YANCOAL 兖煤澳大利亚有限公司

DURALIECOAL
Part of the Yancoal Australia Group

Duralie Coal Mine
EPL 11701

Pollution Reduction Program
Coal Mine Wind Erosion of Exposed Land Assessment
August 2015

1 INTRODUCTION

Duralie Coal is required to report on EPL 11701 PRP U2: Coal Mine Wind Erosion of Exposed Land Assessment as part of their PRP licence conditions. The following is required to meet condition U2:

U2.1 The licensee must undertake the following steps:
1. Calculate the wind erosion exposed surface area (in hectares) within the premises as of 30 June 2015.
2. Determine the wind erosion exposed surface area (in hectares) predicted as at 30 June 2015 within the licensee's Environmental Assessment for the premises.
3. Compare the areas calculated in steps 1 and 2.
4. Submit a written report to the EPA at hunter.region@epa.nsw.gov.au containing the analysis required in steps 1 to 3, by 30 September 2015.

The report submitted to the EPA must be accompanied by spatial data to confirm the wind erosion exposed surface area calculations. The following data is required:

- *Shape files showing the premises boundary.*
- *Shape files showing the wind erosion exposed area within the premises as of 30 June 2015.*
- *Shape files showing areas classified as stabilised surface as of 30 June 2015.*
- *Details of any studies undertaken to verify that the areas of stabilised surface meet the definition.*

The purpose of the following report is to meet the requirements of EPL 11701 PRP U2.

2 SUPPORTING FILES

The following supporting files have been prepared and provided with the final report. The shape files boundaries are also reproduced in **Figure 1** (PRP U2 Exposed Land Assessment Areas).

1. *Shape files showing the premises boundary (i.e. ML boundary)*
2. *Shape files showing the wind erosion exposed area within the premises as of 30 June 2015.*
3. *Shape files showing areas classified as stabilised surface as of 30 June 2015.*
4. *Details of any studies undertaken to verify that the areas of stabilised surface meet the definition.*

Pacific Environment was commissioned to prepare a report to support the submission of Pollution Reduction Program U2, in completing site specific monitoring of wind erosion sources at Duralie Coal. Data were collected to understand the relative control efficiency of control measures on site, whether a surface should be considered stable or unstable using the test method referenced in the PRP, and the threshold friction velocity of these surface types.

Refer to **Attachment 1** (Supporting study for Duralie Coal's PRP U2: Coal Mine Wind Erosion of Exposed Land Assessment).

3 RESULTS

1. *Calculate the wind erosion exposed surface area (in hectares) within the premises as of 30 June 2015.*

The land areas currently disturbed as part of the Duralie Extension Project have been assessed to verify whether a surface should be considered stable or unstable using the test method referenced in the PRP. The results of this assessment are provided in **Attachment 1** (Supporting study for Duralie Coal's PRP U2: Coal Mine Wind Erosion of Exposed Land Assessment).

The results from the supporting assessment have been used to calculate the areas in **Table 1**.

Table 1: Duralie – PRP U2 Exposed Land Assessment – Current Areas (30 June 2015)

Area Category	Total Area Current (Hectares)
Total Mining Lease's	944.5
Wind Erosion Exposed Areas	
• Active Unshaped Overburden	55.1
Stabilised Areas	
• ROM Stockpile	2.4
• Inactive Unshaped Overburden	69.4
• Shaped Overburden	12.5
• Active Mine Void.	69.3
• Successful Rehabilitation	85.0

2. *Determine the wind erosion exposed surface area (in hectares) predicted as at 30 June 2015 within the licensee's Environmental Assessment for the premises.*

The land areas predicted to be disturbed as described in the Duralie Extension Project Modification Environmental Assessment (EA 2014) and the Duralie Coal Mine Mining Operations Plan (MOP 2015) are provided in **Table 2**. These areas do not include the infrastructure areas and water management areas. Additionally, the EA and MOP documents do not specifically differentiate between active unshaped overburden and inactive unshaped overburden, rather a total area is predicted. Hence, the spilt between active and inactive overburden areas has been estimate below.

