Appendix C
Air Quality and Greenhouse Gas Impact Assessment

12 August 2010

Hansen Bailey
PO Box 473
Singleton NSW 2330

Attn: Melissa Walker

RE: MUSWELLBROOK COAL MINE DEVELOPMENT CONSENT MODIFICATION – AIR QUALITY AND GREENHOUSE GAS IMPACT ASSESSMENT

Dear Melissa,

Please find below our assessment of the potential air quality and greenhouse gas impacts of a proposed Development Consent Modification at Muswellbrook Coal Mine.

1 INTRODUCTION

PAEHolmes has been requested by Hansen Bailey on behalf of Muswellbrook Coal Company (MCC) to provide an air quality and greenhouse gas impact assessment for a proposed Development Consent Modification at Muswellbrook Coal Mine located in the Upper Hunter Valley of New South Wales (see **Figure 1.1**).

The assessment forms part of a Statement of Environment Effects (SEE) being prepared by Hansen Bailey to support an application for a modification to Development Consent DA 205/2002 under Section 96(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The modification proposes to extend mining operations to within a 28.4 ha area (known as Area C) of which 8.2 ha falls outside of the No. 1 Open Cut Extension Area (the Project Area). No changes to the approved mining method, production rate, mine life or its coal transport arrangements are proposed.

In 2002, PAEHolmes (formerly Holmes Air Sciences (HAS)) prepared an air quality impact assessment for the MCC No.1 Open Cut Extension (**HAS, 2002**). In 2008, an additional air quality assessment was conducted by PAEHolmes for a Development Consent Modification to relocate the existing Mine Infrastructure Area (MIA) at Muswellbrook Coal (2009 Modification) (**HAS, 2008**). The approach adopted for this assessment is as follows:

- Review the prevailing meteorological conditions in the area;
- Review recent ambient air quality data;
- Estimate emissions from the Modification;
- Provide a qualitative assessment of potential air quality impacts from the Modification including a cumulative assessment;
- Recommend any appropriate mitigation measures based on findings of the qualitative assessment; and
- Provide a greenhouse gas assessment associated with the Modification.

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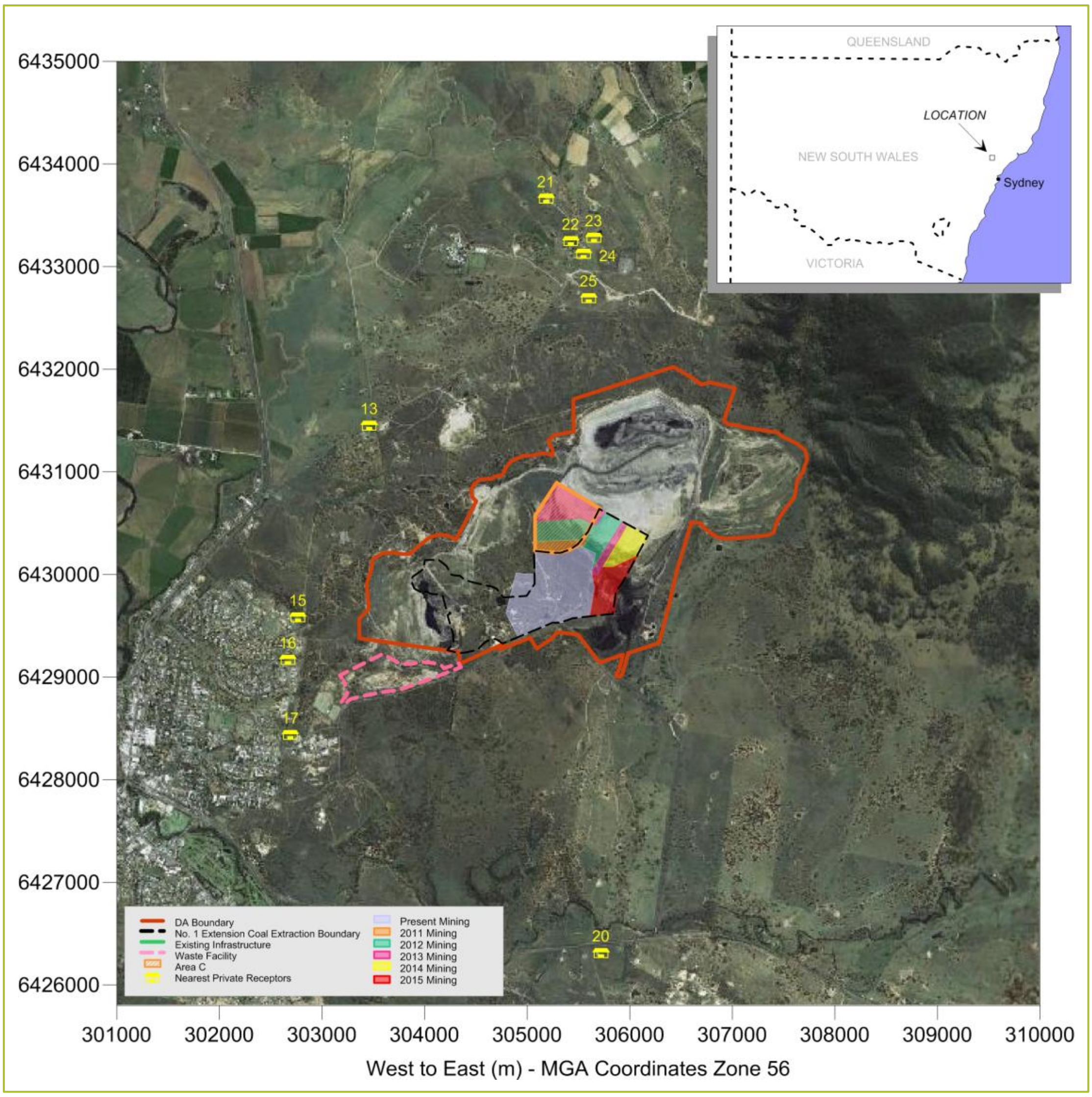

Figure 1.1: Location of the Muswellbrook Coal Mine and Representative Receivers

2 OVERVIEW OF OPERATIONS

2.1 Current Operations

Muswellbrook Coal Mine is located approximately 2.5 km to the north-east of the township of Muswellbrook in the Upper Hunter Valley of NSW (see **Figure 1.1**).

Mining operations within the No. 1 Open Cut Extension (No. 1 Extension) are undertaken in accordance with Development Consent (DA 205/2002) which was granted to MCC on 1 September 2003. The operations approved under DA 205/2002 are described in its supporting documents which include:

- Muswellbrook Coal Company Limited, No. 1 Open Cut Extension Environmental Impact Statement (MCC EIS) (HLA Envirosciences 2002);
- Section 96(1A) Application to Modify Development DA 205/2002 (2005 S96(1A) Modification) (Parsons Brinkerhoff 2005); and
- Muswellbrook Coal Mine Development Consent Modification Statement of Environmental Effects (2009 Modification) (Hansen Bailey 2009).

