NRE Wongawilli Colliery

Coal Mine Particulate Matter Control Best Practice (PRP9) Report

September 2012

Contents

GLOSSARY OF TERMS AND ABBREVIATIONS

Abbreviations

AEMR	Annual Environmental Management Review
CCL	Consolidated Coal Lease
DoPI	Department of Planning & Infrastructure
DRE	Division of Resources and Energy
EPL	Environment Protection Licence
HVAS	High Volume Air Sampler
OEH	Office of Environment and Heritage
ML	Mining Lease
MOP	Mining Operations Plan
MP	Major Project
NRE	Gujarat NRE Wonga Pty Ltd
PKCT	Port Kembla Coal Terminal

1 INTRODUCTION

1.1 Background

Gujarat NRE FCGL Pt Ltd (NRE) owns the NRE Wongawilli Colliery (the Colliery) which is located in the NSW Southern Coalfield located approximately 15 km south west of Wollongong, within the local government areas (LGAs) of Wollongong and Wingecarribee in the Illawarra Region around 70 km south of Sydney.

NRE presently holds mining leases CCL 766, ML 1565 and ML 1596 for the Colliery, with a total area of 14 767 hectares (ha). Extensive underground mining at this location has been undertaken from the early twentieth century; however a substantial volume of high quality coking coal remains along with some thermal coal.

The Wongawilli Colliery currently holds Environmental Protection License (EPL) 1087 for its mining operations. During 2011 the NSW Office of Environment and Heritage (OEH) amended EPL 1087 to include a Pollution Reduction Program (PRP9) that requires the Wongawilli Colliery to prepare a report on the practicability of implementing best practice measures to reduce particulate emissions.

1.2 PRP Requirements

A copy of PRP9 as attached to EPL 1087 is located in **Appendix B**. A copy of the 'Coal Mine Particulate Matter Control Best Practice – Site Specific Determination Guideline' is located in **Appendix C.**

PRP9 requires the following to be completed:

1. Identify, quantify and justify existing measures that are being used to minimise particle emissions
    A. Estimate baseline emissions of TSP, PM_{10} and $PM_{2.5}$ (tonne per year) from each mining activity. USEPA AP42 emission estimation techniques must be used for both uncontrolled emissions (with no particulate matter controls in place) and controlled emissions (with current particulate matter controls in place.
    B. Using the results from step 1(A), rank the mining activities from highest to lowest based on the estimated emissions of TSP, PM_{10} and $PM_{2.5}$.
    C. Identify the top four mining activities from step 1(B) that contribute the highest emissions of TSP, PM_{10} and $PM_{2.5}$.
2. Identify, quantify and justify the measures that could be used to minimise particle emissions
    A. For each of the top four activities identified in step 1(C), identify the measures that could be implemented to reduce emissions
    B. For each of the top four activities identified in step 1(C), estimate the emissions of TSP, PM_{10} and $PM_{2.5}$ from each mining activity after applying the measures identified in step 2(A)
3. Evaluate the practicability of implementing these best practice measures

   A. For each of the best practice measures identified in step 2(A), assess how practicable each one is to implement be taking into consideration:
      i. Implementation costs
      ii. Regulatory requirements
      iii. Environmental impacts
      iv. Safety impacts
      v. Compatibility with current processes and proposed future developments
   B. Identify those best practice measures that will be implemented at the premises to reduce particle emissions
4. Propose a timeframe for implementing all practicable best practice measures
   A. For each of the practicable best practice measures identified in step 3.2, provide a timeframe for their implementation.

1.3 Mining Activity and Associated Emission Factors

The 'Coal Mine Particulate Matter Control Best Practice – Site Specific Determination Guideline' defines mining activities relevant to PRP9 as:

- Wheel generated particles on unpaved roads;
- Wind erosion of overburden;
- Blasting;
- Bulldozing Coal;
- Trucks unloading overburden;
- Bulldozing overburden;
- Front-end loaders on overburden;
- Wind erosion of exposed areas;
- Wind erosion of coal stockpiles;
- Unloading from coal stockpiles;
- Dragline;
- Trucks unloading coal;
- Loading coal stockpiles;
- Graders;
- Drilling;
- Coal crushing;
- Material transfer of coal;
- Scrapers on overburden;
- Train loading;
- Screening; and
- Material transfer of overburden.

Only some of these activities occur at the Wongawilli Colliery. **Section 2** describes the activities undertaken at the Wongawilli Colliery and presents the calculated emissions for each activity.

Emission factors for each of the activities listed above are detailed in **Table 1.1**

PRP Activity	Units	TSP Emission Factor	PM10 Emission Factor	PM2.5 Emission Factor	Emission Factor Source
Wheel generated particulates on unpaved roads	kg/VKT	$\left(\frac{0.4536}{1.6093}\right) \times 4.9 \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1203}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 1.5 \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1203}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 0.15 \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1203}{3}\right)^{0.45}$	AP-42 13.2.2
Wind erosion of overburden (a)	kg/ha/h	0.1	0.5 * TSP (0.5 from AP-42 13.2.5)	0.75 * TSP (0.75 from AP-42 13.2.5)	AP-42 11.9.7 Table 11.9-4
Blasting	kg/blast	$0.00022 \times A^{1.5}$	0.52 * TSP	0.03 * TSP	AP-42 11.9.7 Table 11.9-2
Bulldozing coal	kg/t	$35.6 \times \frac{s^{1.2}}{M^{1.3}}$	$6.33 \times \frac{s^{1.5}}{M^{1.4}}$	$0.022 \times \text{TSP}$	AP-42 11.9.7 Table 11.9-2
Trucks unloading overburden	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	AP-42 13.2.4
Bulldozing overburden & front-end loaders on overburden	kg/t	$2.6 \times \frac{S^{1.2}}{M^{1.3}}$	$0.3375 \times \frac{S^{1.5}}{M^{1.4}}$	0.105 * TSP	AP-42 11.9.7 Table 11.9-2

Wind erosion of exposed areas (b)	kg/ha/h	0.1	0.5 * TSP (0.5 from AP-42 13.2.5)	0.075 * TSP (0.075 from AP-42 13.2.5)	AP-42 11.9.7 Table 11.9-4
Wind erosion of coal stockpiles	kg/ha/h	1.8 * u	0.5 * TSP (0.5 from AP-42 13.2.5)	0.075 * TSP (0.075 from AP-42 13.2.5)	AP-42 11.9.7 Table 11.9-2
Unloading from coal stockpiles	kg/t	$\frac{0.580}{M^{1.2}}$	$\frac{0.0447}{M^{0.9}}$	0.019 * TSP	AP-42 11.9.7 Table 11.9-2
Dragline	kg/bcm	$0.0046 \times \frac{d^{1.1}}{M^{0.3}}$	$0.002175 \times \frac{d^{0.7}}{M^{0.3}}$	0.017 * TSP	AP-42 11.9.7 Table 11.9-2
Trucks unloading coal	kg/t	$\frac{0.580}{M^{1.2}}$	$\frac{0.0447}{M^{0.9}}$	0.019 * TSP	AP-42 11.9.7 Table 11.9-2
Loading coal stockpiles	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	AP-42 13.2.4 (Note: AP-42 11.9.7 Table 11.9.4 has train loading emission factor but footnote direct user to Chapter 13 for more accurate

					emissions factors.)
Graders	kg/VKT	$0.0034 \times S^{2.5}$	$0.00336 \times S^{2.0}$	$0.0001054 \times S^{2.5}$	AP-42 11.9.7 Table 11.9-2
Drilling	kg/hole	0.1	0.52 * TSP	0.03 * TSP	AP-42 11.9.7 Table 11.9-4
Coal crushing	kg/t	0.0027	0.0012	No data	AP-42 11.9.2 Table 11.19.2-2
Material transfer of coal	kg/t	$\frac{0.580}{M^{1.2}}$	$\frac{0.0447}{M^{0.9}}$	0.019 * TSP	AP-42 11.9.7 Table 11.9-2
Scrapers on overburden	kg/t	$0.029^{(b)}$	No data	No data	AP-42 11.9.7 Table 11.9-4
Train loading	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	AP-42 13.2.4 (Note: AP-42 11.9.7 Table 11.9.4 has train loading emission factors but footnote direct user to Chapter 13 for more accurate emissions factors.)
Screening	kg/t	0.025	0.0087	No data	AP-42 11.19.2 Table 11.19.2-2
Material transfer of overburden	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	AP-42 13.2.4

2 OVERVIEW OF OPERATIONS

2.1 Operations

Mining at the Wongawilli Colliery commenced in 1907 and since that time the Colliery has been progressively expanded and upgraded by various owners to produce the current mining operation owned and managed by Gujarat NRE.

Extracted coal from underground mining is transported to the surface by a conveyor to the upper Pit Top at the Colliery. The coal is then transferred onto a decline conveyor that transports the coal approximately 1,100 metres to the Stockpile area at the base of the escarpment. The coal is then screened and transferred to coal bins or the ROM stockpile awaiting loading to trains. Once loaded into trains, the coal is then transported 15 kilometres to the Port Kembla Coal Terminal (PKCT).

Project Approval 09_0161 obtained under the Environmental Planning and Assessment Act 1979 in 2011 extended underground mining and associated surface activities at the Wongawilli Colliery until 31 December 2015. Gujarat NRE plan to submit further approval applications for consideration to expand underground mining operations to complete further extraction of the mining leases.

2.2 Particulate Generating Mine Activities

The last detailed review of dust generating activities for the Wongawilli Colliery was completed in June 2010. The review was required for the 'NRE Wongawilli Colliery – Air Quality Assessment' that was completed for the Part 3A application completed for Project Approval 09_0161. Current activities at the Colliery that have been identified as sources of particulate matter are:

- Wheel generated particulates on unpaved roads
- Bulldozing coal on the stockpile
- Wind erosion on the coal stockpile
- Loading trains from the coal stockpile
- Loading coal to the stockpile
- Material transfer of coal via conveyors
- Train loading from coal bins
- Screening

2.3 Estimated Uncontrolled Particulate Emissions

Estimated baseline emissions of TSP, PM_{10} and $PM_{2.5}$ for each mining activity identified in **Section 2.2**, without any air quality controls are shown in **Table 2-1**. Calculations were based on emission factors from USEPA AP-42, as listed in **Table 1-1**. An emission calculations summary is located in **Attachment A**.