Table 2: Duralie – PRP U2 Exposed Land Assessment – Areas Predicted (30 June 2015)

Area Category	Total Area Predicted (Hectares)
Total Mining Lease's	944.5
Wind Erosion Exposed Areas	
• Active Unshaped Overburden	66.0
Stabilised Areas	
• ROM Stockpile	2.4
• Inactive Unshaped Overburden	70.0
• Shaped Overburden	10.0
• Active Mine Void.	93
• Successful Rehabilitation	92.0

3. *Compare the areas calculated in steps 1 and 2.*

Table 3: Duralie – Wind Erosion Exposed Areas Comparison

Wind Erosion Exposed Areas	Hectares
• Current (30 June 2015)	55.1
• Predicted (30 June 2015)	66.0
Difference	**-10.9**

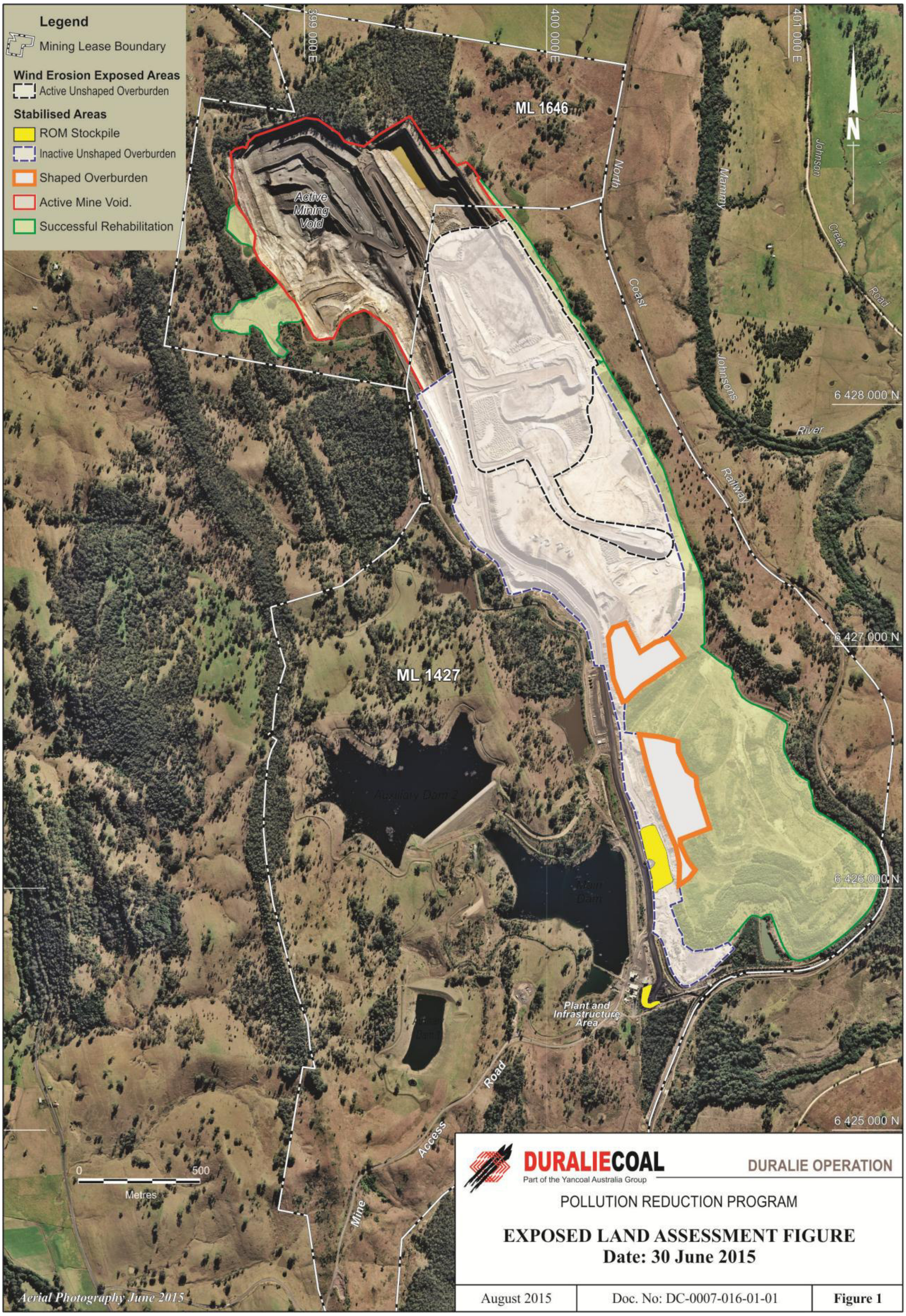

Figure 1: PRP U2 Exposed Land Assessment Areas

Attachment 1

Supporting study for Duralie Coal's PRP U2:
Coal Mine Wind Erosion of Exposed Land Assessment