Mining operations in the No. 1 Extension commenced in March 2005 and have involved the extraction of remnant coal within areas of old underground workings. Mining commenced in the north-western part of the No. 1 Extension and has progressed to the east away from the township of Muswellbrook.

The No. 1 Extension is a truck and shovel/excavator open cut operation, extracting coal from the Greta Coal Measures. DA 205/2002 provides approval for the extraction of an identified coal resource of approximately 11.6 Million tonnes (Mt) Run of Mine (ROM) coal from the No. 1 Extension.

Operations within the No. 1 Extension involve the stripping of topsoil and the drilling and blasting of overburden material which is then removed utilising a P&H 2800 Shovel, hydraulic excavators and a fleet of 11 x Komatsu 730E 190 tonne (t) dump trucks. The uncovered coal seams are extracted utilising a hydraulic face shovel or front end loader to load 100 t rear dump trucks which transport the coal to the Run of Mine (ROM) coal receival area.

DA 205/2002 permits MCC to transport, by road, up to 2 Million tonnes per annum (Mtpa) of product coal from the Muswellbrook Coal Mine out to 2015. All product coal is transported by highway trucks of 25 to 36 t capacity which travel via the Mine Access Road to Muscle Creek Road and then on to the New England Highway. Product coal is hauled to a rail loading facility at the Ravensworth Coal Terminal where it is railed to the Port of Newcastle for sale to the export market. A small amount of product coal has also previously been, and may again be, sold to regional power utilities for use in domestic power generation.

2.2 The Modification

DA 205/2002 provides approval for the extraction of up to 11.6 Mt of coal from the No. 1 Extension. This area was originally defined by the extent of the known coal resource that had not previously been mined by underground operations and was assessed to contain a viable open cut mineable resource. Other areas assessed were considered potentially unsafe for open cut operations at the time.

With extensive operational experience in extracting coal from areas of old underground mining operations, additional resources outside the originally approved No. 1 Extension have been identified for open cut mining operations. Accordingly, the Modification seeks to extend mining operations to within a 28.4 ha area of which 8.2 ha falls outside the No. 1 Open Cut Extension Area. The Modification will result in additional 5.2 Mt of product coal being extracted over the remaining five years of MCC.

Mining operations will continue to be undertaken at the currently approved production rate of up to 2 Mtpa from the Muswellbrook Coal Mine. The currently approved infrastructure will continue to be utilised for the life of the Project.

3 AIR QUALITY CRITERIA

In its modelling and assessment guidelines, the Department of Environment, Climate Change and Water (DECCW) specifies air quality assessment criteria relevant for assessing impacts from dust generating activities (**NSW DEC, 2005**).

These criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (referred to as the Ambient Air-NEPMs (see **NEPC, 1998**)). However, the NSW DECCW's criteria include averaging periods which are not included in the Air-NEPMs and references to other measures of air quality, namely dust deposition and total suspended particulate matter (TSP).

Table 3.1 summarises the air quality criteria for dust that are relevant to this study.

Table 3.1: Air quality impact assessment criteria for particulate matter concentrations

Pollutant	Averaging period	Criteria	Agency
Total suspended particulate matter (TSP)	Annual mean	90μg/m^3	National Health and Medical Research Council (NHMRC)
Particulate matter < 10μm (PM_{10})	24-hour maximum	50μg/m^3	NSW DECCW
	Annual mean	30μg/m^3	NSW DECCW long-term reporting goal

The National Environment Protection Council (NEPC) has also developed a set of NEPM advisory reporting standards goals for $PM_{2.5}$ as shown in **Table 3.2** (**NEPC, 2003**). These goals have not been adopted in NSW for assessment of projects.

Table 3.2: Advisory reporting standards for $PM_{2.5}$ concentrations

Pollutant	Averaging period	Criteria	Agency
Particulate matter < 2.5μm ($PM_{2.5}$)	Annual mean	8μg/m^3	NEPM*
	24-hour maximum	25μg/m^3	NEPM*

**Not included as assessment criteria for projects in NSW*

In addition to health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces and/or on vegetation/crops. **Table 3.3** shows the dust deposition criteria set out in the DECCW procedures for modelling air pollutants from sources (**NSW DEC, 2005**).

Table 3.3: NSW DECCW criteria for dust (insoluble solids) fallout

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

4 EXISTING ENVIRONMENT

4.1 Dispersion Meteorology

The 2009 Modification (**HAS, 2008**) used meteorological data collected from the MCC weather station in its analysis.

Figure 4.1 presents the annual and seasonal windroses used in the **HAS, 2008** assessment for the period August 2007 to August 2008. The windroses show that the dominant wind directions on an annual basis are those from the east-southeast. A significant proportion of winds from this direction can be seen in all seasons, particularly in summer with almost 40%. In winter, while there are still winds from the east-southeast, the majority of winds are from the north-western quadrant. This is a common seasonal pattern found in the Hunter Valley. The annual average wind speed is 3.2 m/s and the annual percentage of calms is 10.2%.

Meteorological data from 2009 have also been reviewed to provide a comparison with the 2007/2008 dataset used in the previous assessment (**HAS, 2008**).

Figure 4.2 presents the annual and seasonal windroses for the MCC weather station for 2009. When compared with the 2007/2008 data (see **Figure 4.1**), the annual wind patterns are very similar with dominant winds from the east-southeast and lighter winds from the north-western quadrant. The autumn windrose appears to have a slightly less frequent percentage of winds from the north-west and a higher percentage of winds from the east. There is also a difference in the winter winds with the 2009 windrose showing less frequent and lighter winds from the east-southeast than in the 2007/2008 data. The annual average wind speed is 3.5 m/s and the annual percentage of calms is 15.1% which is slightly higher than that of the 2007/2008 data.

