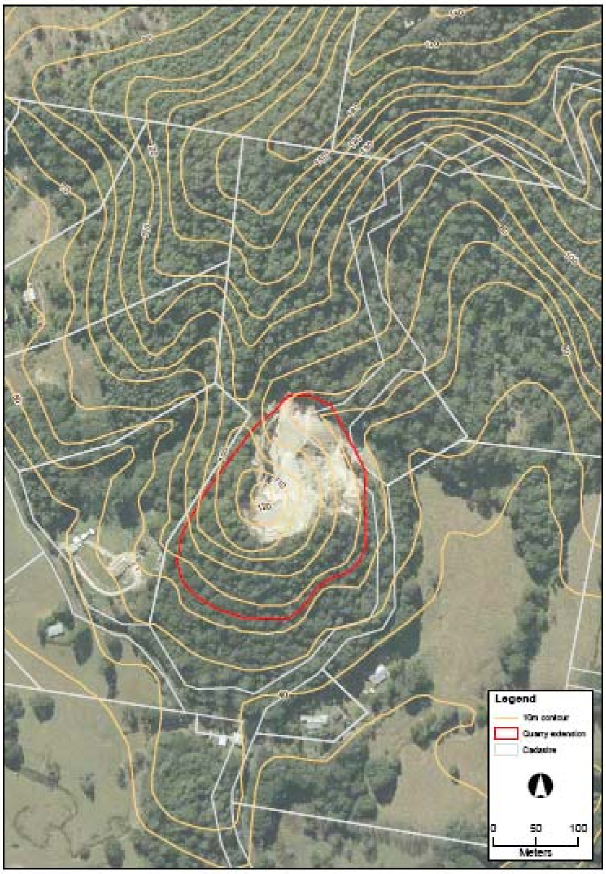
SINCLAIR KNIGHT MERZ

SKM

Burringbar Quarry Expansion



AIR QUALITY ASSESSMENT

- Final
- 12 March 2007

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Sinclair Knight Merz
ABN 37 001 024 095
100 Christie Street
PO Box 164
St Leonards NSW
Australia 1590
Tel: +61 2 9928 2100
Fax: +61 2 9928 2500
Web: www.skmconsulting.com

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1. Introduction

1.1 General Introduction

Tweed Shire Council presently operates a quarry at Burringbar on the far north of NSW. The quarry site is located on Cudgera Creek Road at Lot 6 DP 868345. Tweed Shire Council is looking to expand the scale of extractive operations that occur at Burringbar Quarry. The preferred option for expansion is to begin quarry operations in the southern sector of the site. The proposed southern sector would be located down ridge from the present operation and would be bordered to the south by the RL80 contour.

Sinclair Knight Merz (SKM) was commissioned by Tweed Shire Council to prepare an Environmental Assessment for works proposed as quarry operations. This report provides an assessment of the air quality impacts associated with the extraction of multi-grade base material from Burringbar Quarry. A site locality plan showing the quarry area and the location of the surrounding sensitive receivers is included as **Figure 1-1**.

1.2 Air Quality Objectives

The objective of this air quality study is to provide an assessment of the likely impacts on air quality resulting from the expanding operation of base material extraction at Burringbar Quarry, Burringbar NSW. To achieve these objectives the following tasks were undertaken.

- Description of proposed development and associated air quality issues in the Burringbar area.
- Description of meteorology and existing air quality conditions.
- Discussion of relevant air quality guidelines for the quarry operations.
- Assessment of air quality impacts from onsite operational extracting activities.
- Identification of appropriate management practices for mitigating potential dust impacts from the site.

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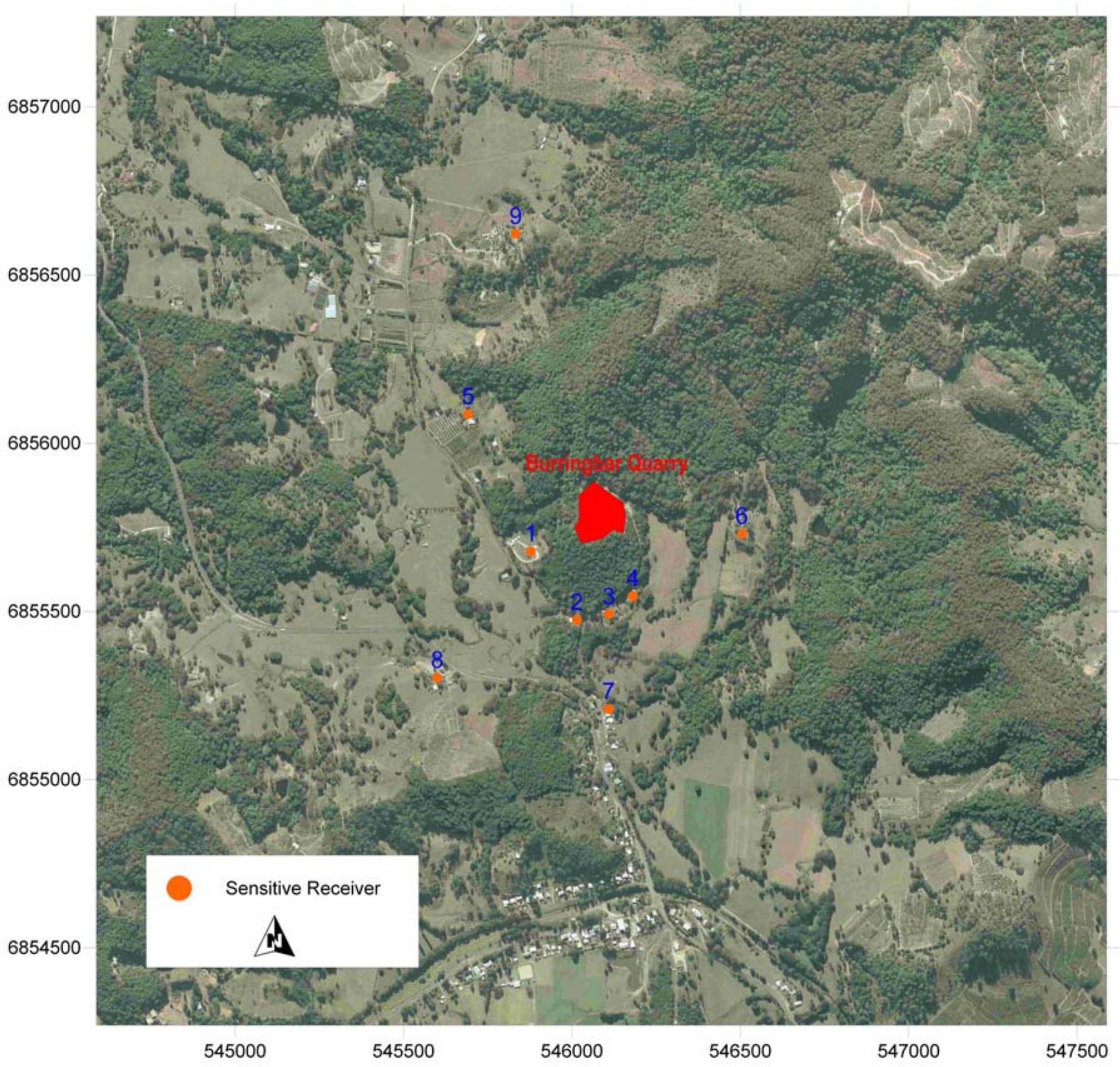
■ **Figure 1-1 Site Locality Plan**



2. Proposed Operations and Air Quality Issues

2.1 Overview

This section of the report provides a description of quarry activities on associated air quality issues.