26 August 2015

Mr Michael Plain
Duralie Coal
1164 Bucketts Way South
Stroud Road NSW, 2415

RE: Supporting study for Duralie Coal's Pollution Reduction U2: Coal Mine Wind Erosion of Exposed Land Assessment

Dear Michael,

This letter report has been prepared to present data recently collected at Duralie Coal in support of the requirements of Pollution Reduction Program (PRP) U2: *Coal Mine Wind Erosion of Exposed Land Assessment* in Environmental Protection Licence (EPL) 11701.

1 INTRODUCTION

Pacific Environment has been commissioned to prepare a report to support the submission of Pollution Reduction Program U2, in completing site specific monitoring of wind erosion sources at Duralie Coal. Data were collected to understand the relative control efficiency of control measures on site, whether a surface should be considered stable or unstable using the test method referenced in the PRP, and the threshold friction velocity of these surface types.

1.1 PRP U2: Coal Mine Wind Erosion of Exposed Land Assessment

Duralie Coal is required to report on PRP U2: Coal Mine Wind Erosion of Exposed Land Assessment as part of their PRP licence conditions. The following is required to meet condition U2:

U2.1 The licensee must undertake the following steps:

1. *Calculate the wind erosion exposed surface area (in hectares) within the premises as of 30 June 2015.*
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3. *Compare the areas calculated in steps 1 and 2.*
4. *Submit a written report to the EPA at hunter.region@epa.nsw.gov.au containing the analysis required in steps 1 to 3, by 30 September 2015.*

The report submitted to the EPA must be accompanied by spatial data to confirm the wind erosion exposed surface area calculations. The following data is required:

- *Shapefiles showing the premises boundary.*
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- *Details of any studies undertaken to verify that the areas of stabilised surface meet the definition.*

Note: Environmental Assessment *means any environmental assessment document prepared in order to gain approval or consent under the Environmental Planning and Assessment Act (1979) under which the licensee currently operates at the premises. If the predictions made in this document*

do not correspond to the current year of mine operation, the licensee should extrapolate between predictions.

Stabilised Surface *means any previously disturbed surface area which shows visual or other evidence of surface crusting and is resistant to wind-driven fugitive dust and is demonstrated to be stabilised. Stabilisation can be determined in accordance with one or more of the applicable test methods contained in the Rule 403 Implementation Handbook located at:* *www.capcoa.org/Docs/SCAQMD%20r403%20handbook.doc*

Wind Erosion Exposed Surface Area *means the portion of the premises surface which has been physically moved, uncovered, destabilised or otherwise modified from its natural state, thereby increasing the potential for fugitive particulate matter emissions, but excluding areas which have been:*

- *paved or covered by a permanent building or structure;*
- *maintained with a vegetative ground cover of at least 50% of ground cover for particular areas.*

Vegetative ground cover can be determined in accordance with the standardised procedure for revegetation assessment contained in Atyeo C. & Thackway R. (2009) located at: *http://data.daff.gov.au/data/warehouse/pe_brs90000004196/revegetationManual200906_20100410_ap14.pdf or*

- *classified as a stabilised surface*

2 STUDY APPROACH AND METHODOLOGY

2.1 Approach and Methodology

Sampling of wind erosion sources at Duralie Coal has been completed using three techniques:

- The Stabilised Surface Test Method, a simplified initial assessment for whether a crusted surface is considered stable (**Section 2.2**).
- Confined Air Burst Method to determine the control efficiencies of controlled wind erosion surfaces relative to active mining areas (**Section 2.3**).
- Threshold Friction Velocity sampling, to determine the susceptibility of particles to be lifted from the surface (**Section 2.4**).