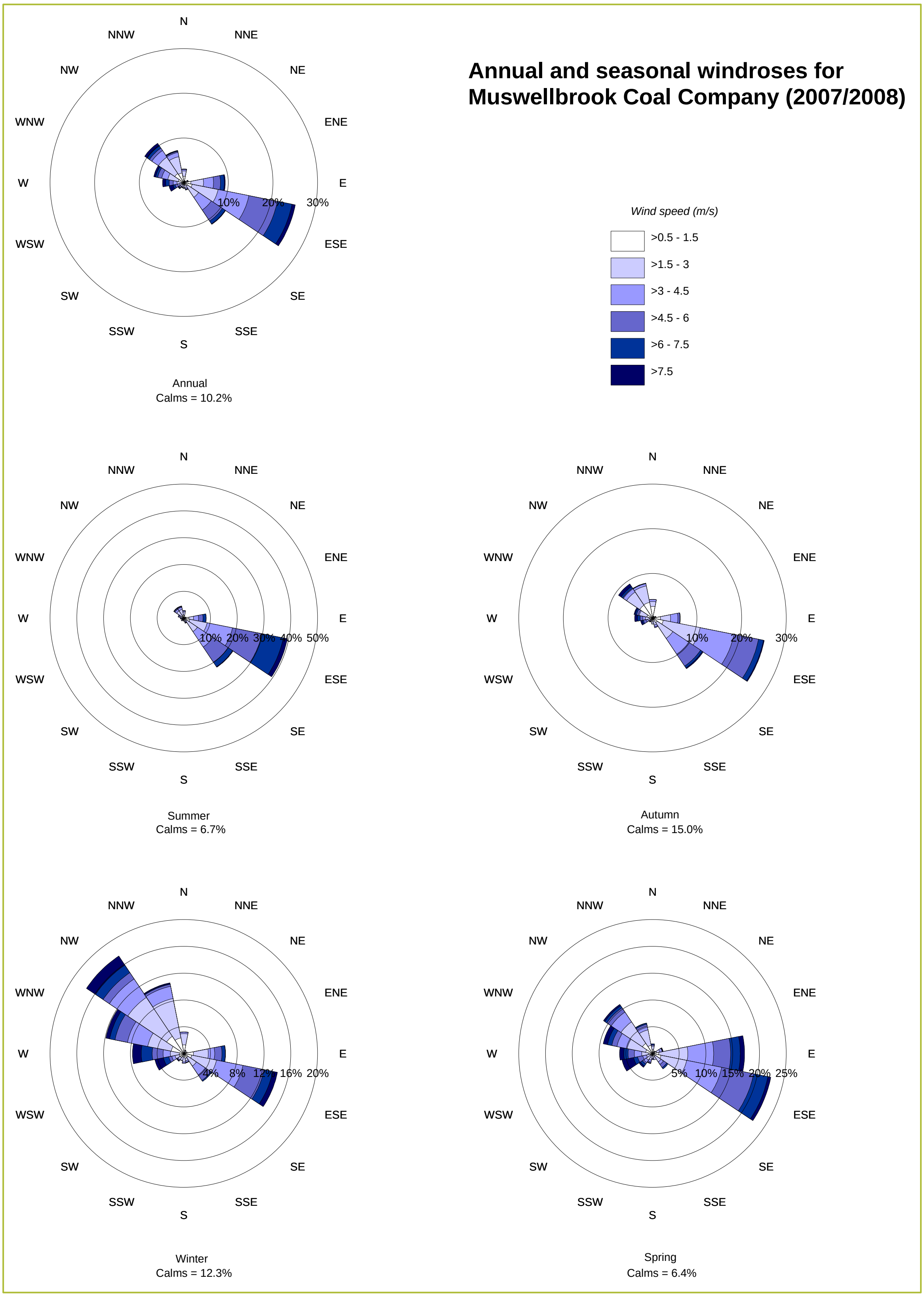

Figure 4.1: Annual and Seasonal Windroses for the Muswellbrook Mine August 2007 – August 2008

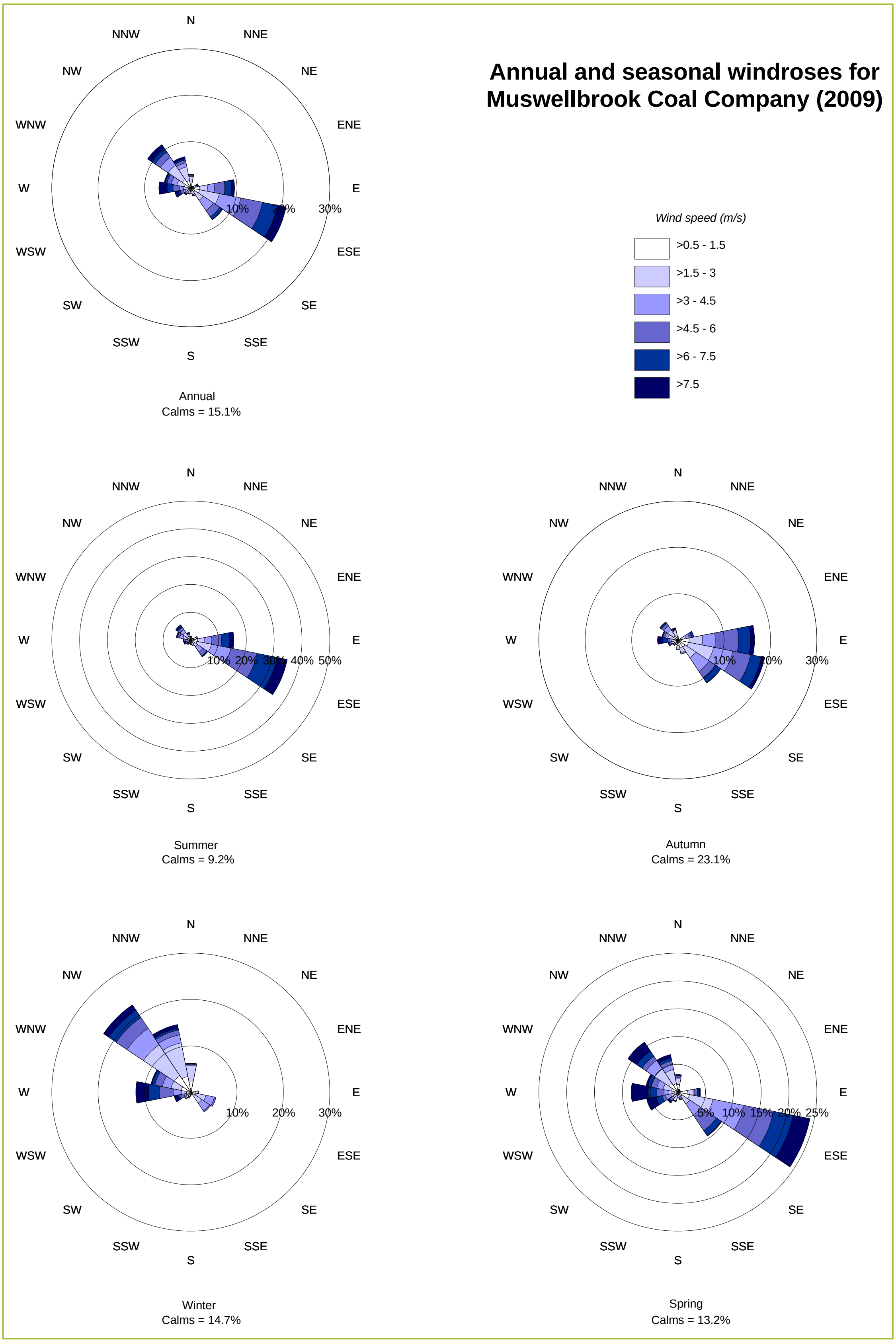

Figure 4.2: Annual and Seasonal Windroses for the Muswellbrook Mine
January – December 2009

4.2 Existing Air Quality

MCC operates three Tapered Element Oscillating Microbalances (TEOMs) measuring 24-hour average PM_{10} concentrations, three High Volume Air Samplers (HVAS) measuring Total Suspended Particulate (TSP) matter and an air quality monitoring network comprising 18 dust deposition gauges.