2.2 Description of Quarry Activities

Extraction of base material from the Burringbar Quarry has been occurring since before 1972. The average rate of extraction throughout operations has been 10 000 tonnes per year. The Tweed council has proposed an expansion of the quarry's extractive capacity to produce 30 000 tonnes of base material per year and an operational plan for the expanded quarry was completed by SKM (2005).

The proposed operation at the expanded quarry would include stripping, extraction, processing and transport. For the initial period, post expansion, it is likely that mobile contract plant will be used episodically as required by Council's demand for the base material.

2.2.1 Machinery and Equipment

The main items of plant and equipment associated with quarry activities are listed in **Table 2-1**.

- **Table 2-1 Equipment Summary**

Activity	Equipment
Transport of stockpile off site	Combination of 12.5 and 30 t trucks
Stripping overburden	Bulldozer
Drilling	Crawler mounted top hammer rig (Airtrak – type)
Blasting	Ammonia nitrate/fuel oil mixture (ANFO)
Screening	Bar screen
Crushing	Jaw crusher
Transfer during processing/ operation	Front end loader

2.2.2 Site Operating Times

Quarry operations are expected to occur during daylight hours only (7 am to 5 pm). It is estimated that drilling blast holes will occupy 1-2 months and blasting will occur 1-2 times per year. The estimated crusher throughput is 100-200 m^3 per hour; this would translate to an operating duration of 120 hours for the predicted 30000 tonne per year (12000 $m^3$of in situ rock) quarry output. Truck activity at the site would be episodic commensurate with material demand but would be limited to quarry operational hours.

2.2.3 Air Quality Issues

The main threat to air quality caused by quarry activities would be from the emission of particulates. Particulates may be emitted whenever bulk material is disturbed. Specific quarry activities that have the ability to contribute to particulate emissions include:

- bulk material transfer, loading and dumping;
- blasting;
- crushing and screening;
- wheel generated dust, and:
- wind generated dust from exposed surfaces.

The emission of particulate matter caused by the above activities is assessed quantitatively in **Section 5**.

3. Air Pollution (Particulates) Effects and Criteria

3.1 Overview

This section of the report provides an overview of the health effects of air borne particulate matter. Air quality objectives relevant to the project are also outlined.

3.2 Air Borne Particulate Matter

Air borne particulate matter is any material, except uncombined water, that exists in the solid or liquid state in the atmosphere or gas stream at standard condition. Air borne particles generally range in size from 0.001-500μm, with the bulk of the particulate mass in the atmosphere ranging from 0.1-10 μm. A number of terms relevant to describing airborne particles are outlined in **Table 3-1**.

- **Table 3-1 Definition of Terms that Describe Airborne Particulate**

Term	Description
Particulate matter	Any material, except uncombined water, that exists in the solid or liquid state in the atmosphere or gas stream at standard condition
Aerosol	A dispersion of microscopic solid or liquid particles in gaseous media
Dust	Solid particles larger than colloidal size capable of temporary suspension in air
Particle	Discrete mass of solid or liquid matter
Smoke	Small gasborne particles resulting from combustion

Source: Wark and Warner (1981)

Common size related terms are the classes Total Suspended Particulate Matter (TSP), PM_{10} and $PM_{2.5}$. Total Suspended Particulate Matter (TSP) refers to the concentration of all particles in the atmosphere. PM_{10} refers to all particles with aerodynamic sizes less than 10 μm and $PM_{2.5}$ is all particles with aerodynamic sizes less than 2.5 μm.

Particulate matter is generated by industry, motor vehicles, refuse disposal, ocean salt, volcanic ash, products of wind erosion, roadway dust, bush fires and plant pollen and seed. Particulate matter presents a health hazard to the lungs, enhances chemical reactions in the atmosphere, reduces visibility, increases the possibility of precipitation, fog and clouds and reduces solar radiation.

The health effects of particles are largely related to the extent to which they can penetrate the respiratory tract. Larger particles (those greater than 10 μm) generally adhere to the mucus in the mouth, pharynx and larger bronchi and are generally removed by swallowing or expectorating.

Respirable particles are particles with an aerodynamic size less than 5 µm. Particles below 2.5 µm can reach the deepest parts of the respiratory system, where they can only be removed by the body's cellular defence system. Respirable particles have been associated with a wide range of respiratory symptoms. A study conducted in six United States cities determined a relationship between airborne fine particulate matter (particles less than 2.5 µm) and mortality (Dockery et al 1993). The findings generally showed an increase in mortality with increasing concentrations of fine particulate matter.

The effects of particulate matter on health and amenity can be assessed by comparing dust deposition rates and dust concentrations with recognised air quality criteria. The New South Wales DEC notes National Health and Medical Research Council (NHMRC) and National Environment Protection Council (NEPC) Guidelines and World Health Organisation (WHO) long-term goals. The New South Wales DEC criteria for dust deposition and particulate matter concentration are outlined in the following sections.

3.3 Air Quality Objectives

Air quality objectives quoted below have been sourced from the Department of Environment and Conservation (DEC) publication - Approved Methods and Guidance for the Modelling of Air Pollutants in New South Wales (2005).

3.3.1 Dust Deposition

Depositing dust, if present at sufficiently high levels, can reduce the amenity of an area. In NSW the DEC set limits on acceptable dust deposition levels. **Table 3-2** shows the maximum acceptable increase in dust deposition over the existing dust levels.

- **Table 3-2 NSW DEC Criteria for Dust Fallout**

Existing dust fallout level ($g/m^2/month$)	Maximum acceptable increase over existing fallout levels ($g/m^2/month$)
	Residential
2	2
3	1
4	0

The maximum acceptable increase in the mean annual dust deposition rate is 2 $g/m^2/month$ in those areas where the existing dust fallout rate does not exceed 2 $g/m^2/month$. The aim of the dust fallout criteria is to limit the total dust deposition rate to 4 $g/m^2/$ month in suburban residential areas.

The quarry operations should not exceed an annual mean deposition rate of 4 g/m^2/month (for total solids). This level should not be exceeded outside the site boundary as a result of all activities at the site.

3.3.2 Dust Concentration

As highlighted above, the NSW DEC recognises air quality goals for particulate matter from the National Health and Medical Research Council of Australia (NHMRC) and NEPC. The air quality criteria for dust concentration are listed in **Table 3-3**.

- **Table 3-3 NSW DEC Particulate Criteria**

Pollutant	Averaging Period	Goal
Total Suspended Particulates (TSP)	Annual	90$\mu g/m^3$
Particulate Matter < 10 μm	24 hours	50 $\mu g/m^3$
Particulate Matter < 10 μm	Annual	30 $\mu g/m^3$

4. Meteorology and Existing Air Quality

4.1 Overview

This section of the report provides a description of Meteorological conditions in the Burringbar area as well as a summary of existing air quality conditions relevant to particles.