2.2 Stabilised Surface Test Method

The Stabilised Surface Test Method is a simplified initial assessment of surface stability used to determine whether a surface is sufficiently crusted to prevent windblown dust (**SCAQMD, 2004**). It is a binary (i.e. pass/fail) initial assessment of surface stability. A limitation of the method is that it can only be applied to crusted surfaces.

A steel ball (diameter 15.9 mm, 16.6 grams) was dropped onto the test surface at 0.3 m height within a 0.3 m x 0.3 m survey area. After the ball was dropped, the ground around the steel ball was observed to determine whether it has sunk into the surface or caused the loosening of grains of dirt. Any indication of surface disturbance following the test was considered a 'fail' for surface stability. Conversely, surfaces that were not disturbed from the ball drop were considered a 'pass', that is, a stable surface. If the ball caused a slight indentation on the surface but there were no loose grains, the surface was considered to have passed the test (i.e. the surface was deemed 'stable'). Three representative locations within the survey area were tested. If the surface passed two or three of three drops, the surface was considered a stable surface. An example of the output of the test is shown in **Figure 2.1**.

Table 2.1: Example Stabilised Surface Test Method data from Duralie

		Test		
		1	2	3
Location	1	Pass	Pass	Pass
	2	Pass	Fail	Pass
	3	Fail	Pass	Fail

At least three representative locations of the exposed areas source were tested. A failed and passed test example is shown in **Figure 2.1**.

Figure 2.1: Stabilised Surface Test Method: insufficiently crusted surface (fail) and stable surface (pass)

2.3 Confined Air Burst Method

MRIGlobal has developed a test method known as the 'confined air burst chamber' (CABC) **(Cowherd, 2012)**. This is a simple[1], semi-quantitative technique that can be used to characterise the relative dust emission potential of various surface types subject to wind erosion, and the effectiveness of measures for controlling dust. The method provides an estimation of the percentage control efficiency of surface treatments such as the seeding of overburden dumps or the use of chemical dust suppressants. The method cannot be used to determine emission factors for wind erosion from surfaces.

The CABC test is designed to produce a cloud of dust within a small, open-floored sampling chamber (of volume 9.4 litres) by forcing a jet of air onto the test surface (**Figure 2.2**). The chamber is connected by a tube to a hand pump equipped with a pressure gauge, and the tube is fitted with a valve release switch. The pump is used to pressurise the tube, and once the pressure has reached a set value the valve is opened and air is forced onto the test surface. An open orifice prevents the build-up of pressure in the chamber during the injection period.

[1] This is a simpler version of DRI's PI-SWERL, which has been more extensively tested (http://www.dri.edu/pi-swerl-use). The CABC data can be used on a proportional basis for evaluating the relative dust emitting potentials of test surfaces and for determining the control efficiencies of various surface treatments.

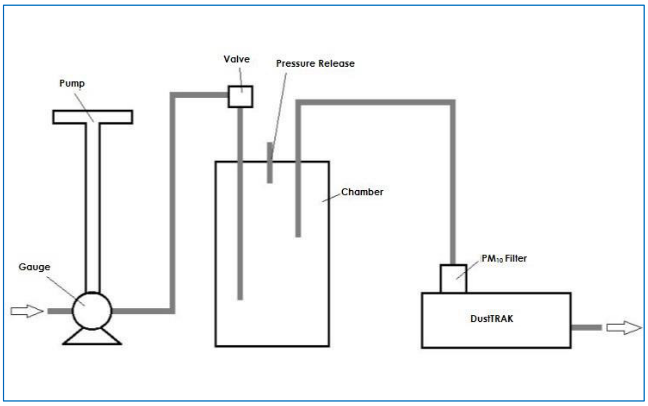

Figure 2.2: Confined air burst chamber test

The disturbance of dust on the surface and the breaking of any crust by the jet of air causes the production of visible dust within the chamber. A portable laser photometer (TSI Dusttrak 8530) records the time history of the PM_{10} concentration in the chamber following the injection of air. The maximum[2] PM_{10} concentration in the chamber is a surrogate for the amount of loose dust on the surface that can be entrained (*i.e.* the 'emission potential' of the surface). A single measurement for a given test surface can be obtained in around 15 minutes, although the time required per test will be lower where multiple tests are conducted in succession.