TABLE 2-1 Estimation of Wongawilli Colliery Uncontrolled Particulate Emissions

Mining Activity	TSP (tonne/year)	PM_{10}	$PM_{2.5}$
Wheel generated particulates on unpaved roads	22.54	7.49	0.75
Bulldozing coal on the stockpile	35.88	11.50	0.79
Wind erosion on the coal stockpile	45.41	22.71	3.41
Loading trains from the coal stockpile	28.07	3.88	0.53
Loading coal to the stockpile	0.15	0.07	0.01
Material transfer of coal via conveyors	112.29	15.52	2.13
Train loading from coal bins	0.46	0.22	0.03
Screening	50	17.4	ND
Total	**276.16**	**72.05**	**7.08**

Distribution of uncontrolled particulate matter emissions for each activity identified in **Table 2-1** for TSP, PM_{10} and $PM_{2.5}$ are shown in **Figure 2-1**, **Figure 2-2** and **Figure 2-3**, respectively.

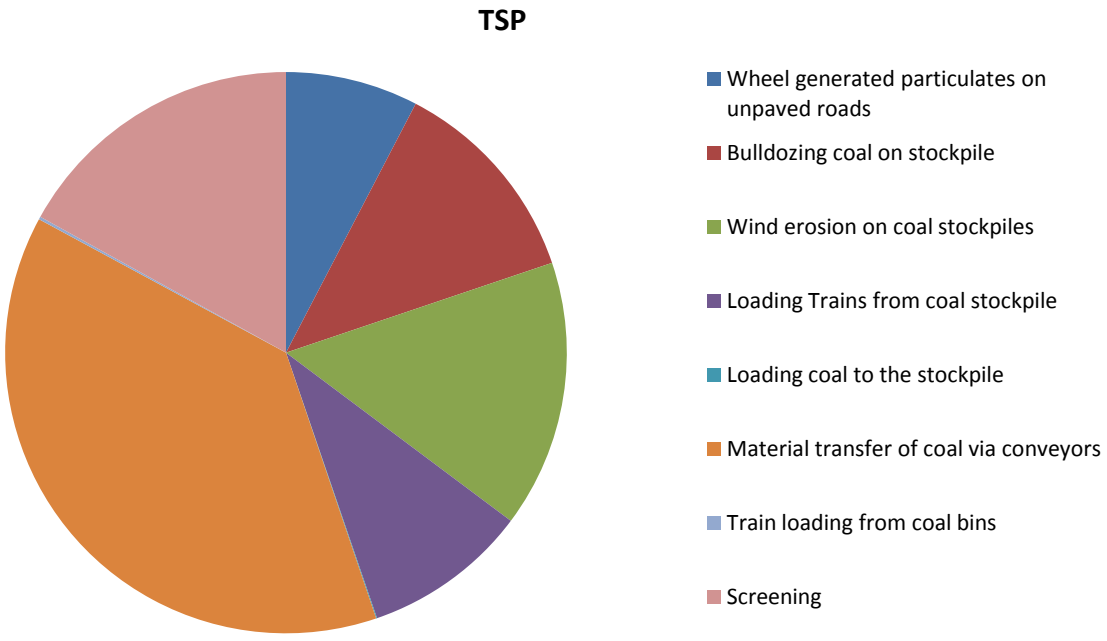

Figure 2-1 Uncontrolled TSP emissions by activity

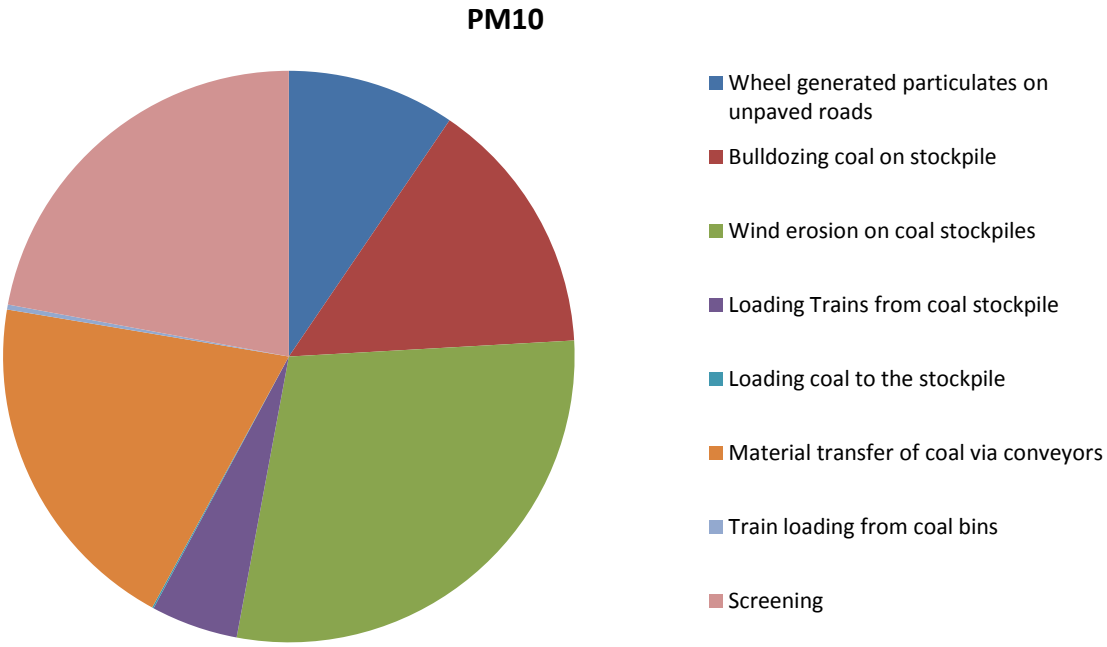

Figure 2-2 Uncontrolled PM_{10} emissions by activity

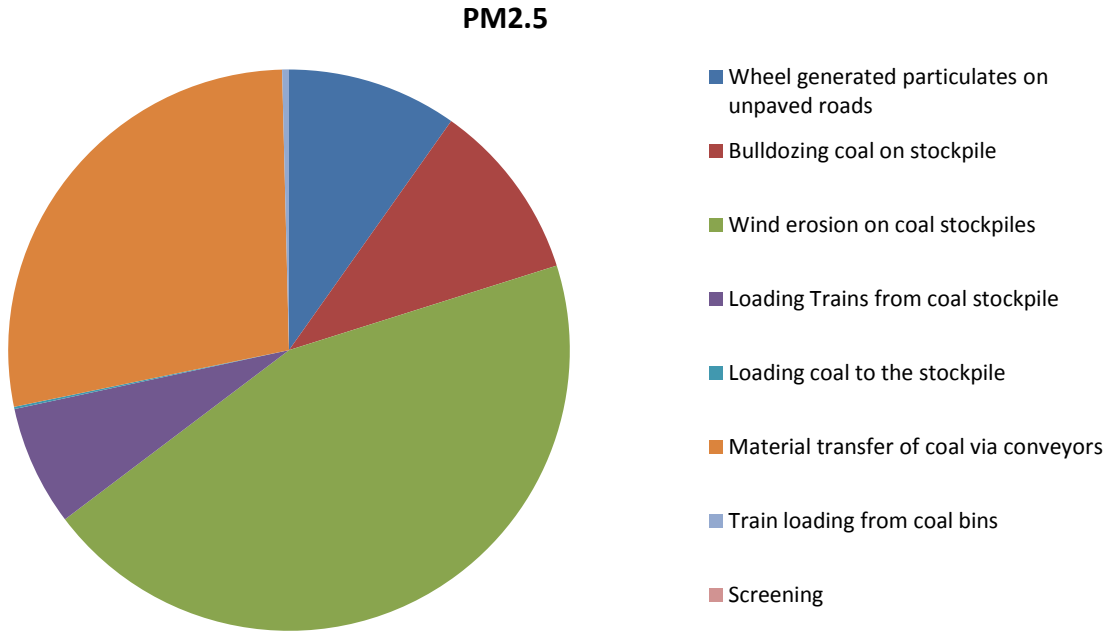

Figure 2-3 Uncontrolled $PM_{2.5}$ emissions by activity

2.4 Estimating Controlled Particulate Emissions

Emissions calculated in **Section 2.3** were then recalculated to take into account particulate emission controls utilised at the Wongawilli Colliery. Controls and their related control factor are shown in **Table 2-2**.

The control factors shown in **Table 2-2** are the default values detailed within the 'NSW Coal Mining Benchmarking Study' (Donnelly et al., 2011).

TABLE 2-2 Particulate Emission Controls and Control Factor

Mining Activity	Particulate Emission Control	Control Factor Applied
Wheel generated particulates on unpaved roads	• Water truck watering unpaved area, 15km/hr speed limit (c)	• 81%
Bulldozing coal on the stockpile	• Keep travel routes and material moist by use of stockpile water sprays (b) and water cart.	• 50%
Wind erosion on the coal stockpile	• Chemical wetting agent (a) • Stockpile water sprays (b)	• 80% • 50%
Loading trains from the coal stockpile	• Residual chemical dust suppressant (a), wetting from conveyor system and use of stockpile sprays (b).	• 50%
Loading coal to the stockpile	• Chemical dust suppressant (a) and stockpile water sprays (b)	• 50%
Material transfer of coal via conveyors	• Enclosed transfer points and covered and enclosed conveyor system, • Water sprays on conveyor system and at transfer points. • Belt cleaning and spillage minimisation (d)	• 70% • 50% • ND
Train loading from coal bins	• Residual chemical dust suppressant (a) and wetting from conveyor system	• 30%
Screening	• Enclosure, covered and enclosed conveyor system • Chemical wetting agent (a)	• 70% • 80%

Notes:

(a) An automated chemical wetting system (Compliance 2000) was installed at the surface screener during 2011. The system applies a 1000 part water to 1 part wetting agent mix to coal at two stages before it enters the screener. Coal located on the conveyor is dosed with the diluted mixture as it approaches the end of the conveyor system and is then dosed again as it falls from the conveyor belt into the screener. The two stages of application aim to ensure that the chemical wetting agent is mixed through the coal, to avoid just the surface crust being treated.

