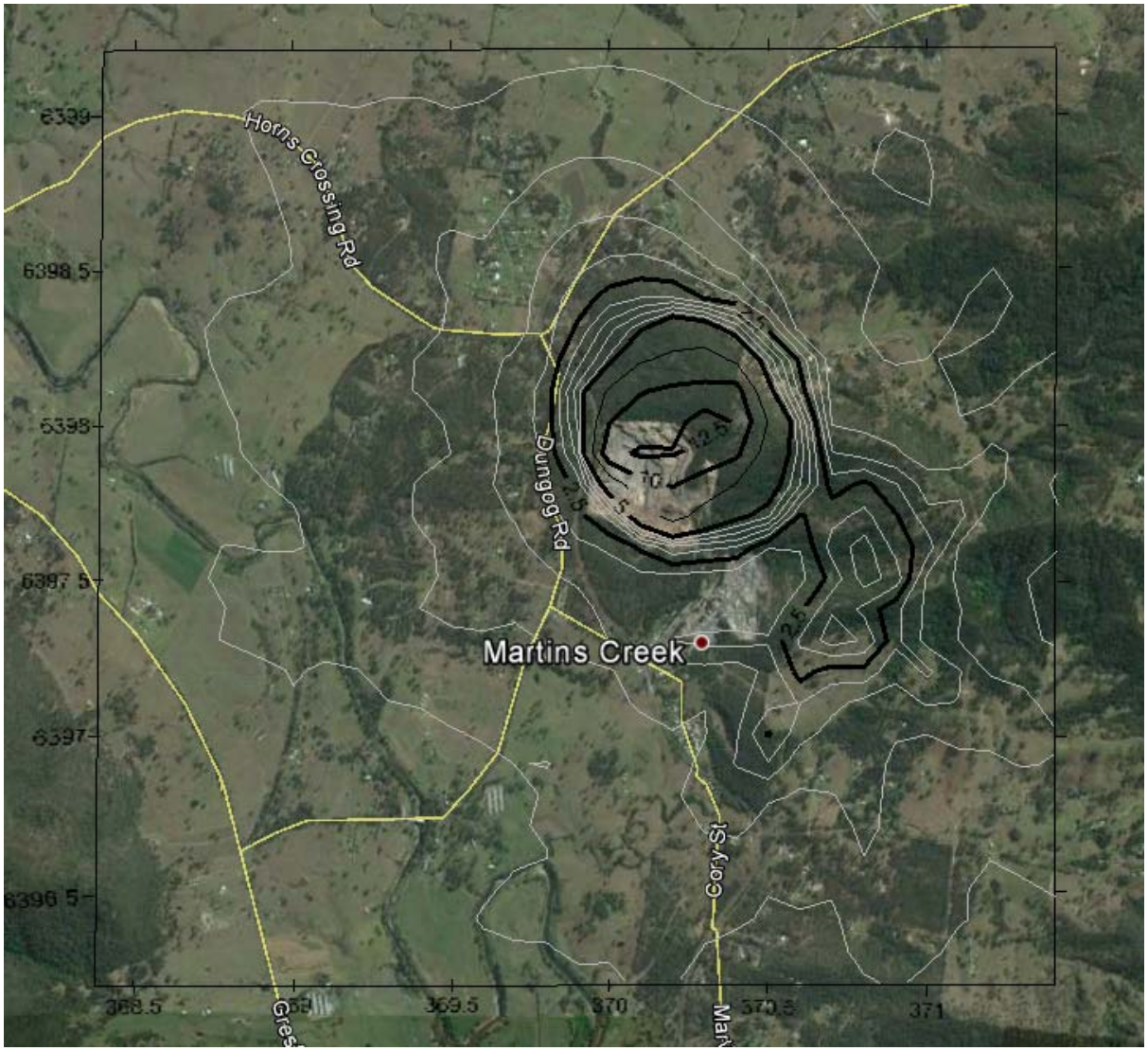
Receptor	Maximum Increment (g/m^2/month)	Background (g/m^2/month)	Maximum Cumulative (g/m^2/month)	Assessment Criterion (g/m^2/month)	
				Increment	Total
1	0.06	1.5	1.56	2	4
2	0.07	1.5	1.57	2	4
3	0.09	1.5	1.59	2	4
4	0.11	1.5	1.61	2	4
5	0.12	1.5	1.62	2	4
6	0.14	1.5	1.64	2	4
7	0.16	1.5	1.66	2	4
8	0.18	1.5	1.68	2	4
9	0.20	1.5	1.70	2	4
10	0.25	1.5	1.75	2	4
11	0.04	1.5	1.54	2	4
12	0.04	1.5	1.54	2	4
13	0.04	1.5	1.54	2	4
14	0.03	1.5	1.53	2	4
15	0.00	1.5	1.50	2	4
16	0.07	1.5	1.57	2	4
17	1.88	1.5	3.38	2	4
18	0.86	1.5	2.36	2	4
19	0.44	1.5	1.94	2	4
20	0.21	1.5	1.71	2	4
21	0.15	1.5	1.65	2	4
22	0.10	1.5	1.60	2	4