PM_{10}, TSP and dust deposition data collected between 2005 and 2009 from the monitoring network shown in **Figure 4.3** have been analysed and a summary can be found in **Table 4.1** and **Table 4.2**.

Table 4.1 shows that there are no recorded exceedances of the annual average DECCW criteria for either PM_{10} or TSP. Both PM_{10} and TSP annual averages are lower at Site 1, near the township of Muswellbrook. The average PM_{10} over all sites is 17.6 µg/m^3 and the average TSP over all sites is 41.4 µg/m^3, both of which are below their respective assessment criterion.

Table 4.1: Measured annual average PM_{10} and TSP concentrations

Year	TEOM (PM_{10}) *DECCW criterion = 30 µg/m^3*			HVAS (TSP) *DECCW criterion = 90 µg/m^3*		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
2005	13.4	16.3	15.9	31.0	33.1	32.3
2006	17.3	21.0	19.8	33.4	51.5	44.3
2007	17.2	20.5	18.0	42.1	57.1	51.6
2008	14.6	15.6	15.7	33.1	40.1	39.3
2009*	17.4	20.3	21.5	36.9	45.8	48.7
Average over site	**16.0**	**18.7**	**18.2**	**35.3**	**45.5**	**43.2**
Average over all sites and years = 17.6				**Average over all sites and years = 41.4**		

* The values for 2009 only include data up to and including June 2009.

Table 4.2 shows that the deposition levels at most of the gauges remain below the DECCW's maximum level of 4 g/m^2/month. There have been four occasions since 2000 that this level has been exceeded at DM27. Given that this gauge is within the mining extension area, this is not unexpected and results from this gauge have not been considered in further discussion. There have also been exceedances at DM2, DM10, DM20 and DM28. These four gauges lie along the WNW – ESE predominant wind direction axis, experienced in the Muswellbrook area. Gauge 10 is located within 200 m of the MCC Project boundary and therefore these data would not be considered representative of typical ambient dust levels as levels.

Data from gauges 10 and 27 have been presented in **Table 4.2** but are not included in any subsequent analysis of dust deposition.

Table 4.2: Annual average dust deposition levels from 2000 to 2009 (g/m^2/month)

Monitor	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
DM2	1.9	1.1	2.6	1.7	0.9	1.8	***6.2***	***4.4***	2.8	**2.5**
DM7	1	0.7	1.2	1.4	0.6	1	1.3	1.5	0.9	**1.1**
DM10	1.7	1.7	1.7	1.4	2	1.5	1.7	4	***5.2***	**2.6**
DM14	1.1	*ND*	1.3	2.3	1	1.1	1.6	1.1	2.2	**1.4**
DM15	2.1	3.7	2.1	1.6	1	1.2	1.9	1.4	2.5	**1.9**
DM16	1.7	2.7	2.2	2.8	2.2	1.7	1.2	2	1.1	**1.9**
DM17	1.4	1.5	2.1	2.3	1.5	1.6	1.5	1.9	1.5	**1.7**
DM18	0.5	1.4	1.3	1	1.3	0.8	1	1.2	1.4	**1.1**
DM19	3	0.9	1.7	2.7	2.8	1.9	3.2	3.7	2.7	**2.5**
DM20	2.2	1.4	1.5	1.9	***4.1***	1.8	2.6	3.1	2.7	**2.3**
DM22	1.1	1.4	1.5	2.7	2	2.1	1.5	2.6	2.7	**1.9**
DM23	1	0.8	1.3	1	1.8	1.8	1.3	2.1	3	**1.6**
DM24	1	1.9	1.9	1.6	1.1	1.5	2	2.1	2.6	**1.8**
DM26	2.5	2.3	1.1	0.9	2	1.2	1.5	2.5	1.9	**1.8**
DM27	***4.2***	1.5	1.4	2.3	2.1	***4.6***	***4.9***	***6.3***	*ND*	**3.4**
DM28	2.1	1.4	2.2	***4.1***	0.8	2.2	2	1.9	1.2	**1.9**
DM29	*NI*	*NI*	*NI*	*NI*	*NI*	1.4	1.7	1.8	1.6	**1.5**
DM30	*NI*	*NI*	*NI*	*NI*	*NI*	1.2	1.8	1.7	1	**1.4**
Average over all sites and years = 1.8 g/m^2/month										

Note: ND – indicates that no data were available for that period. NI – indicates that the monitor was not installed. ***Red Bold Italic*** – indicates levels above 4 g/m^2/month.

In general, the air quality surrounding the Project Area, in terms of deposition, is reasonably good and levels remain below 4 g/m^2/month on average. The average dust deposition level over all sites (excluding sites D10 and D27) and years is 1.8 g/m^2/month.