(b) Thirteen ground-based water sprays are located along the perimeter of the stockpile area to apply water to the stockpile. The water sprays are triggered automatically based on climatic triggers or can be operated manually as required.
(c) The uncontrolled emission estimate assumes an unpaved road. To reflect the use of a water truck for dust suppression and the reduced speed limit, silt loading of 2.8 g/m2 has been adopted. This represents the lower end of estimates within USEPA AP-42
(d) Conveyor belts are inspected daily and cleaned as required

TABLE 2-3 Estimation of Wongawilli Colliery Controlled Particulate Emissions

Mining Activity	TSP (tonne/year)	PM_{10}	$PM_{2.5}$
Wheel generated particulates on unpaved roads	4.28	1.42	0.14
Bulldozing coal on the stockpile	17.94	5.75	0.40
Wind erosion on the coal stockpile	4.54	2.27	0.34
Loading trains from the coal stockpile	14.04	1.94	0.27
Loading coal to the stockpile	0.08	0.04	0.01
Material transfer of coal via conveyors	16.84	2.33	0.32
Train loading from coal bins	0.32	0.15	0.02
Screening	3.0	1.04	ND
Total	**63.11**	**14.44**	**1.49**

Distribution of controlled particulate matter emissions for each activity identified in **Table 2-3** for TSP, PM_{10} and $PM_{2.5}$ are shown in **Figure 2-4**, **Figure 2-5** and **Figure 2-6**, respectively.

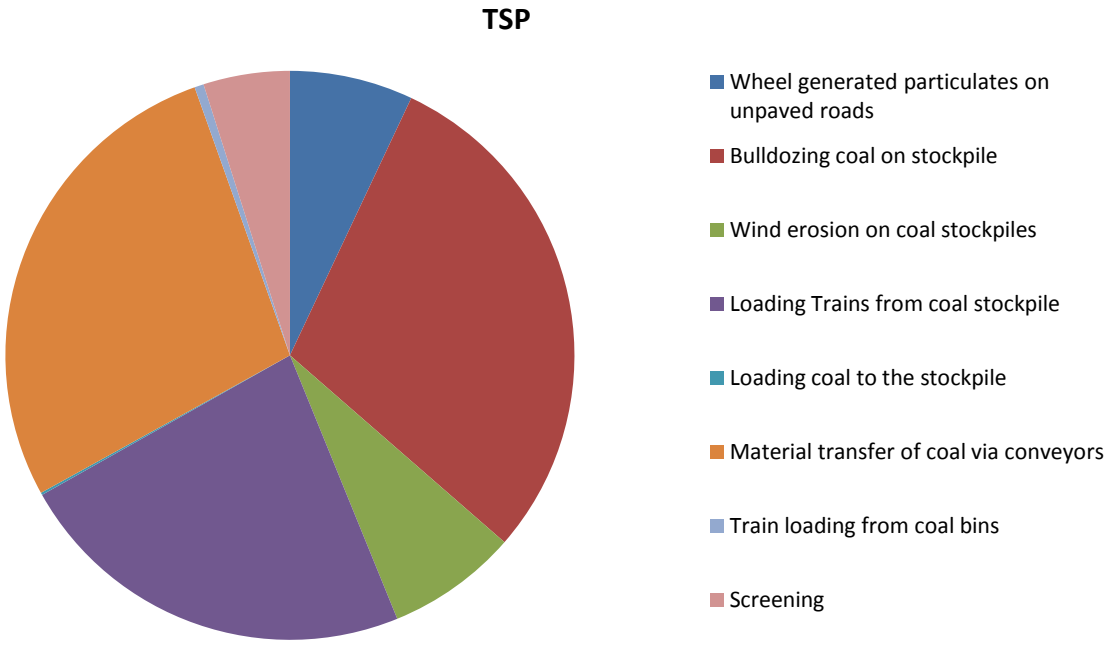

Figure 2-4 Controlled TSP emissions by activity

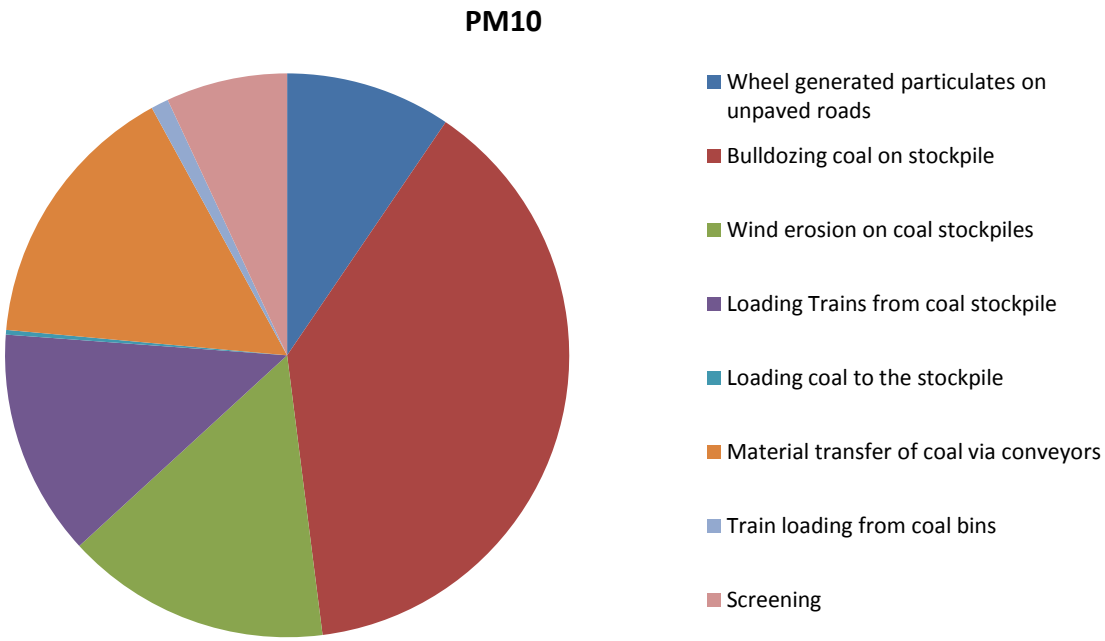

Figure 2-5 Uncontrolled PM_{10} emissions by activity

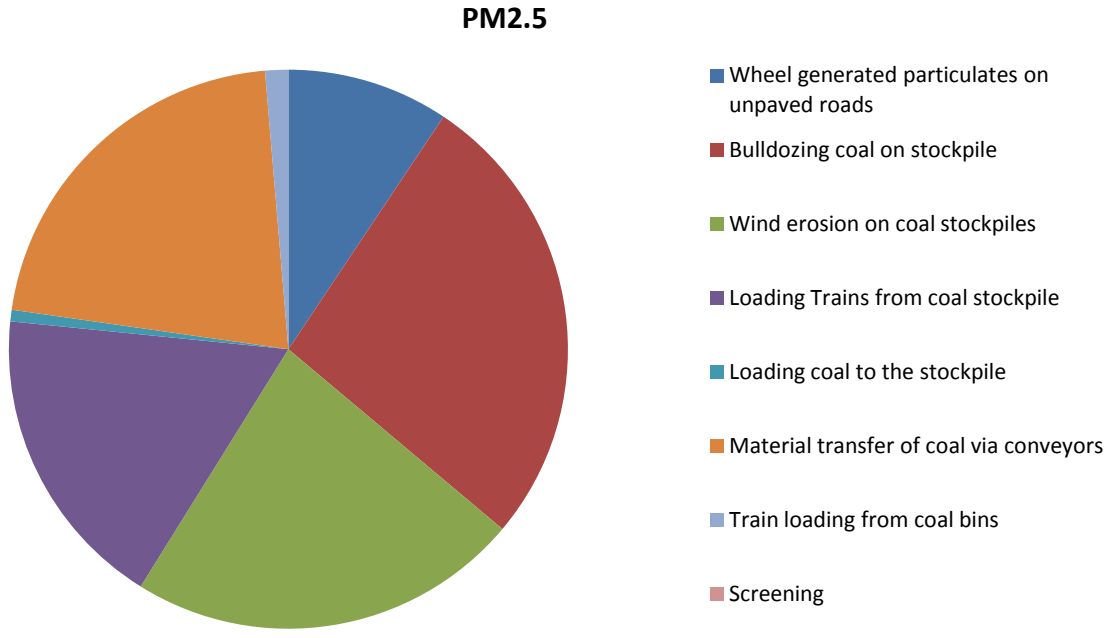

Figure 2-6 Uncontrolled $PM_{2.5}$ emissions by activity

2.5 Ranking of Particulate Emissions Activities

Particulate emissions from activities, as detailed in **Section 2.3** have been ranked according to their annual mass emissions of TSP, PM_{10} and $PM_{2.5}$. Ranking of the activities are shown in **Table 2-4**.