Appendix D

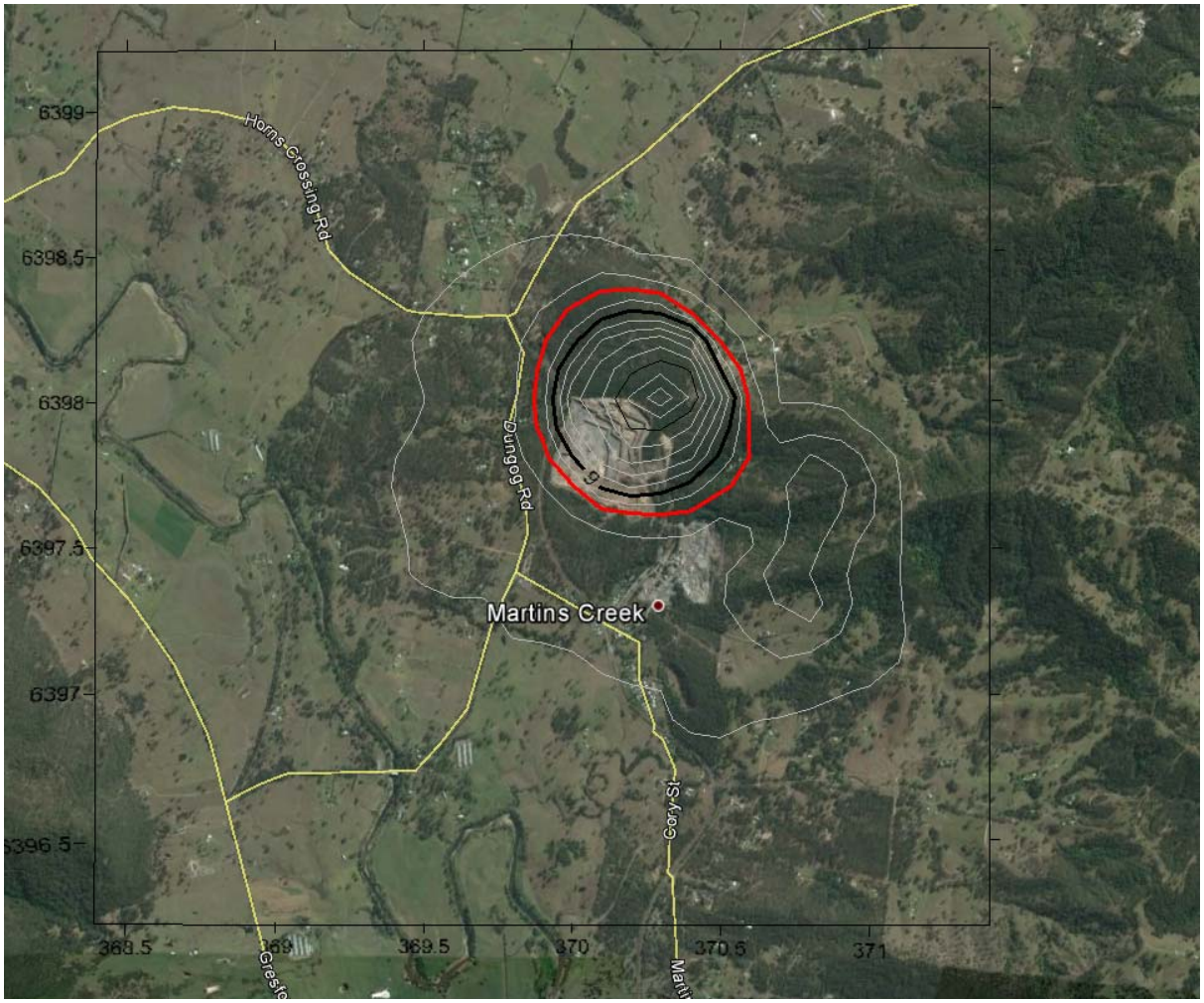
Dust Dispersion Contour Maps