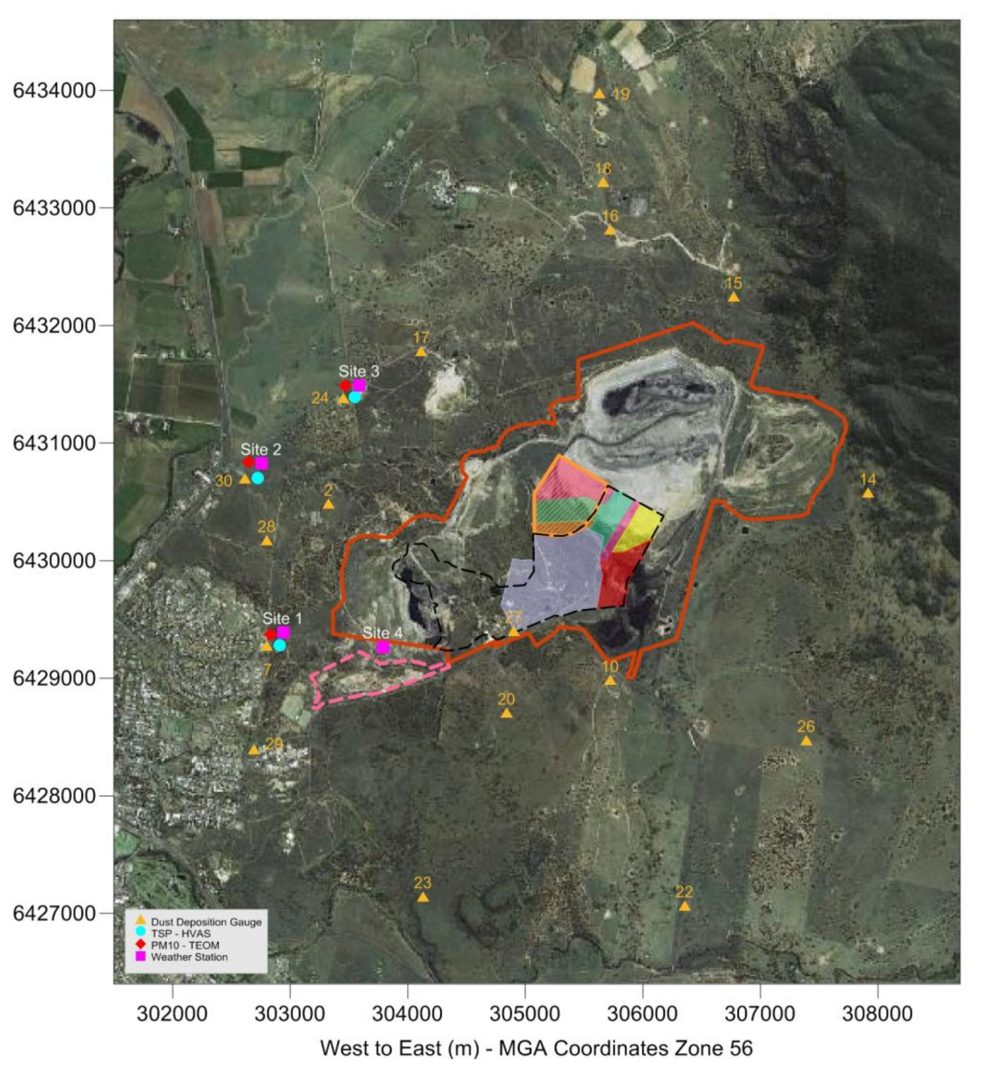

Figure 4.3: Locations of dust and meteorological stations

Based on the monitoring data provided above, the following current background levels have been assumed for assessment purposes:

- Annual average PM_{10} – 17.6 µg/m^3;
- Annual average TSP – 41.4 µg/m^3; and
- Annual average dust deposition – 1.8 g/m^2/month.

5 OVERVIEW OF PREVIOUS AIR QUALITY ASSESSMENTS

5.1 2002 Air Quality Assessment

As described in **Section 1**, an air quality assessment was conducted as part of the MCC EIS to facilitate the No. 1 Open cut Extension (**HAS, 2002**). The 10 year life-of-mine was reviewed and the following 'worst-case' years were modelled and assessed:

- Year 1 – Mining is closest to Muswellbrook;
- Year 4 – High overburden production and mining takes place in the central part of the open cut area; and
- Year 9 – Overburden production is the highest.

The MCC EIS presented predictions of annual average PM_{10} and TSP concentrations as well as dust deposition levels for the Project and other sources of dust (background). Background levels of dust were assumed to include emissions from other mines in the surrounding area including Bengalla, Mt. Arthur North (now a part of Mt Arthur Coal), Drayton, Dartbrook and Mt. Pleasant. Levels of other sources of non-mining sources of dust were assumed based on available monitoring data at the time. These are as follows:

- Annual average PM_{10} – 18.6 µg/m^3;
- Annual average TSP – 46.6 µg/m^3; and
- Annual average dust deposition – 1 g/m^2/month.

The MCC EIS showed that the Project when considered with the above background levels, were well below the air quality assessment criteria for annual average PM_{10}, TSP and dust deposition at all private receptors. Predicted maximum levels in the MCC EIS for each year are summarised below in **Table 5.1**. Private receptors 13 and 14 experienced the maximum predictions for each pollutant, however it is important to note that private receptor 14 no longer exists.

Table 5.1: Maximum dispersion modelling predictions from the MCC EIS

Year 1 Operations	Year 4 Operations	Year 9 Operations	Air Quality Criteria
Predicted annual average PM_{10} concentrations (µg/m^3) (Predictions with background are shown in parentheses)			
4 (22.6)	3 (21.6)	3 (21.6)	30
Predicted annual average TSP concentrations (µg/m^3) (Predictions with background are shown in parentheses)			
7 (53.6)	5 (51.6)	5 (51.6)	90
Predicted annual average dust deposition (g/m^2/month) (Predictions with background are shown in parentheses)			
0.8 (1.8)	0.5 (1.5)	0.5 (1.5)	2 (4 - cumulative)

Source: **HAS, 2002**

Table 5.1 shows that the MCC EIS predicted that no private receptors would be expected to experience PM_{10}, TSP or dust deposition levels above the annual average DECCW assessment criteria.

A greenhouse gas assessment was also conducted as part of the MCC EIS. The assessment found that the annual average CO_2 emissions (averaged over the ten year life of the mine) would be:

- 14,094 t/y attributable to the use of electrical energy and fuels for equipment and blasting; and
- 3,500,000 t/y due to combustion of the coal produced.

The greenhouse gas emissions were estimated to be 0.003% of Australia's 1999 emissions (**HAS, 2002**).

5.2 2009 Air Quality Assessment

As described in **Section 1**, an additional air quality assessment was conducted for a minor Modification to the MCC No. 1 Open cut Extension to allow for a relocation of the MIA and extraction of coal in that area. The MIA would be moved approximately 600m to the south-west and therefore would be some small dust emissions associated with the MIA relocation, but no additional changes to the quantity of dust emissions from the operation of the mine.

The 2009 Modification reviewed the activities associated with the relocation of the MIA as well as the then current meteorological conditions and existing air quality. The 2009 Modification concluded that relocating the MIA would not have a detectable impact on dust levels in the Muswellbrook area (**HAS, 2008**).

6 ASSESSMENT METHODOLOGY

For the purposes of impact assessment for the Modification, Year 2 (2012) was selected as the representative 'worst-case' scenario. Year 2 was chosen for assessment as this year would include the highest quantity of overburden and ROM coal moved as part of the Modification.

Emissions estimates and a qualitative assessment of potential air quality impacts as a result of the Modification are provided below in **Section 7** and **Section 8** respectively.

A greenhouse gas assessment is also provided for the Modification.