TABLE 2-4 Ranking of estimated controlled particulate emissions by activity

Rank	Mining Activity	TSP (tonne/year)	PM_{10}	$PM_{2.5}$
1	Bulldozing coal on the stockpile	17.94	5.75	0.40
2	Material transfer of coal via conveyors	16.84	2.33	0.32
3	Loading trains from the coal stockpile	14.04	1.94	0.27
4	Wind erosion on the coal stockpile	4.54	2.27	0.34
5	Wheel generated particulates on unpaved roads	4.28	1.42	0.14
6	Screening	3.0	1.04	ND
7	Train loading from coal bins	0.32	0.15	0.02
8	Loading coal to the stockpile	0.08	0.04	0.01

2.6 Top Four Particulate Emission Activities

The top four particulate emission generating activities of TSP, PM_{10} and $PM_{2.5}$ at the Wongawilli Colliery are listed in **Table 2-5**.

TABLE 2-5 Top four particulate emission generating activities

Rank	Mining Activity	TSP (tonne/year)	PM_{10}	$PM_{2.5}$
1	Bulldozing coal on the stockpile	17.94	5.75	0.40
2	Material transfer of coal via conveyors	16.84	2.33	0.32
3	Loading trains from the coal stockpile	14.04	1.94	0.27
4	Wind erosion on the coal stockpile	4.54	2.27	0.34

3 BEST PRACTICE MEASURES

The 'NSW Coal Mining Benchmarking Study' (Donnelly et al., 2011) provides details of best practice controls available, as well as their associated effectiveness when implemented. A summary of best practice controls available for the top four particulate emission generating activities at the Wongawilli Colliery is provided in **Section 3.1**.

Where a control activity is currently being implemented at the Wongawilli Colliery, it appears in bold

Section 3.2 then provides estimates of the emissions that would be predicted through implementation of the best practice controls.

3.1 Best Practice Controls for the Top Four Particulate Emitting Activities

3.1.1 Bulldozing Coal on the Stockpile

Currently bulldozers are used to manage the coal stockpile that develops during the times that both coal loading bins have been filled. The stockpile is utilised primarily during longwall change periods as trains are not able to be loaded via the coal loading bins during this time when underground production stops. It is estimated that a coal stockpile is utilised for a maximum 25% of coal produced. Control measures for particulate matter emission from the use of bulldozers on the coal stockpile are listed in **Table 3-1**.

TABLE 3-1 Best practice control measures to reduce particulate matter emissions from bulldozers

Control Activity		Effectiveness
Bulldozer	Minimise travel speed and distance	Not quantified
	Keep travel routes and materials moist	**50%**

The 50% reduction effectiveness value has been applied to bulldozer operations at the coal stockpile for the estimation of existing controls detailed in **Section 2**. Wongawilli Colliery has stockpile water sprays that are utilised to keep the coal stockpile and the stockpile area moist and particulate emissions suppressed.

3.1.2 Material Transfer of Coal via Conveyors

Coal is transported from underground via a network of conveyors at the Wongawilli Colliery. All surface conveyors are enclosed at the top and sides at a minimum, with all conveyors at the stockpile area fully enclosed. All transfer points are located in fully enclosed buildings. Control measures for particulate matter emission from the transfer of coal by conveyors are listed in **Table 3-2.**

TABLE 3-2 Best practice control measures to reduce particulate matter emissions from the transfer of coal by conveyors

Control Activity		Effectiveness
Conveyors	**Application of water at transfers**	**50%**
	Wind shielding – roof or side wall	**40%**
	Wind shielding – roof and side wall	**70%**
	Belt cleaning and spillage minimisation	**ND**
Transfers	**Enclosure**	**70%**

A 70% reduction effectiveness has been applied to particulate emissions generated from the transfer of coal on conveyors for the estimation of existing controls detailed in **Section 2.** This is due to the enclosure of transfer points and the wind shielding installed to all conveyors at the Wongawilli Colliery. A further 50% reduction effectiveness was applied in the calculations due to the additional application of water at transfer points, along with other locations in the conveyor network. The 'NRE Wongawilli Colliery – Air Quality Assessment' estimated that the transfer of coal on conveyors would only generate small amounts of particulate emissions at the Wongawilli Colliery.

3.1.3 Loading Trains from the Coal Stockpile

As detailed in Section 3.1.1, a coal stockpile is utilised for an estimated maximum of 25% of total coal produced. All coal that is loaded to the stockpile is reclaimed from the stockpile and loaded onto trains using front end loaders. Control measures for particulate matter emission from the transfer of coal by conveyors are listed in **Table 3-3**.

TABLE 3-3 Best practice control measures to reduce particulate matter emissions from the loading of trains from the coal stockpile

Control Activity		Effectiveness
Avoidance	Bypass ROM stockpiles	50% reduction in dumping emissions for coal bypassing ROM stockpile(a) Emissions associated with forming coal into stockpiles (e.g. by dozer push) would be reduced by 100% for bypassing coal
Truck or loader dumping coal	**Minimise drop height**	**Reduction from 10 m to 5 m: 30%**
	Water sprays on ROM pad	**50%**

The 50% reduction effectiveness value has been applied when loading trains from the coal stockpile for the estimation of existing controls detailed in **Section 2**. Wongawilli Colliery has stockpile water sprays that are utilised to keep the coal stockpile and the stockpile area moist and particulate emissions suppressed. Use of front end loaders also reduces the drop height of the coal when loading into the train wagons.

3.1.4 Wind Erosion on the Coal Stockpile

As detailed in Section 3.1.1, a coal stockpile is utilised for an estimated maximum of 25% of total coal produced. The maximum operating capacity of the coal stockpile is 100,000 tonne. Control measures for particulate matter emission from the transfer of coal by conveyors are listed in **Table 3-4**

TABLE 3-4 Best practice control measures to reduce particulate matter emissions from coal stockpiles

Control Activity		Effectiveness
Avoidance	Bypass ROM stockpiles	100% reduction in wind erosion for coal bypassing stockpile
Surface stabilisation	**Water spray**	**50%**
	Chemical wetting agents	**80-99%**
	Surface crusting agent	95%
	Carry over wetting from load in	30%
Enclosure	Silo with bag house	95-100%
	Cover storage pile with tarp during high winds	99%(a)
Wind speed reduction	Vegetative wind breaks	30%
	Reduce pile height	30%
	Wind screens/wind fences	75-80%
	Erect 3-sided enclosure around storage piles	75%

Note
(a) Estimated based on the effectiveness of chemical surface treatments

An 80% reduction effectiveness has been applied to particulate emissions generated from the coal stockpile for the estimation of existing controls detailed in **Section 2.** This is due to the use of a chemical wetting agent at the Wongawilli Colliery. A further 50% reduction effectiveness was applied in the calculations due to the additional application of water sprays located at the coal stockpile.

An automated chemical wetting system (Compliance 2000) was installed at the surface screener during 2011. The system applies a 1000 part water to 1 part wetting agent mix to all coal at two stages before it enters the screener, prior to being directly deposited on the coal stockpile; if the coal is not being sent directly to the coal bins. Coal located on the conveyor is dosed with the diluted mixture as it approaches the end of the conveyor system and is then dosed again as it falls from the conveyor belt into the screener. The two stages of application aim to ensure that the chemical wetting agent is mixed through the coal, to avoid just the surface crust being treated.

3.2 Estimated Particulate Emissions for Best Practice Controls

Particulate Emissions after the application of best practice controls for each of the top four particulate emission generating activities in **Section 3.1** have been estimated and are shown in **Table 3-5** for TSP, PM_{10} and $PM_{2.5}$

TABLE 3-5 Estimated particulate emissions by application of best practice controls

Activity	Control	% Reduction	TSP (tonne/year)	PM_{10} (tonne/year)	$PM_{2.5}$ (tonne/year)
Wind erosion on the coal stockpile	Bypass stockpile	100%	0	0	0
	Water Spray	0 – Current control	4.54	2.27	0.34
	Chemical wetting agents	0 – Current Control	4.54	2.27	0.34
	Surface crusting agent	95%	0.227	0.1135	0.017
	Carry over wetting from load in	30%	3.18	1.60	0.24
	Silo with bag house	98%	0.09	0.454	0.01
	Cover storage pile with a tarp during high winds	99%	0.05	0.02	0.01
	Vegetative wind breaks	30%	3.18	1.60	0.24
	Reduce pile height	30%	3.18	1.60	0.24
	Wind screens/wind fences	77.5%	1.02	0.51	0.08
	Erect 3-sided enclosure around storage piles	75%	1.14	0.57	0.09
Material transfer of coal via conveyor	Application of water at transfers on conveyor	0 – Current control	16.84	2.33	0.32
	Wind shielding conveyor – roof or side wall	0 – Current control	16.84	2.33	0.32
	Wind shielding conveyor – roof and side wall	0 – Current control	16.84	2.33	0.32

	Belt cleaning and spillage minimisation on conveyor	0 – Current control	16.84	2.33	0.32
	Enclosure of transfer points	0 – Current control	16.84	2.33	0.32
Loading trains from the coal stockpile	Bypass ROM stockpiles	100%	0	0	0
	Minimise drop height	0 – Current control	14.04	1.94	0.27
	Water sprays on ROM pad	0 – Current control	14.04	1.94	0.27
Bulldozing coal on the stockpile	Keep travel routes and materials moist	0 – Current control	17.94	5.75	0.40

4 EVALUATION OF BEST MANAGEMENT CONTROLS

4.1 Practicability of Best Practice Control Implementation

Wongawilli Colliery currently has particulate emission controls in place for particulate emission generating activities. Controls include:

- An automated dust suppression system located at the coal stockpile. 13 water sprays are located around the perimeter of the coal stockpile. The spray can be activated automatically in response to wind speeds greater than 10m/s or can also be activated manually. The water sprays are used to apply water to the coal stockpile itself, along with the general coal stockpile area.
- An automated chemical wetting system (Compliance 2000) was installed at the surface screener during 2011. The system applies a 1000 part water to 1 part wetting agent mix to all coal at two stages before it enters the screener. Coal located on the conveyor is dosed with the diluted mixture as it approaches the end of the conveyor system and is then dosed again as it falls from the conveyor belt into the screener. The two stages of application aim to ensure that the chemical wetting agent is mixed through the coal, to avoid just the surface crust being treated. The chemical is applied to all coal, regardless of whether the coal is being sent to the coal loading bins or the stockpile. The chemical assists suppression of all particulate emission generating activities past the point of application, that being:
    - screening of coal;
    - loading of the coal stockpile;
    - wind on the stockpile;
    - loading of trains by front end loaders;
    - loading of train by the coal bins; and
    - transport of coal by rail to PKCT
- Enclosed transfer points on the surface conveyor system
- Shielding of the roof and sides of surface conveyors
- Water sprays at conveyor transfer points and other locations along the surface conveyor system
- Enclosure of surface conveyors located at the coal stockpile area
- Use of coal bins to load trains. Reduces the use of the stockpile to an estimated maximum 25% of total production.
- Utilisation of a water cart to suppress particulate emission from unpaved roads
- Use of a mechanical sweeper to remove particulate matter from paved and sealed surfaces
- Vegetation wind breaks around the north, east and west of the coal stockpile
- Use of front end loaders for reduced drop height to load coal to trains from the coal stockpile.