4.2 Dispersion Meteorology

The impact that dust from the operation of the existing Burringbar Quarry and proposed expansion will have on the surrounding area is dependent on the climate and dispersion meteorology. The climatology and dispersion meteorology of Burringbar Quarry is strongly influenced by latitude, topography and elevation. In general, Burringbar experiences mild climatic conditions, due to its coastal location in far north New South Wales, characterised by warm moist summers and dryer winters.

The Australian Bureau of Meteorology (BoM) operates a meteorological station at Murwillumbah (Bray Park :-28.3408, 153.3784) approximately 12 km north east of the site at an elevation of 18 m.

The maximum and minimum temperature, 9 am and 3 pm temperature, rainfall and 9 am and 3 pm humidity in the following sections have been obtained from the Murwillumbah station. The data collected at Murwillumbah is presented below and is considered to be representative of the conditions experienced at Burringbar Quarry.

In the absence of reliable observational data, information on wind speed and direction for Burringbar was created using the TAPM model.

4.2.1 Temperature

The 9 am temperatures at Murwillumbah range between 13.5°C in July to 23.9 °C in January. The 3 pm mean temperature range at Murwillumbah is between 19.6°C in July and 28.1°C in January. The warmest month of the year is January, which experiences a mean daily maximum temperature of 29.6°C and a mean daily minimum temperature of 19.6°C. July is the coolest month experiencing mean daily maximum and minimum temperatures of 20.9°C and 8.5°C respectively.

4.2.2 Humidity

The annual pattern of 9 am relative humidity at Murwillumbah peaks across February, March, April and May, typically falling to a minimum in September and October. The annual pattern for relative humidity shows a peak in February and March, along with a trough in August and September. The 3 pm relative humidity is lower than that at 9 am throughout the year. The average 9 am relative humidity has an annual range of approximately 18% with a minimum of 66% in September and October and a maximum of 84% in February. The maximum 3 pm relative humidity occurs in February and March at 65%. The minimum relative humidity is 50%, occurring in September and August.

4.2.3 Rainfall

The rainfall data show the warmer months of the year, particularly February and March, to receive the greatest amount of rainfall. February is the wettest month of the year, receiving mean monthly rainfall of 234 mm. The driest month in terms of average rainfall received is September receiving approximately 39 mm. The mean annual rainfall is 1584 mm occurring over an average of 150 rain days throughout the year.

4.2.4 Wind Speed and Direction

Figure 4-1 and **Figure 4-2** show wind speed and direction information for Burringbar Quarry averaged annually and by season. Modelled results show the strongest wind that occurred during the year at Burringbar was 9 m/s, and the average wind speed is approximately 4 m/s. The wind most commonly blows from the east (23% of the time), while the least common wind direction during the year is southerly, occurring 7% of the time.

Seasonally, Summer experiences the highest average wind speed at slightly over 4 m/s, while Autumn provides the lowest average wind speed, at just under 4 m/s, demonstrating minimal variation in wind intensity by season.

Summer wind directions tend to come from the north west and the east, while during Autumn, the wind primarily blows from the east to south east, swinging to the north west in winter. By contrast, spring produces diffuse wind conditions, with contributions from most directions.

4.2.5 Atmospheric Stability Class

Atmospheric stability class is used to categorise the rate at which a plume will disperse. The Pasquill-Gifford stability class assignment scheme uses six stability classes from A through to F. Class A refers to unstable conditions where pollutants spread rapidly throughout the mixed layer. Class F refers to stable conditions where plume spreading is slow and dispersion is poor. The most common stability class at Burringbar is class D, which occurs 34% of the time. By contrast, class A (unstable) occurs only 3% of the time.

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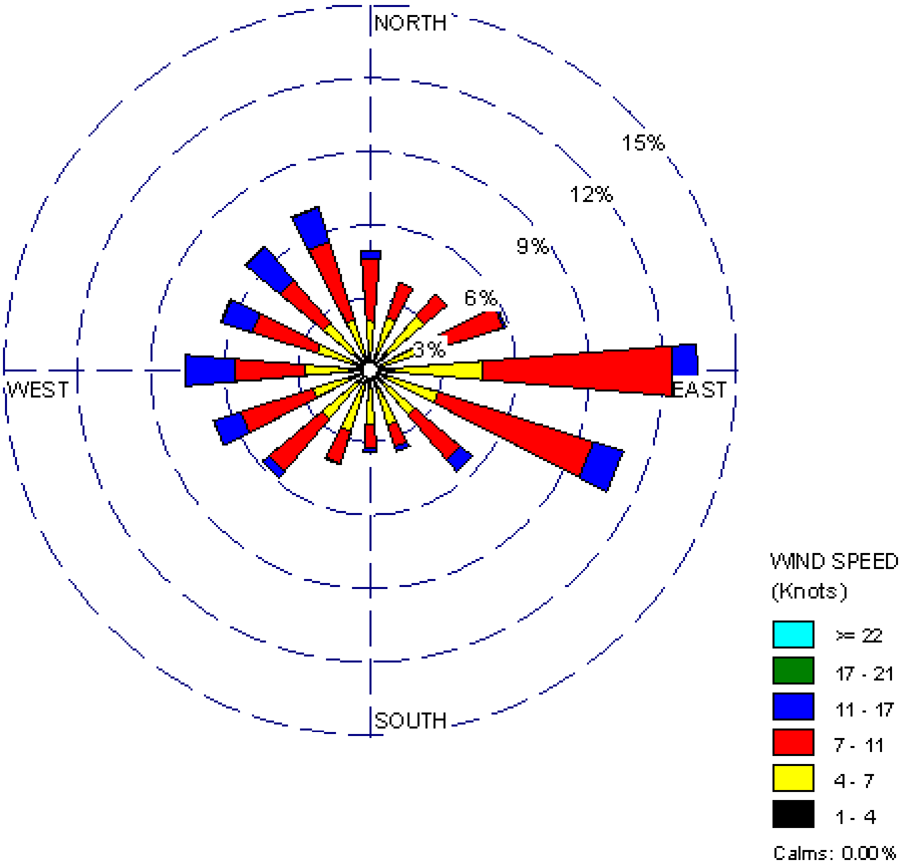
▪ **Figure 4-1 Burringbar Annual Wind Rose**