7 REVISED EMISSIONS ESTIMATES

The operation of the mine in Year 2 has been analysed and estimates of dust emissions for the individual activities have been made. Emission factors developed both locally and by the US EPA, have been applied to estimate the amount of dust produced by each activity. The emission factors applied are the most reliable and up-to-date for determining dust generation rates. The mining plans for the Project have been analysed and a detailed emissions inventory has been prepared for Year 2.

TSP emissions for Year 2 have been estimated and are provided below in **Table 7.1**.

Table 7.1: Estimated dust emissions from the MCC Modification (Year 2)

ACTIVITY	TSP emissions for Year 2 (kg/y)
OB - Scraper stripping topsoil	462
Topsoil removal - Sh/Ex/FELs loading topsoil	7
Topsoil removal - Hauling topsoil to emplacement area	119
Topsoil removal - Emplacing topsoil at emplacement area	7
OB - Drilling Overburden	6,980
OB - Blasting Overburden	11,732
OB - Loading Overburden	18,326
OB - Hauling o/b	316,321
OB - Dumping overburden	18,326
OB - Dozers on o/b in pit	20,390
OB - Dozers on o/b on dumps	27,187
CL - Dozers on coal	185,950
CL - Loading coal	168,268
CL - Hauling coal to CHPP	96,198
CL - Unloading coal from trucks to hopper	15,312
CL - Unloading coal from hopper to temporary stockpile	7,656
CL - Reload coal to hopper	84,134
CL - Crushing	4,134
CL - Screening	19,141
CL - Unloading coal to stockpile	11,484
CL - Load coal to trucks for export off-site	981
CL - Hauling coal off-site	73,500
Grading roads and other areas	1,123
Wind erosion from exposed working areas (in pit)	7,282
Wind erosion from exposed working areas (out of pit)	11,498
Wind erosion from stockpiles	3,066
Total	**1,109,584**

The hauling of overburden material by haul trucks is the most significant dust generating activity that would occur at the site. The estimated total annual emission of TSP for Year 2 operations is approximately 1,109,584 kg/y.

8 ASSESSMENT OF IMPACTS

Year 9 as assessed in the MCC EIS is the closest modelled year to Year 2 of the Modification and will therefore be considered when assessing the Modification. **Table 8.1** presents a comparison of the total ROM coal and waste produced in Year 9 of the MCC EIS and Year 2 of the Modification.

Table 8.1: ROM coal and waste produced in 2002 and current air quality assessments

Assessment	ROM coal production (Mt)	Waste (Mbcm)
MCC EIS – Year 9	1.25	8.67
The Modification – Year 2	1.53	8.94

Source: 2002 EA information – **HAS, 2002.** Current assessment information – **Hansen Bailey, 2010**

Table 8.1 shows that Year 2 of the Modification produces slightly higher ROM coal and waste production rates than previously assessed operations but still remains below the approved 2 Mtpa product coal production rate. Year 2 of the Modification therefore produces an increase of 0.28 Mt ROM coal and 0.27 Mt of overburden waste from the previously assessed scenario. Further to this, it was estimated that Year 9 of the MCC EIS would produce 972,967 kg/y of dust emissions while Year 2 of the Modification would produce 1,109,584 kg/y of emissions (see **Section 7**). Therefore the estimated increase in dust emissions during Year 2 of the Modification is 136,617 kg/y which represents approximately 14% of the estimated MCC EIS Year 9 emissions.

Table 5.1 showed that predicted concentrations of annual PM_{10}, TSP and dust deposition levels from Year 9 of the 2002 EA were very low and well below the assessment criteria. The small predicted increase in dust emissions as a result of Year 2 of the modification is unlikely to cause a significant additional impact on predicted concentrations presented in HAS, 2002. Further to this, it is also unlikely that concentrations at nearby private receptors would exceed the assessment criteria based on the proposed increase. Revised background concentrations and cumulative predictions as a result of updated monitoring data are discussed in **Section 8.2**.

Figure 4.1 and **Figure 4.2** present the annual and seasonal windroses used in the 2002 EA and in the current assessment respectively. The windroses show prominent northwest and east-northeast wind directions. As expected, private receptor 13 and 14 (14 no longer existing) experienced the maximum predicted concentrations for Year 9 as they are generally aligned in this direction to the mine. Considering the estimated increase in emissions as a result of Year 2 of the modification, it is unlikely that the other private receptors in the area would experience a significant increase in concentrations given their locations are not in a prevailing downwind direction. For example, for private receptors to the north, south and southwest of the Project (see **Figure 1.1**) to be adversely impacted as a result of the Project, winds would need to prevail from the south, north and northeast directions respectively. **Figure 4.2** shows that there are very few winds from these directions both seasonally and annually and therefore it is unlikely that significant amounts of dust would be blown towards these receptors.

As previously stated, private residence 13 would only likely experience a minor increase in concentrations but would not be expected to exceed the assessment criteria.

8.1 Estimated 24-hour average PM_{10} concentrations

Predictions of 24-hour average PM_{10} concentrations have not been made in previous assessments for the MCC EIS. Therefore a brief assessment of measured 24-hour average PM_{10} concentrations around the site is provided.

Figure 8.1 presents the 24-hour average PM_{10} concentrations around MCC measured at all three TEOM stations between January 2005 and July 2009. As these measurements have been made while MCC operations have taken place, it can be assumed that these levels of dust include background as well as any dust generated from the mine.

The results show that while there are some exceedances of the PM_{10} 24-hour criterion, the majority of concentrations fall below the criterion and are in a general pattern of higher concentrations during summer and lower during winter which is a typical trend seen in the Hunter Valley. Further analysis of the data shows that at the three sites a minimum of 67% of the data falls below 20 $\mu g/m^3$ and a minimum of 96% of data falls below 40 $\mu g/m^3$.

Natural events such as bushfires and dust storms are often responsible for elevated 24-hour PM_{10} concentrations and exceedances of the 24-hour criterion can be expected from time to time. This is reflected in the National Environment Protection Measure (NEPM) reporting standard for PM_{10} which allows exceedances of the criterion for up to five days in a year. **Table 8.2** presents the number of days that each TEOM site has exceeded the PM_{10} 24-hour criterion in each year. The results show that all sites except Site 2 in 2007 and Site 3 in 2009 record exceedances over the criterion on less than 5 days in the year. It is likely that many of these exceedances are the result of localised dust-generating or regional weather events. For example, the unusually high levels of dust recorded in April 2009 are likely to be the result of a regional dust-generating event as all sites recorded a high value on the same day.

As the measured 24-hour average PM_{10} results include the MCC mine's contribution, and as discussed in **Section 8**, the Modification is not anticipated to create significant additional dust impacts, it is unlikely that additional exceedances of the 24-hour PM_{10} criterion would occur as a result of the Modification.