Best practice control options for the top four particulate emission generating activities have been assessed by the Wongawilli Colliery and are listed in **Table 4-1**.

Table 4-1 Assessment of Practicability of best practice control options

Best Practice Control	Regulatory Requirement	Environmental Implications	Safety Implications	Compatibility with current Processes and future development	Conclusions of Evaluation
WIND EROSION ON COAL STOCKPILE					
Bypass Stockpiles (use of coal bins only)	Train movements are restricted by SSD Project Approval 09_0161. All coal to be transported by train. Construction of additional infrastructure would require SSD approval from the Department of Planning and Infrastructure	Introduction of additional noise and light sources. Additional use of electricity	None identified	The bypass of the coal stockpile is not feasible due to the requirement for the additional storage of coal during periods when: • Current coal bins are full • During restricted operating times (MP 09_0161 • During a longwall change Ability to store coal on stockpile would still be required if additional coal bins were constructed.	Not considered further in this assessment
Water Sprays	**Best Practice Controls in place. Stockpile dust suppression system sprays**				**Control in place**
Chemical Wetting Agents	**Best Practice Controls in place. Stockpile dust suppression system sprays**				**Control in place**
Surface Crusting Agents	Agent would be required to meet discharge water quality limits of EPL	Introduction of new potential polluting substance to site.	Introduction of new substance to site. Potential OHS issues introduced	The coal stockpile is actively stacked and reclaimed. Surface crusting agents would not be an appropriate control due to constant movement of the stockpile and also given that a Chemical Wetting Agent is currently applied to all coal.	Not considered further in this assessment
Carry over wetting from load in	None identified	Additional water reaching surface water management system. Additional water	None identified	Applying additional water to coal prior to being placed on the coal stockpile is not a feasible control. Due to transport of coal by train to PKTC, moisture content must be controlled to prevent handling issues at the end	Not considered further in this assessment

		use		point. Given application of chemical wetting agent and water from stockpile sprays, along with water applied at transfer points along the conveyor system; the additional wetting would not be practical due to excessive moisture content	
Cover storage pile with a tarp during high winds	None identified	None identified	Risk of entrapment during placement of tarp. Risk of strike injury during placement of tarp during high winds due to size of tarp required	Coal is loaded to the coal stockpile on a 24/7 basis, which makes the use of a tarp difficult. The stockpile is also approved to hold 100,000 tonnes of coal at a height of 12 metres, which makes the application of a tarp impractical and introduces safety risks to workers during application.	Not considered further in this assessment
Silo with bag house **(addition to current coal bins)**	Construction of additional infrastructure would require SSD approval from the Department of Planning and Infrastructure	Introduction of additional noise and light sources. Additional use of electricity	None identified	The use of the current coal bins reduces use of coal stockpile to estimated maximum 25% of total production. Construction of additional coal bins is not feasible due to the limitations of the stockpile area, rail infrastructure and ability to store coal on stockpile would still be required if additional coal bins were constructed.	Not considered further in this assessment
Vegetation wind breaks	None identified	None identified	None identified	Vegetation wind breaks are located around the coal stockpile on the north, east and west. Due to the layout of the stockpile area, a windbreak on the	Not considered further in this assessment

				southern side is not feasible and could not be planted.	
Reduce pile height	None identified	Particulate emissions as a result of increase bulldozer movements may increase during movement of the stockpile	None identified	There is no ability to reduce the height of the stockpile when at maximum capacity (100,000 tonnes at 12 metres high). There is potential to reduce stockpile height at times when the stockpile is not at full capacity in line with predicted forecast high winds.	Control to be investigated further
Wind screens/wind fences	None identified	None identified	None identified	Due to the layout of the stockpile area, dams, drains, roadways and creeks would impede the construction of wind screens and fences.	Not considered further in this assessment
Material Transfer of Coal by Conveyor					
Application of water at transfers on conveyor	**Best Practice Controls in place.**				**Control in place**
Wind shielding conveyor – roof or side wall	**Best Practice Controls in place.**				**Control in place**
Wind shielding conveyor – roof and side wall	**Best Practice Controls in place.**				**Control in place**
Belt cleaning	**Best Practice Controls in place.**				**Control in place**

and spillage minimisation on conveyor					
Enclosure of transfer points	**Best Practice Controls in place.**				**Control in place**
Loading Trains from the Coal Stockpile					
Bypass ROM stockpiles	Train movements are restricted by SSD Project Approval 09_0161. All coal to be transported by train. Construction of additional infrastructure would require SSD approval from the Department of Planning and Infrastructure	Introduction of additional noise and light sources. Additional use of electricity	None identified	The bypass of the coal stockpile is not feasible due to the requirement for the additional storage of coal during periods when: • Current coal bins are full • During restricted operating times (MP 09_0161 • During a longwall change Ability to store coal on stockpile would still be required if additional coal bins were constructed.	Not considered further in this assessment
Minimise drop height	**Best Practice Controls in place.**				**Control in place**
Water sprays on ROM pad	**Best Practice Controls in place.**				**Control in place**
Bulldozing Coal on the Stockpile					
Keep travel routes and materials moist	**Best Practice Controls in place.**				**Control in place**

4.2 Best Practice Implementation Costs

Best Practice control measures identified in **Table 4-1** were evaluated and are presented in **Appendix D**. The costing exercise was conducted as per the requirements of Appendix A of the Site Specific Determination Guideline and is located in **Appendix C** of this report.

4.3 Evaluation of Existing Controls

In addressing the practicality of implementing additional Best Practice Measures, the effectiveness of existing controls needs to be assessed. Air quality monitoring data and community complaints reflect the effectiveness of existing controls for particulate emissions from the Wongawilli Colliery.

One High Volume Air Sampler (HVAS) and five Depositional Dust Gauges are used to monitor compliance with Wongawilli Colliery's Environmental Protection License limits, along with current Project Approvals.

Air quality criteria for the Wongawilli Colliery are currently being met. Air quality criteria are presented in **Table 4-2**, with HVAS and Depositional Dust monitoring results shown in **Figure 4-1** and **Figure 4-2**.

Table 4-2 Air Quality Criteria

Pollutant	Averaging Period	Criteria	Regulator
Total Suspended Particulates	Annual	90μg/m3	DoPI
Particulate Matter < 10μm (PM_{10})	Annual	30μg/m3	DoPI
Particulate Matter < 10μm (PM_{10})	24 Hour	50μg/m3	DoPI
Dust (Depositional Gauges)	Annual	4g/m2/month	EPA & DopI