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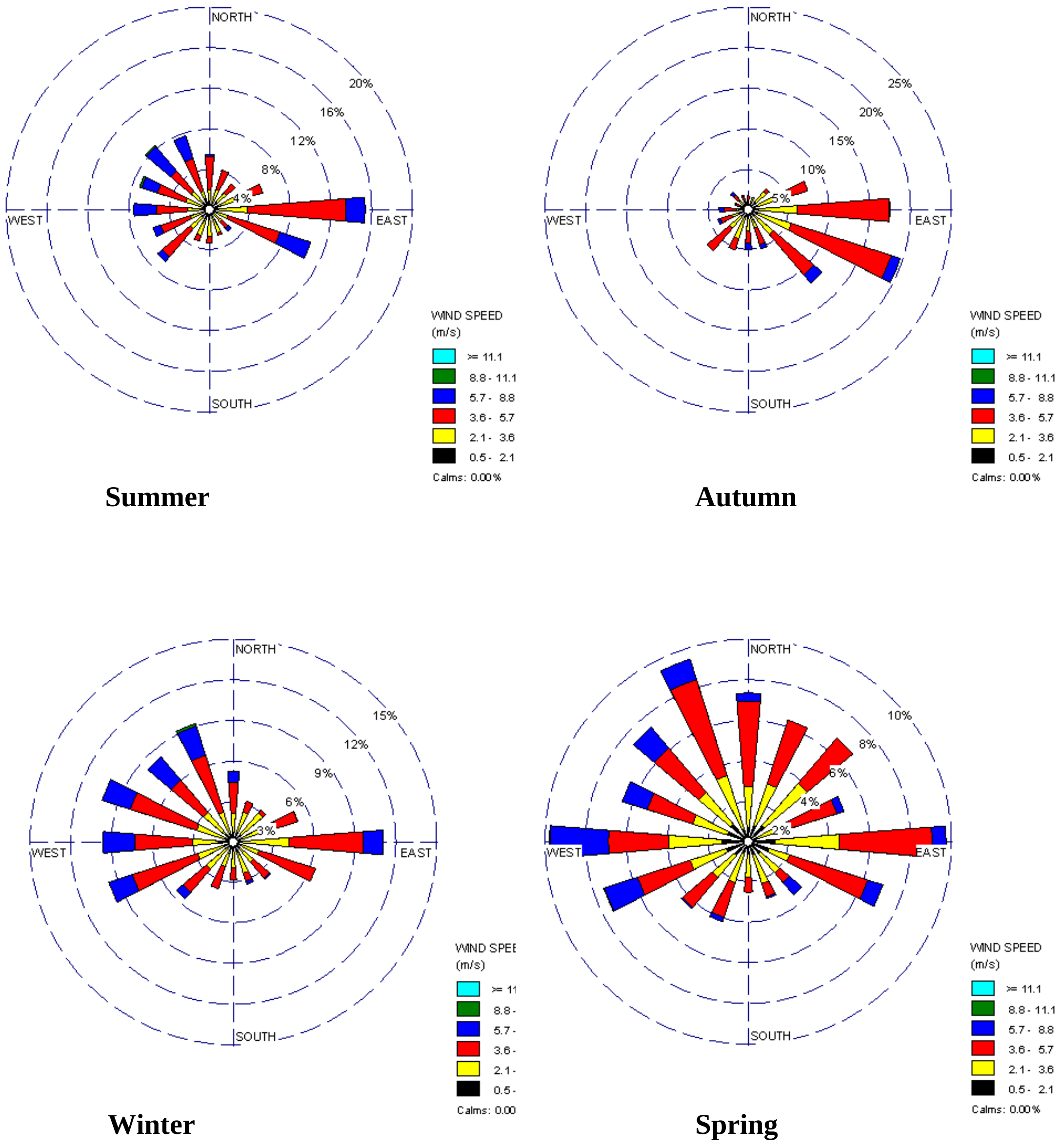
- **Figure 4-2 Burringbar Seasonal wind Roses**



4.3 Existing Air Quality

There are currently no DEC ambient air quality monitoring sites located in close proximity to Burringbar Quarry.

Tweed Quarry, located at Terranora, is considered to be a representative location for the purposes of establishing background levels of ambient particulate matter and deposited dust at Burringbar. Tweed Quarry is located approximately 20 km north of Burringbar and performs similar quarry operations. Insoluble dust deposition and 24 hour PM_{10} data were monitored at Terranora. Data from the Terranora monitoring exercise was utilised and presented by *Holmes Air Sciences (2005)* for an air quality study for the Tweed Quarry expansion. **Table 4-1** shows summary data for depositional dust. In recent years since (2001) the dust deposition levels at all off site receivers were lower than the DEC guideline of 4 g/m^2/month.

- **Table 4-1 Terranora Dust Deposition Data (Holmes 2005)**

Annual Average Insoluble Solids Dust Deposition Rate									
Year	**Off site (g/m^2/month)**				**On Site (g/m^2/month)**				
	D1	**D2**	**D3**	**D4**	**D33**	**D34**	**D35**	**D36**	**D37**
2001	2.6	1.3	1.0	0.6	6.0	2.9	2.8	2.3	2.5
2002	1.2	1.2	0.8	0.8	2.5	1.9	2.0	1.2	1.4
2003	1.2	1.3	1.9	0.9	1.0	0.7	0.9	0.6	0.5
2004	1.7	1.9	1.6	0.9	2.0	2.1	1.3	0.6	1.2
Avg	**1.67**	**1.42**	**1.32**	**0.80**	**2.87**	**1.90**	**1.75**	**1.17**	**1.4**

The maximum recorded 24 hour PM_{10} GLC between August 2003 and May 2004 was 47 $\mu g/m^3$. The average annual GLC for the same monitoring period was 18 $\mu g/m^3$ (Holmes 2005). Annual average TSP concentrations can be estimated from dust deposition data, with Holmes (2005) estimating an annual average TSP of 45 $\mu g/m^3$.

5. Air Quality Impact Assessment

5.1 Overview

This section of the report provides an assessment of air quality impacts resulting from the extraction of base material at Burringbar Quarry. An estimate of the total TSP, PM_{10} and dust deposition impacts resulting from these activities is provided.

5.2 Methodology

The AUSPLUME (version 6) dispersion model has been used, along with site representative meteorological data generated by TAPM, to predict the dispersion of PM_{10}, TSP and dust deposition within an approximate 3 km x 3 km receptor grid surrounding the site. The receptor spacing within the grid was 100 m. The predicted ground level dust concentration and deposition rates were compared with the criteria listed in **Table 3-2** and **Table 3-3** to determine the level of impact at nearby sensitive receiver locations.

5.3 Meteorological and Terrain Data

TAPM (version 3) was used to create site representative meteorological data, which, could be used as an input for AUSPLUME. The lack of available meteorological data, at an appropriate quality for dispersion modelling meant that a synthetic meteorological file for Burringbar Quarry had to be created.

The Air Pollution Model (TAPM), developed by CSIRO Atmospheric Research, was used to create synthetic meteorological data for the Burringbar site. The meteorological data created by TAPM is compatible with AUSPLUME, providing AUSPLUME with its required meteorological input. TAPM consists of coupled prognostic meteorological and air pollution concentration components, eliminating the need to have site specific meteorological observations. It predicts winds, temperature, pressure, water vapour, cloud/rain water and turbulence. The model also includes urban/vegetation canopy, soil effects and radiative fluxes The model is driven by six-hourly analysis fields of wind, temperature and specific humidity from the Bureau of Meteorology Limited Area Prediction System (LAPS) model, which account for the larger-scale synoptic variability (CSIRO 2003; Hurley 2002). Synoptic observations for the period 1st January 2005 through 31st December 2005 were used in TAPM to create the Burringbar meteorological data set.