Table 8.2: No of days each TEOM station exceeds the 24-hour PM_{10} criterion in each year

TEOM	No. of days above the criterion				
	2005	2006	2007	2008	2009
Site 1	0	2	7	2	2
Site 2	0	5	14	3	4
Site 3	0	4	4	3	6

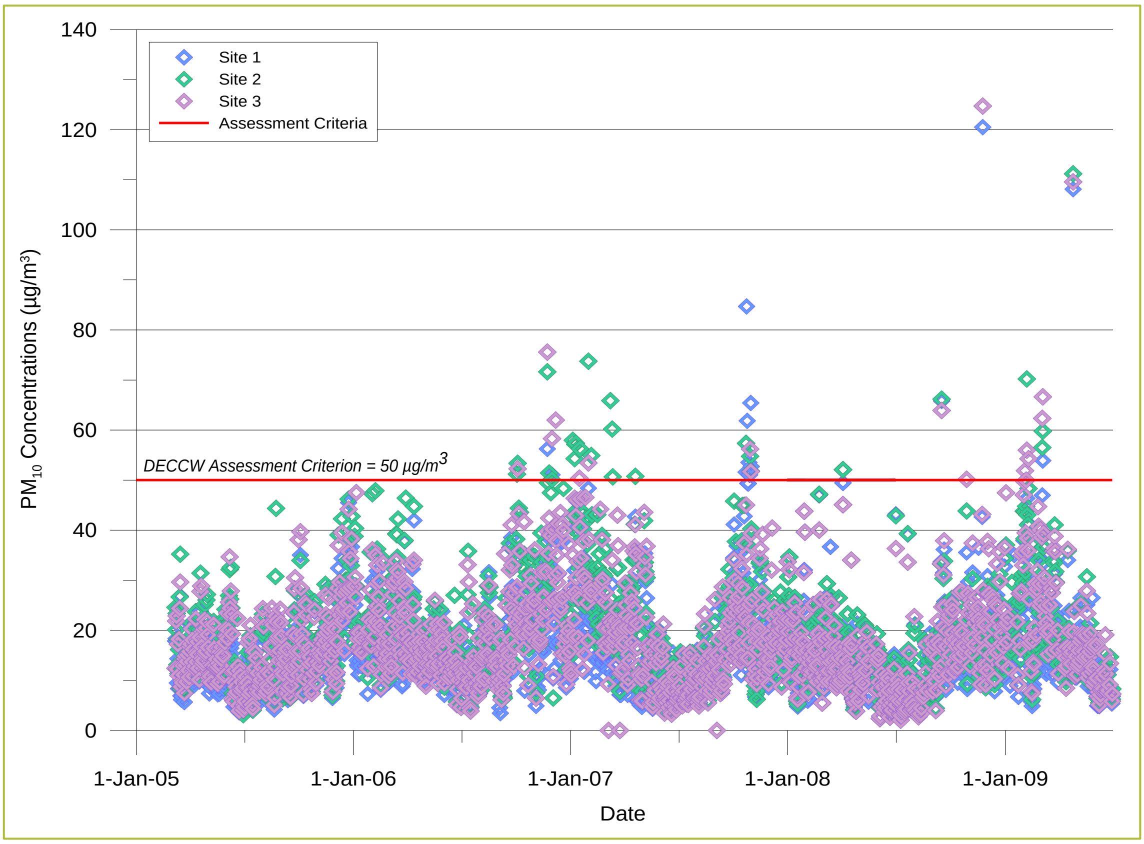

Figure 8.1: TEOM 24-hour average PM_{10} concentrations at the MCC project

8.2 Cumulative Assessment

8.2.1 Annual average TSP, PM_{10} and Dust Deposition Cumulative Predictions

As described in **Section 4.2,** the following background levels apply to the Modification:

- Annual average PM_{10} – 17.6 µg/m^3;
- Annual average TSP – 41.4 µg/m$^{3;}$ and
- Annual average dust deposition – 1.8 g/m^2/month.

As in the MCC EIS, it is assumed that these background levels include all existing sources of dust including other mines in the area and any dust that may be generated from MCC. When these background levels are compared with those used in the MCC EIS (see **Section 5.1**), the PM_{10} and TSP levels are slightly lower but the dust deposition levels are higher.

If these revised background levels were added to the MCC EIS Year 9 maximum predicted concentrations, the maximum annual average PM_{10}, TSP and dust deposition levels would be 20.6 µg/m^3, 46.4 µg/m^3 and 2.3 g/m^2/month respectively which are all below their respective assessment criteria. As stated in **Section 8,** although Year 2 of the Modification would create some extra emissions as a result of operations, it is not likely to have a substantial impact or exceed the assessment criteria.

9 MITIGATION MEASURES

9.1 Introduction

The air quality assessments for the MCC EIS, 2009 Modification and the current Modification are based on the assumption that MCC applies the control measures discussed in following sections to minimise dust emissions. This section outlines procedures proposed for the management and control of dust emissions.

9.2 Proposed dust management and control procedures

The term "best practice" is frequently used in pollution control and pollution management. However, what constitutes "best practice" is difficult to define in practical situations. Environment Australia has published a series of booklets to assist the mining industry with incorporating best practice environmental management through all phases of mineral production from exploration through construction and eventual closure. In the booklet for Dust Control (**Environment Australia, 1998**) "best practice" is defined as follows:

> *Best Practice can be defined as the most practical and effective methodology that is currently in use or otherwise available. Best practice dust management can be achieved by appropriate planning in the case of new or expanding mining operations and by identifying and controlling dust sources during the active phases of all mining operations.*

This document has since been updated by the Department of Energy, Resources and Tourism (DERT) who have published the handbook *Leading Practice Sustainable Development Program for the Mining Industry* (**DERT, 2009**). This new handbook introduces the term "leading practice", which:

> "...considers the latest and most appropriate technology applied in order to seek better financial, social and environmental outcomes for present stakeholders and future generations."

The following procedures are proposed for the management of dust emissions from the Modification. The aim of these procedures is to minimise the emission of dust in a cost effective manner. The effects of these controls are included in the model simulations. Dust can be generated from two primary sources:

- Windblown dust from exposed areas; and
- Dust generated by mining activities.

The proposed controls have been considered against those determined to be best or leading practice in the Environment Australia booklet for Dust Control.

Table 9.1, **Table 9.2** and **Table 9.3** list the mine design, wind-blown and mining-generated dust sources respectively and associated controls. These have been incorporated in the analysis, where relevant.