The evolution of the PM_{10} concentration with time is measured and logged by the TSI DustTrak 8530 instrument. An example of the raw data collected from ten samples on the ROM stockpile is shown in **Figure 2.3**.

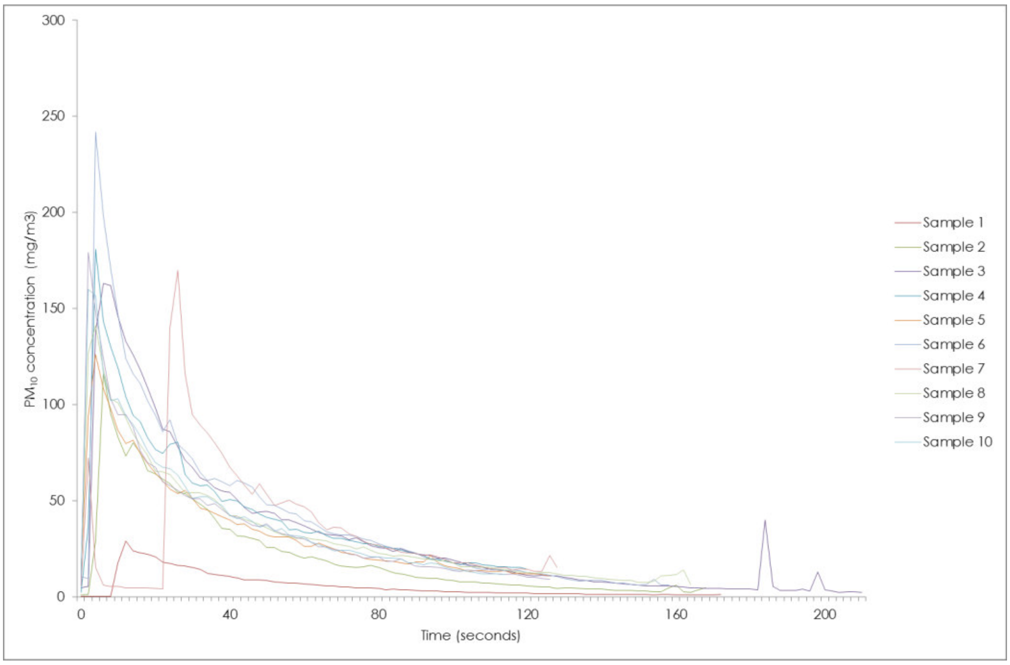

Figure 2.3: Raw concentration profiles from ROM stockpile CABC dataset

[2] The peak PM_{10} concentrations in CABC tests are generally higher than the atmospheric concentrations generated during high winds. This is because the vertical forces created by the air burst are much larger than those created by wind passing over the surface. Therefore, the results should only be used on a proportional basis.

2.4 Threshold friction velocity sampling

Threshold Friction Velocity (TFV) is a measure of susceptibility to wind-driven soil erosion (**SCAQMD, 2004**). On a scale, the lower the TFV, the greater the susceptibility of fine particles to be entrained at low wind speeds. Larger rocks protect against soil erosion, so they raise TFV on the disturbed surface.

Samples were collected during each sampling campaign of the surfaces tested with the CABC and Stabilised Surface Test Method.

A hand sieving method, consistent with protocols described within the USEPA's AP-42 documentation (**SCAQMD, 2004**) was implemented to determine the mode of the surface aggregate size distribution. The sample was sieved through a nest of sieves and then inspected for relative catch amount. The sieves used are 4 mm, 2 mm, 1 mm, 0.5 mm, 0.25 mm and a collector pan at the bottom (**Figure 2.4**). Rocks larger than 1 cm in diameter are removed prior to sieving. The sieves were moved in a circular motion at a speed just necessary to achieve relative horizontal motion between sieve and particles.

Figure 2.4: Threshold friction velocity sampling

2.5 Sampling locations and set-up

The methods described above were used to characterise the wind erosion potential of the following types of locations:

- Active overburden areas where dumping and loading operations were operating
- Areas that were inactive and crusted within the active mining area
- Rehabilitated land
- Topsoil areas and stockpiles
- ROM stockpile

Sampling was completed on 23 June 2015. The locations and numbers of samples collected at Duralie Coal for the different surface types are shown in **Table 2.2**.