Digital terrain data, at 10 m contour intervals, were input into the AUSPLUME model.

5.4 Dust Emission Data

5.4.1 Dust Sources

Air quality impacts associated with the quarry operation arise in the form of dust emissions. Dust would be emitted during extraction operations as well as transportation of stock pile material offsite. The sources of dust emissions include use of front end loader, bulldozer, drilling (negligible), blasting, wheel generated dust and wind erosion from unsealed surfaces.

5.4.2 Dust Emission Factors

Emission factors were used to estimate the rate at which dust is emitted from each of the above sources during the quarry works at the site. An emission factor is a representative value that attempts to relate the quantity of a pollutant released into the atmosphere, with an activity associated with the release of that pollutant. They are usually expressed as the weight of a substance emitted divided by the unit weight, volume, distance, and/or duration of the activity emitting the substance. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category.

Emission factors are used to estimate a facility's emissions by the general equation:

$$E_{kpy,i} = [A * OpHrs] * EF_i * [1-(CE/100)]$$

where:

$E_{kpy,i}$	=	emission rate of pollutant i, kg/yr
A	=	Activity rate, t/h
OpHrs	=	Operating hours, h/yr
EF_i	=	Uncontrolled emission factor of pollutant i, kg/t
CE_i	=	Overall control efficiency for pollutant i, %

Quarrying machinery are only sources of dust during operating hours (7 am to 5 pm), while wind erosion is a potential source 24-hours a day. For modelling purposes, it has been assumed that base material extraction and processing would occur on a year-round basis. However, to extract 30000 tonnes annually, it is estimated that the quarry would operate for a total of approximately 2 – 3 months. Wind emission was assumed to occur all year. Transportation of stockpiled material off site would occur episodically. It is assumed that up to 8 x 12.5 t and 4 x 30 t trucks would be loaded at the site each hour, a total of 80 per day.

In calculating dust emissions for TSP and PM_{10} it was assumed that the material moisture content was approximately 4% and a surface silt content of 5%. Level 1 watering, corresponding to 50% control of dust emission, of unpaved surfaces has been assumed for modelling.

All emission factors used in this study were sourced from the either the National Pollutant Inventory Emission Estimation Technique Manual for Mining (Environment Australia, 1999) or the USEPA AP-42 document (USEPA, 1995). A summary of each of the activities associated emission rates, is provided in **Table 5-1**.

- **Table 5-1 Burringbar Particulate Emission Rates**

Source	Emission Rates	
	TSP	PM_{10}
Wheel Generated Dust	164 kg/year	47 kg/year
Excavating Quarry Material	592 kg/year	109 kg/year
Front End Loader	2670 kg/year	1284 kg/year
Drill	Negligible	Negligible
Screener	22 kg/year	7 kg/year
Crusher	4000 kg/year	400 kg/year
Blasting	70 kg/year	36 kg/year
Site Wind Erosion	1087 kg/ha/year	543 kg/ha/year

5.5 Project Criteria

Project specific criteria take into account existing background concentrations when assessing potential impact. The site specific criteria for PM_{10}, TSP and dust deposition are outlined below.

5.5.1 PM_{10}

The NSW DEC goal for annual average PM_{10} is 30 $\mu g/m^3$. The existing annual average PM_{10} concentration is 18 $\mu g/m^3$. Therefore the site specific criteria for annual average PM_{10} is 12 $\mu g/m^3$ (i.e. 30 $\mu g/m^3$ – 18 $\mu g/m^3$ = 12 $\mu g/m^3$).

The DEC criteria for 24 hour PM_{10} is 50 $\mu g/m^3$. This assessment considers the total DEC criteria as project criteria. This practice is often used for the assessment of mining operations (Holmes 2005).

5.5.2 TSP

Annual TSP, as indicated in Section 4.1, was calculated to be 45 $\mu g/m^3$. The DEC criterion for TSP is 90 $\mu g/m^3$, therefore the site specific criteria would be 45 $\mu g/m^3$
(i.e. 90 $\mu g/m^3$ – 45 $\mu g/m^3$ = 45 $\mu g/m^3$).

5.5.3 Dust Deposition

A background deposition level of 2 g/m^2/month is a reasonable assumption in a semi rural area. This assumption is validated for Burringbar Quarry by the annual depositional values presented in **Table 4-1** for Terranora Quarry. The highest annual average dust deposition recorded was found at site D1, corresponding to 2.16 g/m^2/month. Under this assumption the site specific criteria is 2 g/m^2/month (i.e. 4 g/m^2/month – 2 g/m^2/month = 2 g/m^2/month).

5.6 Dispersion Modelling Results

Dispersion modelling was used to predict maximum 24 hour and annually averaged PM_{10} concentrations, annually averaged TSP concentrations and monthly dust deposition rates in the area surrounding the site. Particulate concentration levels and deposition rates at the nearest residences were compared to the project criteria in **Section 5.5** with the results outlined and discussed below.

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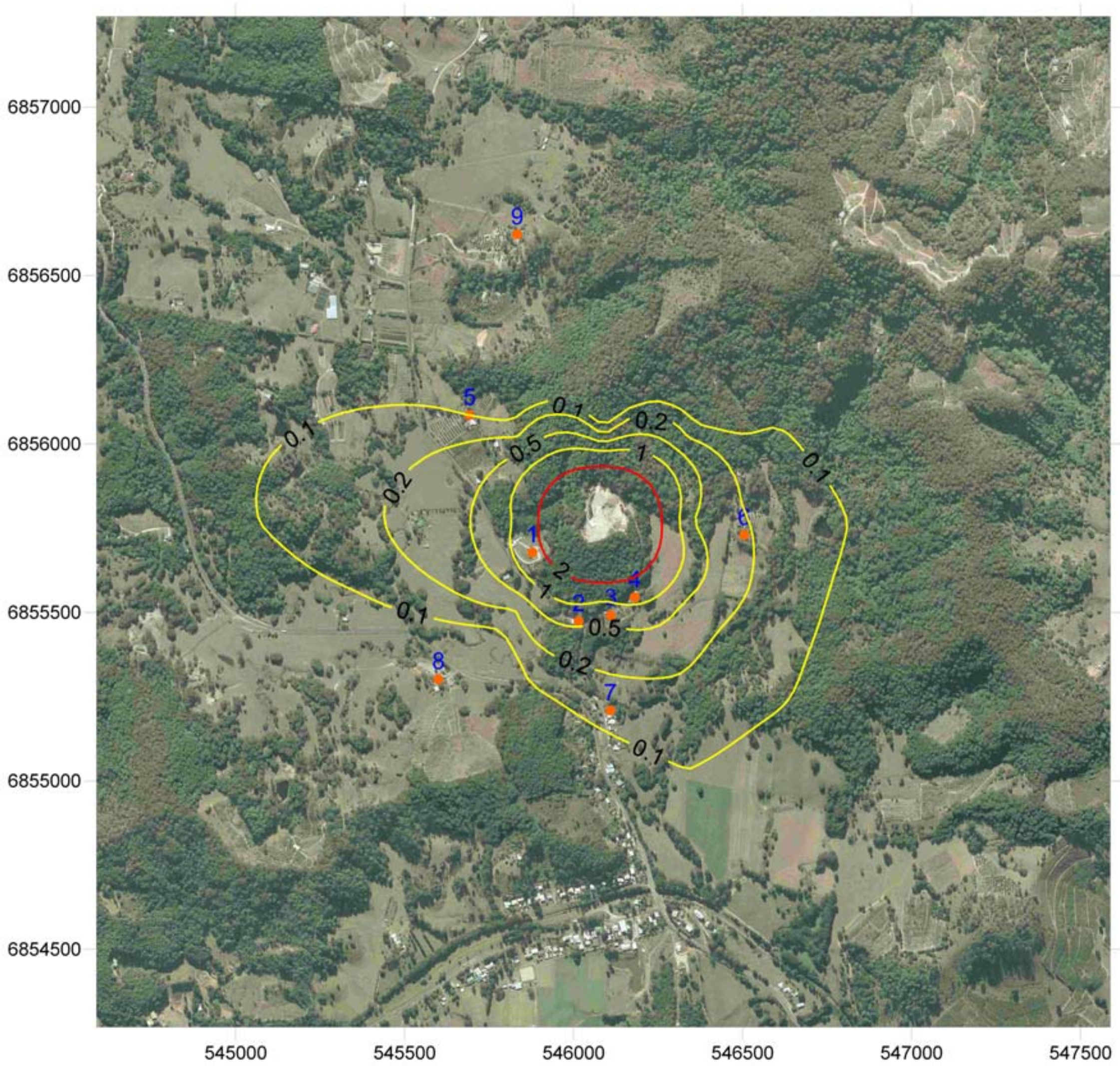
5.6.1 Dust Deposition Results