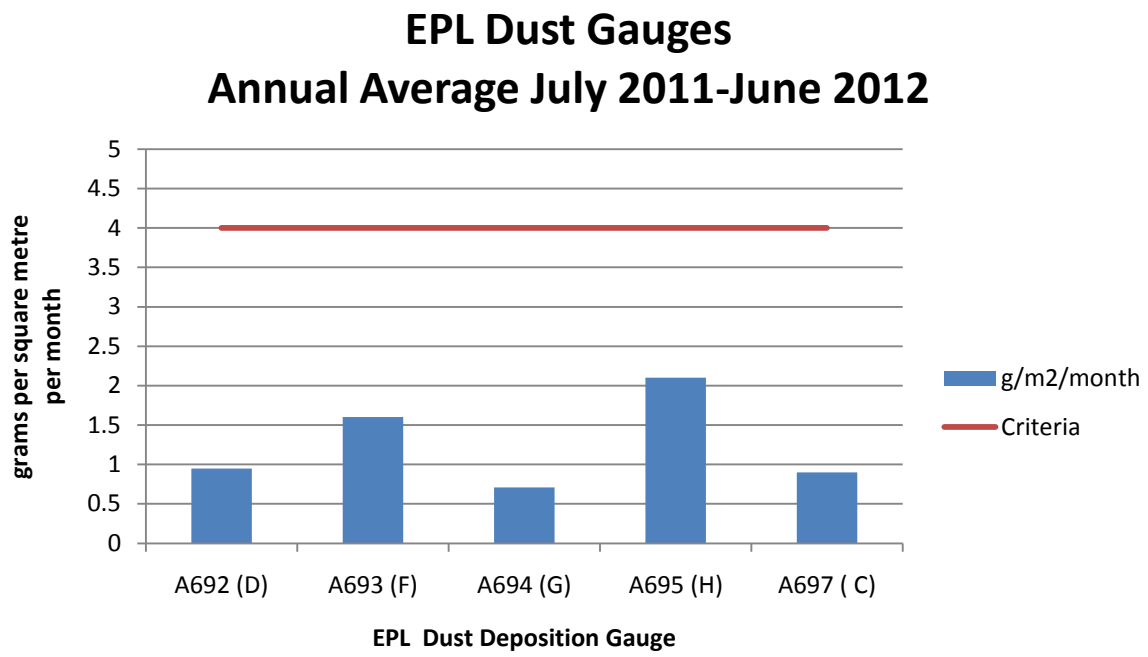

Figure 4-1 EPL Depositional Dust Gauge Results

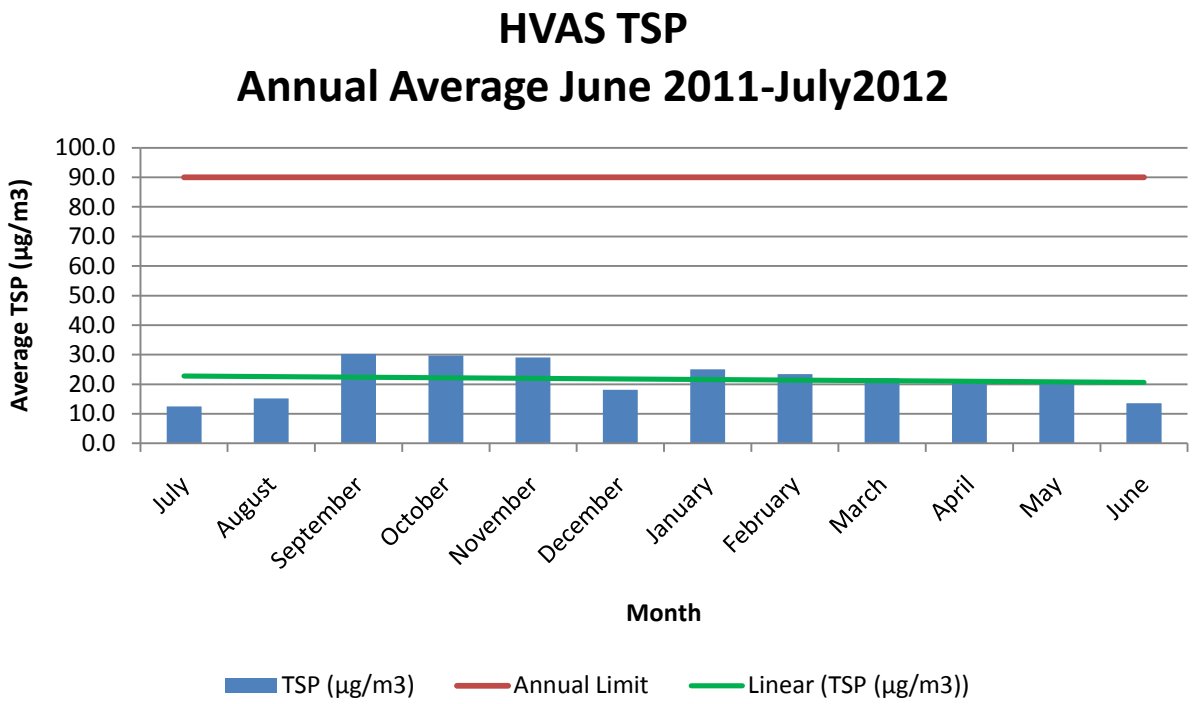

Figure 4-2 TSP Results from Wongawilli Colliery HVAS

One complaint regarding dust has been received by the Wongawilli Colliery in the previous 2 financial years. The complaint was received on 14 July 2010.

4.4 Best Management Controls to be Implemented

As identified in this report, there are several best practice controls in place at the Wongawilli Colliery to reduce particulate emissions from the top particulate generating activities.

This report has identified one additional control with potential to further reduce particulate emissions from the Colliery, being;

1. Reducing the height of the coal stockpile

Reducing the height of the coal stockpile could achieve a 30% reduction in particulate emissions from this source and result in a predicted maximum TSP level of 3.18 tonnes/year. This would result in a 1.36 tonne/year reduction in TSP emissions.

The Wongawilli Colliery is committed to the further investigation of this best practice control measure. This is a reasonable additional control to achieve a further reduction of particulate emissions from the Colliery given the relatively low calculated particulate emissions from this activity, along with demonstrated low particulate emissions from monitoring, low number of complaints and the cost of implementing such a control.

5 IMPLEMENTATION TIMEFRAMES

A trial for the reduction in the height of the coal stockpile is proposed. Following the further investigation of this best practice control measure, a trial could commence from January 2013, following the next scheduled longwall move, and continue over a yet to be determined time period that would allow the adequate assessment of air quality monitoring results; being existing HVAS and Depositional Dust Gauges.

6 CONCLUSION

This report was prepared to satisfy the requirements of the Coal mine Particulate Matter Control Best Practice PRP as attached to the Wongawilli Colliery EPL 1087.

The report identified the top four particulate generating activities at the Wongawilli Colliery, they being;

1. Bulldozing coal on the coal stockpile
2. Material transfer of coal via conveyors
3. Loading trains from the coal stockpile
4. Wind erosion on the coal stockpile

Best Practice control measures were identified for each of the top four particulate emission generating activities and the practicality of implementation assessed, along with a costing exercise undertaken.

At the Wongawilli Colliery there are Best Practice control measures in place for all of the top four particulate emission generating activities. All applicable Best Practice controls measures are utilised at the Wongawilli Colliery for the top two ranked particulate emission generating activities. For the remaining two particulate emission generating activities, it was assessed that one additional Best Practice control measure will be investigated, with implementation following a trial period.

7. REFERENCES

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8 ATTACHMENTS

8.1 ATTACHMENT A – Emissions Estimate Calculations

Bulldozing Coal on the Stockpile

Coal is maintained on the stockpile using bulldozers and front end loaders. The emission factor for bulldozing coal on the stockpile was derived using US EPA (AP-42) emission factor equations, shown by **Equations 1, 2 and 3.**

Equation 1 – TSP Emission Factor

$$E_{TSP} = 35.6 \times \frac{s^{1.2}}{M^{1.3}} \; kg/hr$$

Equation 2 – PM_{10} Emission Factor

$$E_{PM10} = 6.33 \times \frac{s^{1.5}}{M^{1.4}} \; kg/hr$$

Equation 3 – $PM_{2.5}$ Emission Factor

$$E_{PM2.5} = 0.022 \times E\mathrm{TSP}$$

Where,

s = silt content of the material in percent (%)
M = moisture content of material in percent (%)

The number of dozer hours is dependent on bulldozer productivity. It is assumed that a maximum of 25% of coal production may be stockpiled and require the use of bulldozers and front end loaders. Wongawilli Colliery is currently approved to produce 2 million tonnes of coal per annum, with 25% representing 500,000 tonnes. At a productivity rate of 1500 tph, then it will require 333 hours of bulldozing work per annum

- **Without existing controls**

A silt content of 11.3% has been used (highest AP42 range) and a moisture content of 4% (lowest AP42 range) has been used in the emission calculations for bulldozing coal on the stockpile.

TSP

Using Equation 1, the TSP emission factor is 107.8 kg/hr. Applying 333 hours of this activity per annum; the total annual TSP emission is estimated to be 35.88 t/yr.

PM_{10}

Using Equation 2, the PM_{10} emission factor is 34.5 kg/hr. Applying 333 hours of this activity per annum; the total annual PM_{10} emission is estimated to be 11.5 t/yr.

$PM_{2.5}$

Using Equation 3, the $PM_{2.5}$ emission factor is 2.4 kg/hr. Applying 333 hours of this activity per annum; the total annual $PM_{2.5}$ emission is estimated to be 0.79 t/yr.

- **With Existing Controls**

Wongawilli Colliery has stockpile water sprays that are utilised to keep the coal stockpile and the stockpile area moist and particulate emissions suppressed. A 50% reduction effectiveness value has been applied to bulldozer operations at the coal stockpile for the estimation of existing controls (Donnelly et al., 2011).

Material Transfer of Coal via Conveyor

Coal is transported from underground workings to both the stockpile and coal loading bins using an overland conveyor system. The emission factor for the material transfer of coal via conveyor was derived using US EPA (AP-42) emission factor equations, shown by **Equations 4, 5 and 6.**

Equation 4 – TSP Emission Factor

$E_{TSP} = \frac{0.580}{M^{1.2}}$ kg/hr

Equation 5 – PM_{10} Emission Factor

$E_{PM10} = \frac{0.0447}{M^{0.9}}$ kg/hr

Equation 6 – $PM_{2.5}$ Emission Factor

$E_{PM2.5} = 0.019 * E_{TSP}$

Where,

M = moisture content of material in percent (%)

Particulate emissions resulting from the transfer of coal via conveyor were then calculated using **Equation 7** (US EPA AP42).

Equation 7

$$Emiss = \frac{EF \times coal\ per\ annum}{1000}\ t/yr$$

Where,

Emiss = mass of emissions per year
EF = emission factor

Wongawilli Colliery is approved to produce up to 2 million tonnes per annum and this has been assumed as the coal per annum.

- **Without Existing Controls**

A moisture content of 7% has been used in the emission calculations for the material transfer of coal via conveyor, as the accepted average moisture content for coal at the Wongawilli Colliery.

TSP

Using **Equation 4**, the TSP emission factor is 0.056 kg/t. Using **Equation 7**, TSP particulate emissions are 112.29 t/yr.

PM_{10}

Using **Equation 5**, the PM_{10} emission factor is 0.008 kg/t. Using **Equation 7**, PM_{10} particulate emissions are 15.51 t/yr.

$PM_{2.5}$

Using **Equation 6**, the $PM_{2.5}$ emission factor is .001 kg/t. Using **Equation 7**, $PM_{2.5}$ particulate emissions are 2.13 t/yr.

- **With Existing Controls**

Coal is transported from underground via a network of conveyors at the Wongawilli Colliery. All surface conveyors are enclosed at the top and sides at a minimum, with all conveyors at the stockpile area fully enclosed. All transfer points are located in fully enclosed buildings.