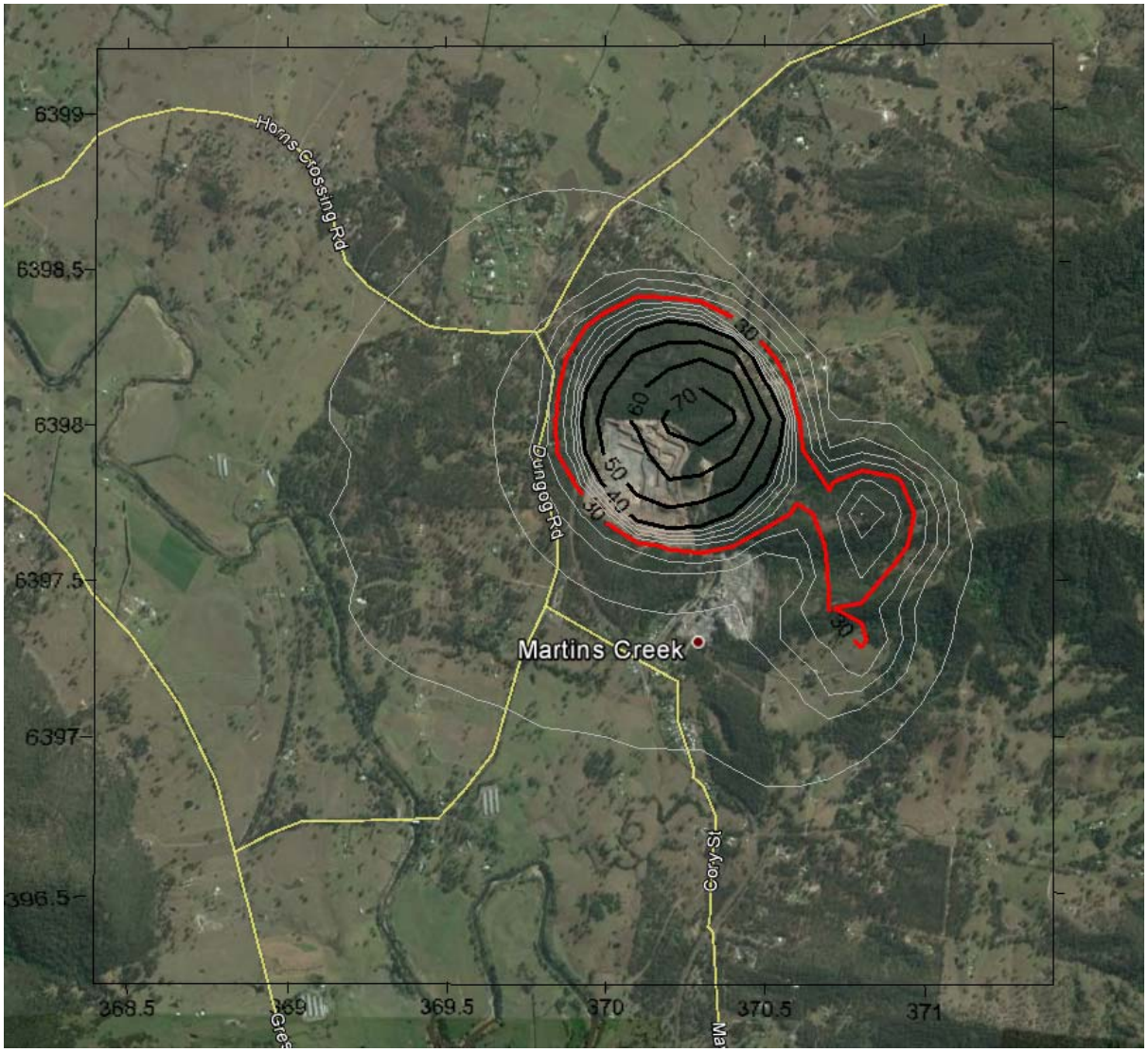
PM10 24 hour Countor



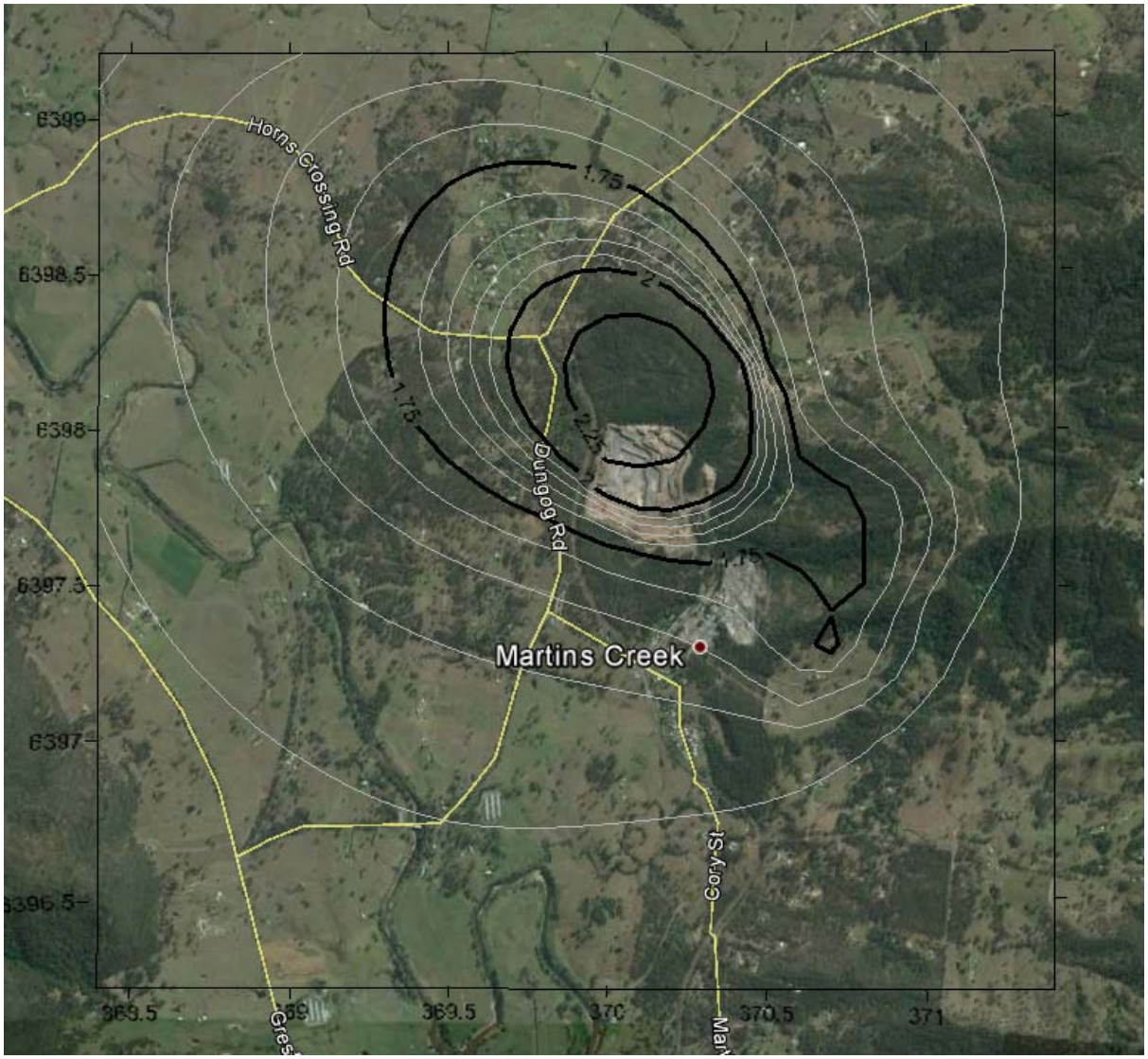
PM2.5 24 Hour Contours



PM2.5 Annual Contours



PM10 Annual Contours



TSP monthly contour