Monthly dust deposition rates were predicted on the basis of year-round quarry operations. Given that quarry operations are expected to occur episodically throughout the year, for an estimated total of just 2 - 3 months, these results were reduced by approximately 80% (2 months in 12) compared to those for year-round operations.

Based on this adjustment, the project criterion of 2 g/m^2/month is not expected to be exceeded on an annual basis. For example, the highest predicted rate of dust deposition based on year-round operations was 6 g/m^2/month. After modification (80% reduction), this value is approximately 1 g/m^2/month. Hence, all predicted dust deposition rates, as presented in **Figure 5-1,** should meet the DEC criterion of 2 g/m^2/month.

- **Figure 5-1 Dust Deposition Contours – Annual Operations (g/m^2/month)**



5.6.2 24 hour PM_{10} Results

24 hour PM_{10} GLCs were predicted exclusive and inclusive of blasting. **Figure 5-2** shows model results for 24 hour PM_{10} without considering blasting. Results show that when blasting is not considered, there is no exceedance of the DEC criterion (50 µg/m^3). The maximum modelled GLC at a sensitive receiver is 44 µg/m^3 (receiver 1). Considering the effect of retention of dust within the pit, this value is likely to be less than predicted.

- **Figure 5-2 24 hour PM10 Contours – Excluding Blasting**

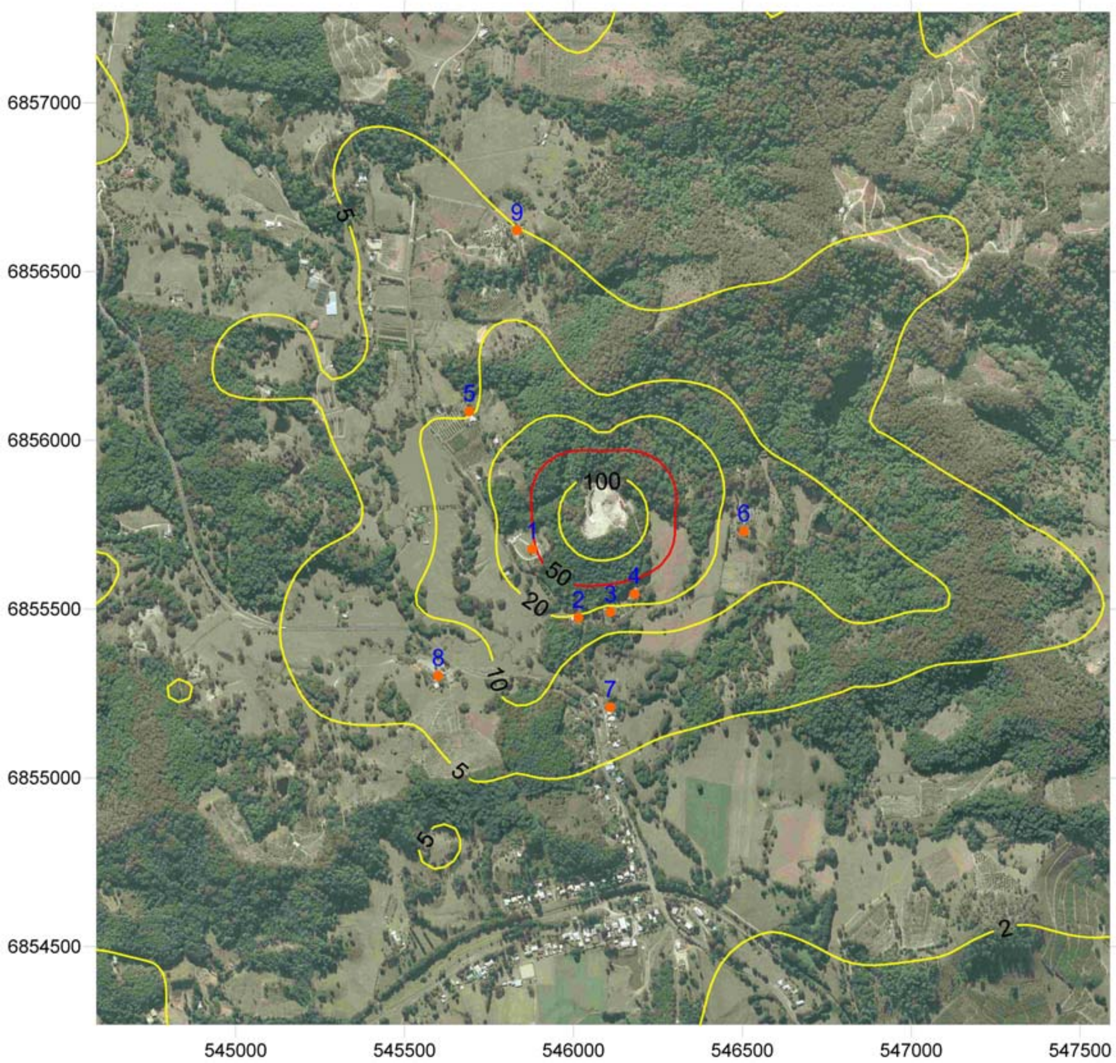
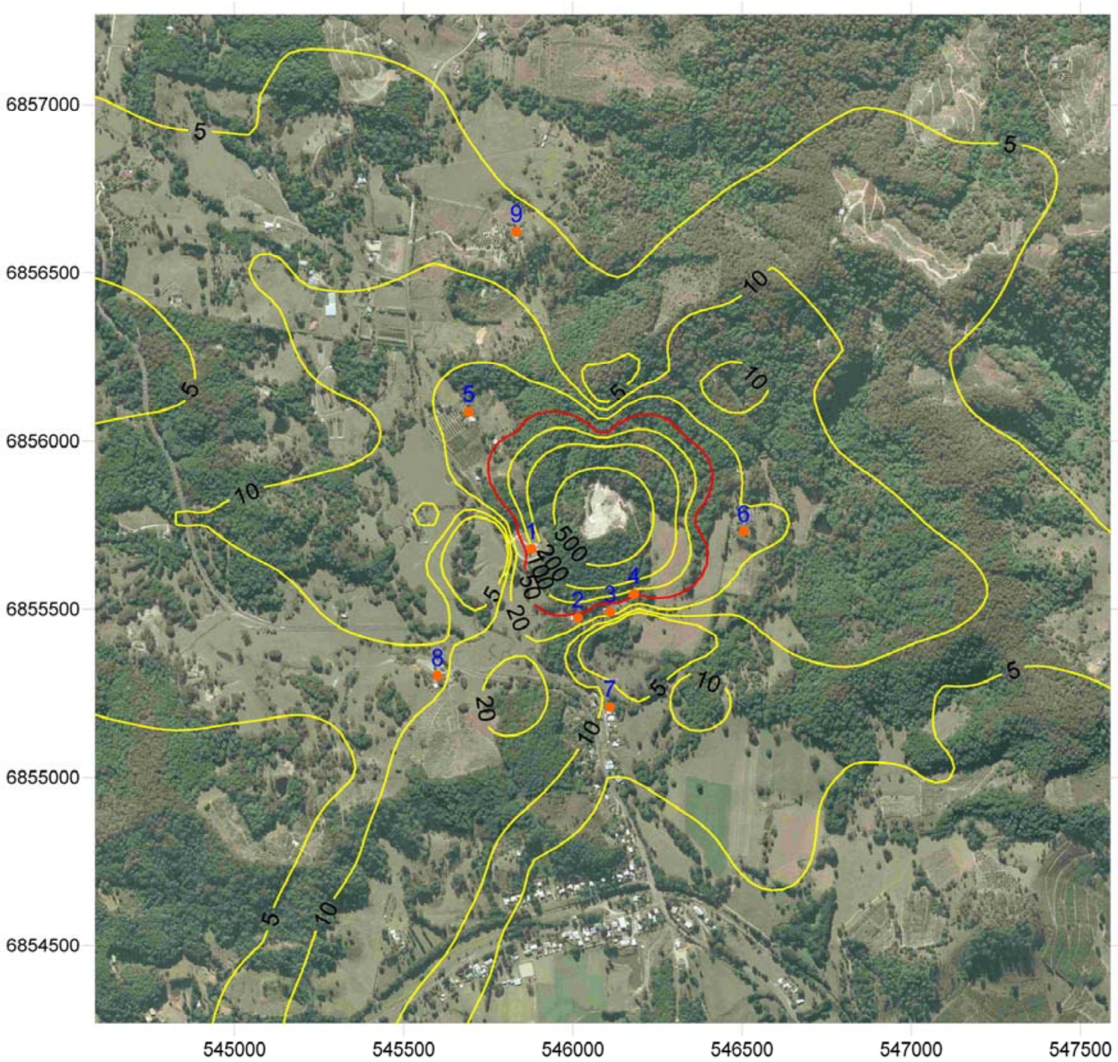