A 70% reduction effectiveness has been applied to particulate emissions generated from the transfer of coal on conveyors**.** This is due to the enclosure of transfer points and the wind shielding installed to all conveyors at the Wongawilli Colliery. A further 50% reduction effectiveness was applied in the calculations due to the additional application of water at transfer points, along with other locations in the conveyor network (Donnelly et al., 2011).

Loading Trains from the Coal Stockpile

When coal is stockpiled, front end loaders are utilised to reclaim and load trains. The emission factors for the loading of trains from the coal stockpile were derived using US EPA (AP-42) emission factor equations, shown by **Equations 8, 9 and 10.**

Equation 8 – TSP Emission Factor

$E_{TSP} = \frac{0.580}{M^{1.2}}$ kg/hr

Equation 9 – PM_{10} Emission Factor

$E_{PM10} = \frac{0.0447}{M^{0.9}}$ kg/hr

Equation 10 – $PM_{2.5}$ Emission Factor

$E_{PM2.5} = 0.019 * E_{TSP}$

Where,
M = moisture content of material in percent (%)

Particulate emissions resulting from the transfer of coal via conveyor were then calculated using **Equation 11** (US EPA AP42).

Equation 11

$$Emiss = \frac{EF \times coal\ per\ annum}{1000}\ t/yr$$

Where,
Emiss = mass of emissions per year
EF = emission factor

It is assumed that a maximum of 25% of coal production may be stockpiled and require trains to be loaded from the coal stockpile. Wongawilli Colliery is currently approved to produce 2 million tonnes of coal per annum, with 25% representing 500,000 tonnes. 500,000 tonnes per annum has been assumed as the coal per annum for this activity.

- **Without Existing Controls**

  A moisture content of 7% has been used in the emission calculations for the material transfer of coal via conveyor, as the accepted average moisture content for coal at the Wongawilli Colliery.

  TSP

  Using **Equation 8**, the TSP emission factor is 0.056 kg/t. Using **Equation 11**, TSP particulate emissions are 28.07 t/yr.

PM_{10}

Using **Equation 9**, the PM_{10} emission factor is 0.008 kg/t. Using **Equation 11**, PM_{10} particulate emissions are 3.88 t/yr.

$PM_{2.5}$

Using **Equation 10**, the $PM_{2.5}$ emission factor is .001 kg/t. Using **Equation 11**, $PM_{2.5}$ particulate emissions are 0.53 t/yr.

- **With Existing Controls**

A 50% reduction effectiveness value has been applied when loading trains from the coal stockpile. Wongawilli Colliery has stockpile water sprays that are utilised to keep the coal stockpile and the stockpile area moist and particulate emissions suppressed. Use of front end loaders also reduces the drop height of the coal when loading into the train wagons (Donnelly et al., 2011).

Wind Erosion on the Coal Stockpile

Particulate emissions may be generated from the Wongawilli Colliery from the storage of coal on the stockpile. Annual emissions for wind erosion on the coal stockpile have been calculated using US EPA (AP-42) emission factors and by **Equations 12.**

Equation 12

$$Emiss = \frac{EF \times u \times ha \times hr}{1000}\ t/yr$$

Where,

Emiss = mass of emissions per year
EF_{TSP} = 1.8 (kg)
EF_{PM10} = 0.5 x 1.8 (kg)
$EF_{PM2.5}$ = 0.075 x 1.8 (kg)
u = wind speed (m/s)
ha = surface area of stockpile (ha)
hr = hours of operation

The calculations are based on the assumption that the stockpile has a conical shape. Maximum capacity of the stockpile is 100,000 t, with the maximum stockpile height and base radius estimated at 48 m and 42 m, respectively. The surface area of the stockpile, excluding the base surface area, will be approximately 0.96 ha.

The calculation is based on the assumption that the maximum hours of operation are 8,760 hr/yr, representing 24 hours a day, 365 days a year.

Annual average wind speed is taken from historical meteorological data, at 3 m/s (ERM 2010)

- **Without Existing Controls**

TSP

Using **Equation 12**, TSP emissions are 45.41 t/yr

PM_{10}

Using **Equation 12**, PM_{10} emissions are 22.71 t/yr

$PM_{2.5}$

Using **Equation 12**, $PM_{2.5}$ emissions are 3.41 t/yr

- **With Existing Controls**

An 80% reduction effectiveness has been applied to particulate emissions generated from the coal stockpile**.** This is due to the use of a chemical wetting agent at the Wongawilli Colliery. A further 50% reduction effectiveness was applied in the calculations due to the additional application of water sprays located at the coal stockpile (Donnelly et al., 2011)

Screening

Prior to coal being loaded to the coal bins or sent to the stockpile, coal is screened and sized to remove reject material. Annual emissions from the screening of coal were calculated using US EPA (AP-42) emission factors and by **Equations 13.** No emission factor is available for $PM_{2.5}$ for this activity (US EPA AP42).

Equation 13

$$Emiss = \frac{EF \times coal\ per\ annum}{1000}\ t/yr$$

Where,

Emiss = mass of emissions per year
EF_{TSP} = 0.025 (kg/t)
EF_{PM10} = 0.0087 (kg/t)

Wongawilli Colliery is approved to produce up to 2 million tonnes per annum and this has been assumed as the coal per annum.

- **Without Existing Controls**

TSP

Using **Equation 13**, TSP emissions are 50.0 t/yr

PM_{10}

Using **Equation 13**, PM_{10} emissions are 17.4 t/yr

- **With Existing Controls**

An 80% reduction effectiveness has been applied to particulate emissions generated from the screening of coal**.** This is due to the use of a chemical wetting agent at the Wongawilli Colliery, applied directly prior to the screening and sizing of coal. A further 70% reduction effectiveness was applied in the calculations due to the screening process being located in a fully enclosed and covered building, with enclosed conveyor systems (Donnelly et al., 2011).

Wheel Generated Particulates on Unpaved Roads

Particulate emissions from the re-suspension of loose material on unpaved road surfaces due to vehicle travel on a dry road has been estimated using factors from US EPA (AP-42) and **Equation 14**.

Equation 14

$EF = k(\frac{s}{12})^a(\frac{W}{3})^b$ kg/VKT

Where,

k(tsp) = 1.381
k(PM_{10}) = 0.423
k($PM_{2.5}$) = 0.042
s = surface material silt content (%)
a(tsp) = 0.7
a(PM_{10}) = 0.9
a($PM_{2.5}$) = 0.9
W = mean vehicle weight
b = 0.45

Equation 14 requires the average weight of all vehicles travelling the road (W). For Wongawilli Colliery the average weight of the vehicle 'fleet' is 13 tons.

Road surface silt content (s) has been taken at 18 g/m2, which is the maximum of the range provided by the US EPA (AP-42 13.2.2 Unpaved Roads).

The particle size multiplier (k) varies with aerodynamic size range. Values for TSP, PM10 and PM2.5 have been sourced from US EPA AP-42 13.2.2 Unpaved Roads and appear above.

Annual particulate matter emissions are calculated by applying these particle size emission factors to **Equation 15**.

Equation 15

$$Emiss = EF \times VKT \times D/yr$$

Where,

EF = emission factor
VKT = vehicle kilometres travelled
D/yr = days per year (365)

It is assumed that 60 vehicle movements will occur each day over the 290 metre distance of haul road leading into the portal at Wongawilli Colliery.

- **Without Existing Controls**

  TSP

  Using **Equation 14**, the TSP emission factor is 3.55.

  Using **Equation 15**, annual TSP emissions are 22.54 t/yr.

  PM10

  Using **Equation 14**, the PM10 emission factor is 1.18.

  Using **Equation 15**, annual PM10 emissions are 7.49 t/yr.

  PM2.5

  Using **Equation 14**, the PM2.5 emission factor is 0.12.

  Using **Equation 15**, annual PM2.5 emissions are 0.75 t/yr.

- **With Existing Controls**

An 81% reduction effectiveness has been applied to particulate emissions from wheel generated particulate emissions on unpaved roads**.** This is due to the use of a water truck and a speed limit of 15km/hr (Donnelly et al., 2011).

Train Loading from Coal Bins

Trains are loaded by two enclosed gravity fed coal bins that are positioned above the rail line at the coal stockpile area. Emissions factors from the train loading from the coal bins have been calculated using US EPA (AP-42) and **Equation 16**.

Equation 16

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

Where,

$k_{(TSP)}$ = 0.74
$k_{(PM10)}$ = 0.35
$k_{(PM2.5)}$ = 0.053
U = wind speed (m/s)
M = moisture content (%)

The average annual wind speed taken from historical meteorological data is 3.0 m/s (ERM 2010).

The average moisture content of coal loaded from the coal bins is 7%.

Annual particulate matter emissions are calculated by applying these emission factors to **Equation 17**.

Equation 17

$$Emiss = \frac{EF \times coal\ per\ annum}{1000}\ t/yr$$

Where,

EF = Emission factor

Wongawilli Colliery is approved to produce 2 million tonnes of coal per annum (Mtpa), of which it is assumed that 75% would be loaded to trains via the coal bins. It is therefore assumed that 1.5 million tonnes of coal would be the maximum volume loaded to trains by the coal bins.

- **Without Existing Controls**

  TSP

  Using **Equation 16**, the TSP emission factor is 0.00031 kg/t

  Using **Equation 17**, annual TSP emissions are 0.46 t/yr

PM10

Using **Equation 16**, the PM10 emission factor is 0.00015 kg/t

Using **Equation 17**, annual PM10 emissions are 0.22 t/yr

PM2.5
Using **Equation 16**, the PM2.5 emission factor is 0.00002 kg/t

Using **Equation 17**, annual PM2.5 emissions are 0.03 t/yr

- **With Existing Controls**

A 30% reduction effectiveness has been applied to particulate emissions from train loading from coal bins**.** This is due to the use of a chemical dust suppressant and wetting from the conveyor system (Donnelly et al., 2011).