Table 9.1: Best/Leading Practice Control Procedures for Mine Design

Source	Control Procedures
Transport of coal	Largest practical truck size Shortest route Water sprays on key transfer points
Overburden dumps	Profiling of surfaces to reduce surface speed Contouring of dump shape to avoid strong wind flows and smooth gradients to reduce turbulence at surface
Revegetation	Complete as soon as practical after disturbance Apply as widely as practical

Table 9.2: Best/Leading Practice Control Procedures for Wind-blown Dust

Source	Control Procedures
Areas disturbed by mining	Disturb only the minimum area necessary for mining. Reshape, topsoil and rehabilitate completed overburden emplacement areas as soon as practicable after the completion of overburden tipping.
Ore handling areas/stockpiles	Maintain ore handling areas / stockpiles in a moist condition as required using water carts to minimise wind-blown and traffic-generated dust.

Table 9.3: Best/Leading Practice Control Procedures for Mining-generated Dust

Source	Control Procedures
Haul Road Dust	All roads and trafficked areas will be watered as required using water trucks to minimise the generation of dust. All haul roads will have edges clearly defined with marker posts or equivalent to control their locations, especially when crossing large overburden emplacement areas. Obsolete roads will be ripped and re-vegetated.
Minor roads	Development of minor roads will be limited and the locations of these will be clearly defined. Minor roads used regularly for access etc will be watered. Obsolete roads will be ripped and re-vegetated.
Topsoil Stripping	Access tracks used by topsoil stripping equipment during their loading and unloading cycle will be watered.
Topsoil Stockpiling	Long term topsoil stockpiles not regularly used will be re-vegetated.
Drilling	Dust aprons will be lowered during drilling. Drills will be equipped with dust suppression systems which will be used when high levels of dust are being generated.
Blasting	Meteorological conditions will be assessed prior to blasting. Adequate stemming will be used at all times.
Processing	Activities in the processing plant will be dust controlled.

10 GREENHOUSE GAS ASSESSMENT

10.1 Introduction

This greenhouse gas assessment considers the greenhouse gas emissions (GHG) from MCC, including existing approved operations and the Modification.

The greenhouse gas assessment has been conducted in accordance with the methodologies established by various government policies and guidelines and using the National Greenhouse Accounts (NGA) Factors, published by the Department of Climate Change (**DCC, 2009a**). The DCC defines three 'scopes' (or emission categories):

- Scope 1 covers direct emissions from sources within the Project Site boundary such as fuel combustion and manufacturing processes;
- Scope 2 covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation; and
- Scope 3 includes all other indirect emissions that are a consequence of the organisations activities but are not from sources owned or controlled by the organisations, e.g. extraction of diesel fuel, off-site transport of the product, or staff travel etc.

For the purposes of this assessment, Modification-related greenhouse gas sources include the following:

- Diesel combustion during mine operations - Scope 1;
- Fugitive methane (CH4) emissions released from the extraction of coal – Scope 1;
- Indirect emissions resulting from off-site diesel extraction and transport to site - Scope 3;
- Indirect emissions resulting from transportation of product by rail – Scope 3;
- Indirect emissions resulting from the use of product coal in a power station – Scope 3; and
- Indirect emissions resulting from the consumption of purchased electricity i.e.:
  - Scope 2 – The consumption of purchased electricity; and
  - Scope 3 – Electricity lost through transport of purchased electricity.

10.2 Emission factors

The National Greenhouse Accounts (NGA) Factors published by the DCC (**DCC, 2009a**) have been used to convert fuel usage and electricity consumption into CO_2-e emissions. The relevant emission factors are summarised in **Table 10.1**.

Table 10.1 provides a summary of the emission factors used.

Table 10.1: Summary of Emission Factors for Greenhouse Gas Assessment

Emission Source	Emission factor		Scope	Source
Diesel - Non-transport activities	69.5	kg CO_2-e/GJ	1	Table 3 (**DCC, 2009a**)
	5.3	kg CO_2-e/GJ	3	Table 38 (**DCC, 2009a**)
Extraction of coal	45.0	kg CO2-e/tonne ROM	1	Table 8 **(DCC 2009a)**
Electricity	0.89	kg CO_2-e/kWh	2	Table 39 (**DCC, 2009a**)
	0.18	kg CO_2-e/kWh	3	Table 3 (**DCC, 2009a**)
Transport of coal by rail	12.3	g/net tonne-km	3	**QR Network Access 2002**
Burning coal in a power station	88.43	kg CO_2-e/GJ	3	Table 1 **(DCC, 2009a)**

10.3 Greenhouse gas emissions results

A summary of the total GHG emissions associated with the Modification are presented in **Table 10.2**.

Table 10.2: Summary of estimated CO_2-e emissions (t CO_2-e/y)

Year	Scope 1	Scope 2	Scope 3	Total
Year 1	88,680	4,099	2,633,612	2,726,392
Year 2	92,188	4,219	2,747,143	2,843,549
Year 3	89,375	3,761	2,735,360	2,828,496
Year 4	84,386	2,988	2,706,140	2,793,514
Year 5	80,267	2,646	2,617,157	2,700,070
Total	**434,897**	**17,713**	**13,439,412**	**13,892,022**

The total CO_2–e emissions for the State of NSW in 2007 were 162.7 Mt CO_2 –e (**DCC, 2009b**). The average annual emissions estimated for the lifetime of the proposed Modification (Scope 1 and 2) is 0.09 Mt CO_2–e. This equals approximately 0.05% of the total emissions for NSW in 2007.

The maximum annual increase of emissions would be in Year 2 (2012) which would represent an approximate annual contribution of 0.059% to baseline 2007 NSW emissions.

Table 10.3: Summary of estimated percentage increase CO_2-e emissions (t CO_2-e/y)

Year	% Increase from NSW 2007 greenhouse emissions
Year 1	0.057
Year 2	0.059
Year 3	0.057
Year 4	0.054
Year 5	0.051

11 CONCLUSIONS

This study has assessed the air quality and greenhouse gas impacts associated with the proposed Modification to Muswellbrook Coal Mine. A qualitative assessment was conducted to assess the impact of dust emissions on the local air quality. The Modification includes an additional mining area with a mine life of five years but the ROM production rate remains below the approved 2 Mtpa.

Estimated TSP emissions from the previously modelled worst-case scenario were compared with estimated emissions from the Modification. It was shown that there would only be a small increase in emissions as a result of new operations. It is concluded that adverse air quality impacts above DECCW criteria would be unlikely at nearest private receptors due to the Modification. When background levels are considered, concentrations at the nearest private receptors are still expected to be below the assessment criteria.

The greenhouse gas assessment assessed the Modification. It was estimated that the development on average would release approximately 0.09 Mt/y CO_2-e. The maximum annual increase of emissions would be in Year 2 which would represent an approximate annual contribution of 0.059% to baseline 2007 NSW emissions.

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