Figure 5-3 shows predicted concentrations for 24 hour PM_{10} including blasting, which indicate that the 50 µg/m^3 criterion may be slightly exceeded at receiver 1 at a value of 68 µg/m^3.

Blasting evidently contributes substantially to the 24 hour GLC and any exceedance of the assessment criterion. However, given that blasting expected to occur 1 to 2 times each year, the DEC requirement of no more than 5 such exceedances would be complied with.

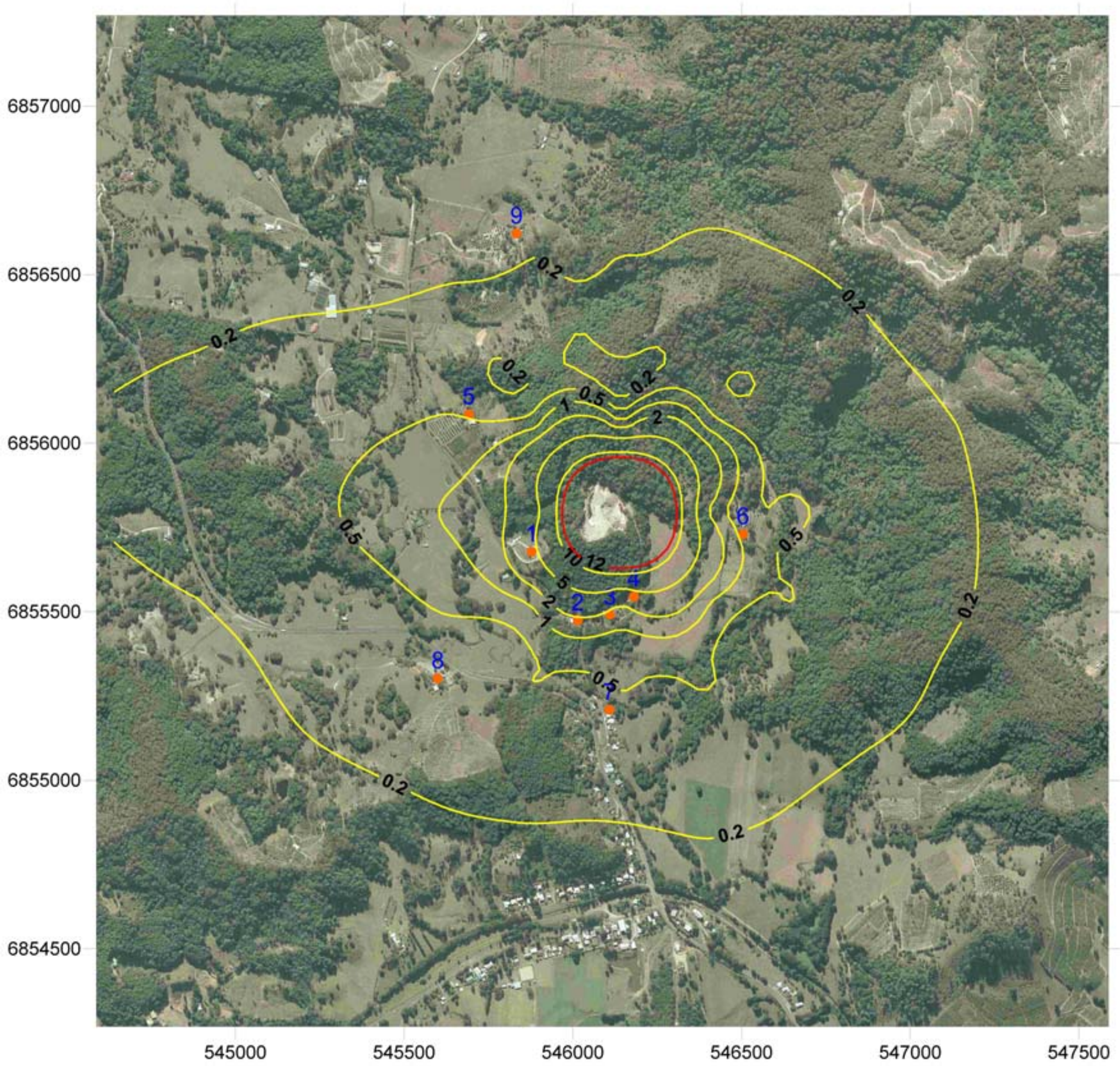
- **Figure 5-3 24 hour PM_{10} Contours – Including Blasting (µg/m^3)**



5.6.3 Annual PM_{10} Results

Figure 5-4 shows model contours for the increase in annual average PM_{10} concentrations. All concentration increases are below project criteria (12 µg/m^3). The maximum increase predicted at an identified receiver is 4 µg/m^3.