Loading Coal to the Stockpile

Coal is loaded to the stockpile by enclosed overland conveyor system to two rill towers that distribute coal to the stockpile area. Emissions factors from loading coal to the stockpile have been calculated using US EPA (AP-42) and **Equation 18**.

Equation 18

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

Where,

$k_{(TSP)}$ = 0.74
$k_{(PM10)}$ = 0.35
$k_{(PM2.5)}$ = 0.053
U = wind speed (m/s)
M = moisture content (%)

The average annual wind speed taken from historical meteorological data is 3.0 m/s (ERM 2010).

The average moisture content of coal loaded from the coal bins is 7%.

Annual particulate matter emissions are calculated by applying these emission factors to **Equation 19**.

Equation 19

$$Emiss = \frac{EF \times coal\ per\ annum}{1000}\ t/yr$$

Where,

EF = Emission factor

Wongawilli Colliery is approved to produce 2 million tonnes of coal per annum (Mtpa), of which it is assumed that 25% would be loaded to the stockpile area. It is therefore assumed that 0.5 million tonnes of coal would be the maximum volume loaded to the stockpile.

- **Without Existing Controls**

  TSP

  Using **Equation 18**, the TSP emission factor is 0.00031 kg/t

  Using **Equation 19**, annual TSP emissions are 0.15 t/yr

  PM10

  Using **Equation 18**, the PM10 emission factor is 0.00015 kg/t

  Using **Equation 19**, annual PM10 emissions are 0.07 t/yr

  PM2.5
  Using **Equation 18**, the PM2.5 emission factor is 0.00002 kg/t

  Using **Equation 19**, annual PM2.5 emissions are 0.01 t/yr

- **With Existing Controls**

A 50% reduction effectiveness has been applied to particulate emissions from loading coal to the stockpile**.** This is due to the use of a chemical dust suppressant and wetting from the stockpile water spray system (Donnelly et al., 2011).

8.2 ATTACHMENT B – Copy of Coal Mine Particulate Matter Control Best Practice PRP

8 Pollution Studies and Reduction Programs

U1 PRP9: Coal Mine Particulate Matter Control Best Practice

U1.1 Pollution Reduction Program 9 - Coal Mine Particulate Matter Control Best Practice

The Licensee must conduct a site specific Best Management Practice (BMP) determination to identify the most practicable means to reduce particle emissions.

The Licensee must prepare a report which includes, but is not necessarily limited to, the following:

- identification, quantification and justification of existing measures that are being used to minimise particle emissions;
- identification, quantification and justification of best practice measures that could be used to minimise particle emissions;
- evaluation of the practicability of implementing these best practice measures; and
- a proposed timeframe for implementing all practicable best practice measures.

In preparing the report, the Licensee must utilise the document entitled Coal Mine Particulate Matter Control Best Practice – Site Specific Determination Guideline - November 2011.

All cost related information is to be included as Appendix 1 of the report.

The report required must be submitted by the Licensee to the EPA by 28 September 2012

The report required by this condition, except for cost related information contained in Appendix 1 of the Report, must be made publicly available on the Licensee's website by 5 October 2012.

8.3 ATTACHMENT C – Copy of Coal Mine Particulate Matter Control Best Practice – Site Specific Determination Guideline November 2011

Coal Mine Particulate Matter Control Best Practice

Site-specific determination guideline

November 2011

Published by:
Office of Environment and Heritage
59 Goulburn Street, Sydney NSW 2000
PO Box A290, Sydney South NSW 1232
Phone: (02) 9995 5000 (switchboard)
Phone: 131 555 (environment information and publications requests)
Phone: 1300 361 967 (national parks, climate change and energy efficiency information, and publications requests)
Fax: (02) 9995 5999
TTY: (02) 9211 4723
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

Report pollution and environmental incidents
Environment Line: 131 555 (NSW only) or info@environment.nsw.gov.au
See also www.environment.nsw.gov.au

ISBN 978 1 74293 367 2
OEH 2011/0813
November 2011

Purpose of this guideline

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.

It also provides the required content and format of the report required for the pollution-reduction program *Coal mine particulate matter best practice*.

The site-specific determination process

In preparing the report, as a minimum, the following steps must be followed:

1. Identify, quantify and justify existing measures that are being used to minimise particle emissions

1.1. Estimate baseline emissions of TSP, PM_{10} and $PM_{2.5}$ (tonne per year) from each mining activity. This estimate must:

- utilise USEPA AP42 emission estimation techniques (or other method as approved in writing by the EPA)
- calculate uncontrolled emissions (with no particulate matter controls in place), and
- calculate controlled emissions (with current particulate matter controls in place).

Note: These particulate matter controls must be clearly identified, quantified and justified with supporting information).

1.2. Using the results of the controlled emissions estimates generated from step 1.1, rank the mining activities according to the mass of TSP, PM_{10} and $PM_{2.5}$ emitted by each mining activity per year from highest to lowest.

1.3. Identify the top four mining activities from step 1.2 that contribute the highest emissions of TSP, PM_{10} and $PM_{2.5}$.

2. Identify, quantify and justify the measures that could be used to minimise particle emissions

2.1. For each of the top four activities identified in step 1.3, identify the measures that could be implemented to reduce emissions, taking into consideration:

- the findings of Katestone (June 2011) *NSW coal mining benchmarking study − international best practice measures to prevent and/or minimise emissions of particulate matter from coal mining* (see www.environment.nsw.gov.au/resources/air/KE1006953volumeI.pdf)
- any other relevant published information, and
- any relevant industry experience from either Australia or overseas.

2.2. For each of the top four activities identified in step 1.3, estimate the emissions of TSP, PM_{10} and $PM_{2.5}$ from each mining activity after applying the measures identified in step 2.1.

3. Evaluate the practicability of implementing these best practice measures

3.1. For each of the best practice measures identified in step 2.1, assess how practicable each one is to implement by taking into consideration:

- implementation costs
- regulatory requirements
- environmental impacts
- safety implications, and
- compatibility with current processes and proposed future developments.

3.2. Identify those best practice measures that will be implemented at the premises to reduce particle emissions.

4. Propose a timeframe for implementing all practicable best practice measures

4.1. For each of the practicable best practice measures identified in step 3.2, provide a timeframe for their implementation.

Report content

The report must clearly identify the methodologies utilised and all assumptions made. It must contain detailed information justifying and supporting all the information used in each step of the process. For example, in calculating the controlled emissions in step 1, current particulate matter controls being used at the mine must be clearly identified, quantified and justified. This means adding supporting information and evidence, including monitoring data, record keeping, management plans and/or operator training.

In evaluating practicability in step 3, the licensee must document the following specific information:

- estimated capital, labour, materials and other costs for each best practice measure on an annual basis for a 10-year period − this information must be set out in the format provided in Appendix A and included as an attachment to the report
- details of any restrictions on implementing each best practice measure due to an existing approval or licence
- quantify any new or additional environmental impacts that may arise from applying a particular best practice measure, such as increased noise or fresh-water use
- details of safety impacts that may result from applying a particular best practice measure
- details of any incompatibility with current operational practices on the premises, and
- details of any incompatibility with future development proposals on the premises.

Report format

The report must be structured according to the process outlined. It must be submitted as a pdf *and* hard copy in triplicate. All emission estimates, costs and supporting calculations must be in electronic format as an Excel spreadsheet.

Abbreviations and definitions

USEPA AP42 emission estimation techniques – all of the following:

- USEPA (1995), *AP 42, fifth edition, Compilation of air pollutant emission factors, volume 1: stationary point and area sources*, Technology Transfer Network − Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA. www.epa.gov/ttn/chief/ap42/index.html
- USEPA (1998), *AP 42, chapter 11.9, Western surface coal mining*, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA. www.epa.gov/ttn/chief/ap42/ch11/final/c11s09.pdf
- USEPA (2006), *AP 42, chapter 13.2.2, Unpaved roads*, Technology Transfer Network − Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA. www.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf
- USEPA (2006), *AP 42, Chapter 13.2.4, Aggregate handling and storage piles*, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA. www.epa.gov/ttn/chief/ap42/ch13/final/c13s0204.pdf
- USEPA (2006), *AP 42, Chapter 13.2.5, Industrial wind erosion*, Technology Transfer Network − Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA. www.epa.gov/ttn/chief/ap42/ch13/final/c13s0205.pdf

PM_{10} Particulate matter of 10 micrometres or less in diameter

$PM_{2.5}$ Particulate matter of 2.5 micrometres or less in diameter

Mining activities any of these:

- wheel generated particulates on unpaved roads
- wind erosion of overburden
- loading and dumping overburden
- blasting
- bulldozing coal
- trucks unloading overburden
- bulldozing overburden
- front-end loaders on overburden
- wind erosion of exposed areas
- wind erosion of coal stockpiles
- unloading from coal stockpiles
- dragline
- front-end loaders on overburden
- trucks unloading coal
- loading coal stockpiles
- graders
- drilling
- coal crushing
- material transfer of coal
- scrapers on overburden
- train loading
- screening, or
- material transfer of overburden

TSP Total suspended particulate matter

Appendix A Presentation of information on cost of implementation

The report should provide spreadsheets including estimates of the annual capital, labour and materials costs for each year over a ten year period for implementing each best practice measure identified in step 2.

The template below is for one best practice measure.

Mining activity	**Example: Wheel-generated particulates on unpaved roads**										
Specific best practice measure	**Example: Truck replacement – larger vehicles**										
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Cost of specific capital items (e.g. new vehicle)*											
Total capital costs											
Labour costs including directly related on-costs											
Cost of specific materials and other items (e.g. fuel)*											
Total material and other costs											
Estimated additional cost per tonne of particulate matter suppressed for TSP, PM_{10} and $PM_{2.5}$*											
Cost savings from implementing each best practice measure*											
Estimated net cost per tonne of particulate matter suppressed for TSP, PM_{10} and $PM_{2.5}$*											

** Each item must be specified – one item per row in spreadsheet*