Table 2.2: Sampling numbers and techniques by surface type

ID	Surface type/control		Surface type	Stabilised Surface Test Samples	TFV Samples	CABC Tests
1	Active OB[(a)]		Mine working area	9	1	10
2	Controlled OB	Inactive crusted OB[(b)]	Natural control measure	9	1	10
3		Shaped OB (topsoil spread)	Control measure / mitigation	9	1	10
4	ROM coal stockpile		Storage area	9	1	10
		Total		**36**	**4**	**40**

(a) OB = overburden

(b) A crusted surface refers to a section of overburden that has been sealed by a hardened cap as a result of water drying on the surface

Figure 2.5 shows examples of the types of locations that were sampled at Duralie Coal. Locations were selected after reviewing all exposed surfaces at the site to ensure that the sampling locations were representative. Samples were taken in randomly selected locations across the area to capture the variability across the surface. There is currently no rehabilitation area at Duralie Coal with lower than 50% vegetative ground coverage.

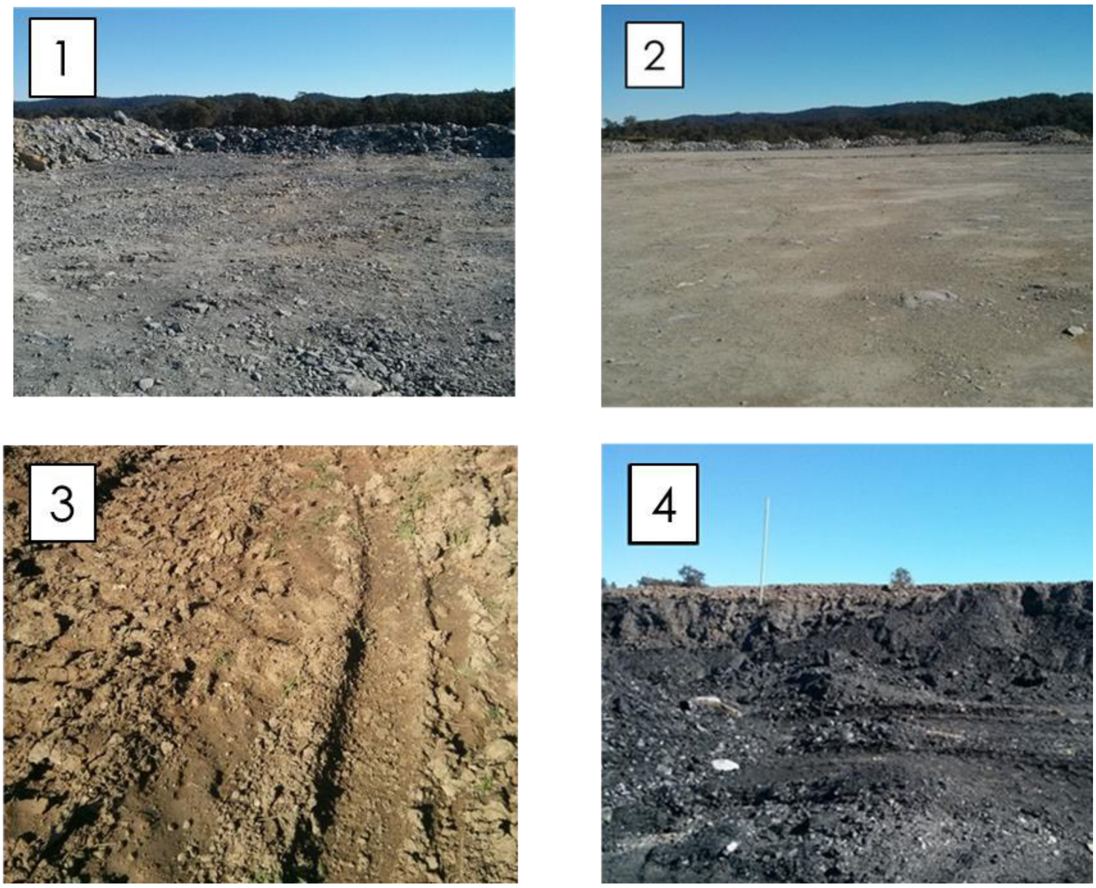

Figure 2.5: Duralie Coal CABC sampling locations: (1) Active Overburden (2) Inactive Overburden (3) Shaped Overburden (Topsoil Spread) (4) ROM Coal Stockpile

3 RESULTS

A summary of wind erosion potential by method from exposed areas at Duralie Coal is shown in **Table 3.1**.