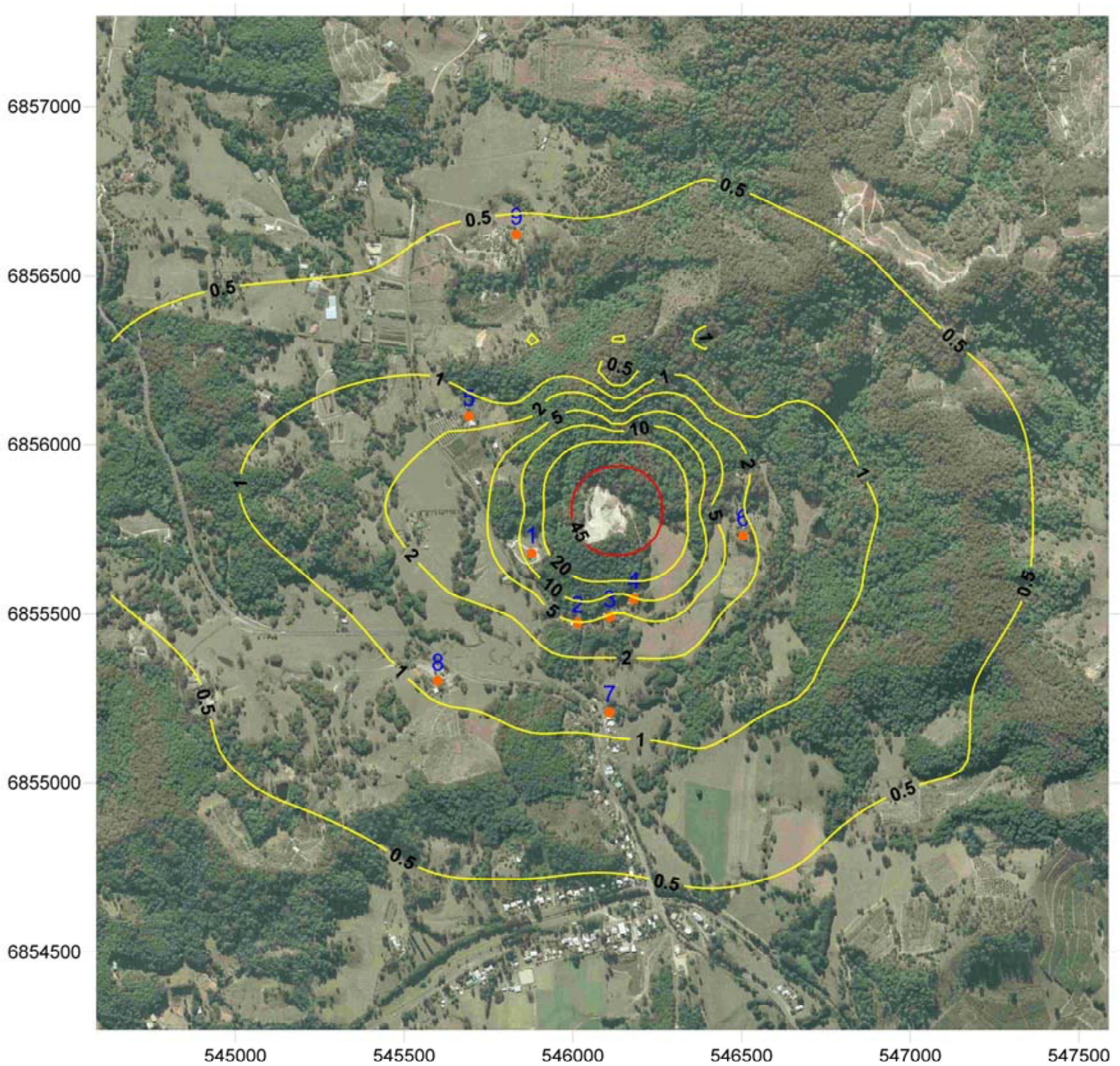
- **Figure 5-4 Annual Average PM_{10} Contours (µg/m^3)**



5.6.4 Annual TSP Results

Figure 5-5 shows results of increases in TSP concentrations. The results show no exceedance of project criteria at identified receiver locations (45 µg/m^3). The maximum expected increase in TSP concentration at an identified receiver is 13 µg/m^3.

- **Figure 5-5 TSP Contours (µg/m^3)**



6. Conclusions and Recommendations

6.1 General Conclusions

SKM was commissioned to undertake an air quality assessment for the proposed extraction and processing operations at Burringbar quarry, located within the Tweed Shire on Cudgera Creek Road at Lot 6 DP 868345.

Particulates from the activities associated with quarry operations would arise from bulldozing, excavation of top soil and base material, grading, transfer of materials with a front end loader, material processing and crushing, wheel generated dust, and wind erosion from the entire site.

Air dispersion modelling using the AUSPLUME (Version 6) was undertaken to predict maximum GLCs and deposition rates within the area surrounding the site. Given the episodic nature of the operations, modelling showed that extraction and crushing activities are not likely to cause exceedences of project specific criteria for annual average PM_{10} and TSP GLCs or dust deposition (refer **Section 5**).

In addition, 24-hour GLCs are not likely to exceed assessment criteria provided blasting does not occur. When blasting is undertaken, the 24-hour criterion may be exceeded, however this would only occur 1 or 2 times each year and would be within the DEC requirement of a maximum of 5 exceedances per year.

It is unlikely that the quarry operations will cause significant adverse impacts at nearby sensitive receivers. However the following recommendations should be considered to maintain the potential impacts at a practical minimum.

6.2 Recommendations

Increasing the moisture content of the trafficked areas via watering or the use of chemical wetting agents are the principal means of reducing dust emissions from these sources. The most appropriate control techniques at Burringbar Quarry would include:

- watering of all road and exposed surfaces (water trucks or sprinklers), in particular during dry and windy conditions;
- sealing egress and ingress points to the site;
- prompt clean up of any spills on trafficked areas;
- maximum vehicle speed of 10 km/hr.
- notification of all sensitive receivers before blasting episodes.
- plan for blasting to take place under favourable meteorological conditions, as to facilitate dispersion away for receivers (e.g. during a southerly wind).

7. References

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