Table 3.1: Wind erosion potential data for surfaces at Duralie Coal

ID	Surface type/control		Stabilised Surface Test Method (Pass/Fail)	Threshold Friction Velocity (m/s)	Control Efficiency[(a)] Average (range) (%)	Wind Erosion Exposed Surface Area Stability
1	Active OB		Fail	1	Uncontrolled	Unstable
2	Controlled OB	Inactive crusted OB	Pass	0.8	60 - 65 %	Stable
3		Shaped OB (topsoil spread)	Pass	0.8	80 - 85 %	Stable
4	ROM coal stockpile		Pass	0.6	N/A	Stable

(a) Control efficiency determined using the CABC has been rounded to the nearest 5% to reflect precision of the method. Control efficiency achieved has been calculated for each sampling campaign to capture sampling conditions; this is reflected in the range of controls achieved.

Active overburden areas, where equipment had been dumping or loading in the past 24 hours was used as the baseline and considered an uncontrolled emission surface. This surface was tested using the Stabilised Surface Test Method and determined to be unstable.

All other surfaces tested using the Stabilised Surface Test Method were determined to be stable.

High control efficiencies were derived from all controlled surfaces when compared to the uncontrolled active mining areas. Shaped OB (topsoil spread) had a control efficiency of 80 - 85%. Inactive crusted overburden where otherwise no control/mitigation measures had been implemented had a control efficiency of 60 – 65%.

Threshold friction velocity sampling suggests that the ROM coal stockpile, followed by inactive crusted overburden and shaped overburden (topsoil spread) has the highest susceptibility for wind erosion. This does not support the observation or the results of the sampling from the two other methodologies. The threshold friction velocity method is conducted using a sample dug from 5 – 10 cm beneath the surface, so does not take into the account the surface crusting which has a considerable influence on wind erosion potential which is taken into account using the Surface Stabilisation Method and the Confined Air Burst Chamber.

4 CONCLUSION

This letter report has been prepared to support Duralie Coals submission to Pollution Reduction Program (PRP) U2.

Active mining areas, those areas where equipment was actively moving overburden, were deemed 'unstable'. These areas were considered uncontrolled and the emission potential was used to determine a control efficiency for other controlled surfaces.

All other tested areas on the mine were deemed 'stable' using the test method referenced in the PRP. This suggests that the natural or managed wetting of active mining areas acts to control such surfaces from wind erosion processes.

Control efficiencies ranged from 80 – 85 % on shaped overburden (topsoil spread), and from 60-65% on inactive crusted overburden areas using the confined air burst method. The ROM coal stockpile, whilst being deemed stable using the test method referenced in the PRP, did not demonstrate any level of control efficiency using the CABC test.

The results of the undisturbed crusted area sampling are significant for the purposes of estimating wind erosion of exposed land. The results suggest that any mining operational area that has been left undisturbed from activities following rain should be considered a stable area as defined by the Stabilised Surface Test Method (and therefore the terms of reference of the PRP).

I trust that the above provides adequate information to support your response to PRP U2. Do not hesitate to contact the undersigned if you would like any additional clarification.

Regards,

S. Oswald

Samuel Oswald
Consultant – Air Quality

5 REFERENCES

Cowherd C (2012). Procedure for testing with confined air burst chamber. MRIGlobal.

Pacific Environment (2015). ACARP Project C22027 - Development of Australia-Specific PM_{10} Emission Factors for Coal Mines: Winter Sampling Results. March 2014.

South Coast Air Quality Management District (2004). Rule 403 Implementation Handbook. Draft Final. Office of Planning and Policy, April 2004.

US EPA (1995a). Procedures for sampling surface/bulk dust loading. Appendix C.1. AP-42. Emissions Factors & Policy Applications Centre.

USEPA (1995b). Procedures for laboratory analysis of surface/bulk dust loading sampling. Appendix C.2. AP-42. Emissions Factors & Policy Applications Centre.