TARRAWONGA COAL MINE PRP U1: MONITORING RESULTS – WHEEL GENERATED DUST

TARRAWONGA COAL PTY LTD

Job ID. 07487a

29 July 2014
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**PREPARED FOR:** Tarrawonga Coal Pty Ltd

**APPROVED FOR RELEASE BY:** Judith Cox

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**DOCUMENT CONTROL**

<table>
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<th>DATE</th>
<th>PREPARED BY</th>
<th>REVIEWED BY</th>
</tr>
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<tr>
<td>D1</td>
<td>23.07.2014</td>
<td>Greer Laing</td>
<td>Judith Cox</td>
</tr>
<tr>
<td>FINAL</td>
<td>29.07.2014</td>
<td>Greer Laing</td>
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1 INTRODUCTION

Tarrawonga Coal Pty Ltd (TCPL) holds Environmental Protection Licence (EPL) 12365 for the Tarrawonga Coal Mine (TCM). Condition U1 (Particulate Matter Control Best Practice Implementation - Wheel Generated Dust) requires that TCPL must achieve and maintain a dust control efficiency of 80% or more on its haul roads.

To satisfy the requirements of the EPL, a Monitoring Plan was developed for condition U1 which outlined the proposed monitoring method to determine the site wide haul road control efficiency (Pacific Environment, 2013a).

This report provides results from the haul road dust control efficiency monitoring for Tarrawonga Coal Mine.

1.1 Licence Requirements

Condition U1.1 (Particulate Matter Control Best Practice Implementation - Wheel Generated Dust) requires that TCM must achieve and maintain a dust control efficiency of 80% or more on its haul roads. Control efficiency is calculated as:

\[
CE = \frac{E_{\text{uncontrolled}} - E_{\text{controlled}}}{E_{\text{uncontrolled}}} \times 100
\]

Where

\[E = \text{measured emissions (mg/m}^3)\] .

Condition U1.2 requires that to assess compliance with U1.1, TCM must:

- Measure uncontrolled and controlled haul road emissions on at least 3 occasions using a mobile dust monitor.
- Continuously measure and record additional site data including:
  - Vehicle kilometres travelled (VKT)
  - Meteorological conditions
  - Water use for dust suppression
- Undertake silt content and soil moisture sampling during sampling events.
- Determine if a site specific relationship can be derived between the measured control efficiency, additional site data, water use, meteorological data, and silt content and soil moisture levels.

The measurement of controlled and uncontrolled haul road dust emissions must be undertaken under varying meteorological conditions, including at times when analysis of meteorological data indicated that elevate levels of dust are most likely at the site.

2 SAMPLING METHODOLOGY

2.1 Mobile Monitoring

PM_{10} emissions from haul roads were measured using the mobile system REX (Road Emissions eXpert). REX measures the concentration of PM_{10} generated from the test vehicle and so by comparing data collected from haul roads with and without controls, control efficiencies can be calculated.

The monitoring method is described in greater detail in ACARP Project C20023 (Cox & Laing, in press). All monitoring was conducted according to the internal Quality Management Plan for the use of REX (Pacific Environment, 2013).
2.2 Sampling Approach

All active haul routes on the mine were sampled repeatedly over the sampling day. Within the full active circuit of the mine was an uncontrolled section of road, left at least 12 hours without controls (further details in Section 2.3).

2.3 Calculating Control Efficiency

Critical to the determination of haul road dust control efficiency is the definition of what constitutes an ‘uncontrolled’ section of haul road.

Seasonal changes in meteorology play a large role in the efficiency of controls applied to haul roads to manage wheel-generated dust. Conditions such as rainfall, high humidity, fog or damp are natural controls that reduce dust generated from an unsealed road. Conversely, higher ambient temperatures can cause increased evaporation, requiring more watering or suppressant to be used to meet a sufficient level of control. Road management, construction and maintenance also contribute to controlling dust.

For these reasons, it is not appropriate to calculate a control efficiency using baseline data that is heavily impacted by these seasonal conditions and management factors, where the control efficiency calculated does not have any bearing on the dust being generated (i.e. winter control efficiency being much lower than summer control efficiency). Therefore, the maximum uncontrolled data collected over all monitoring campaigns has been used to reflect an uncontrolled baseline and applied across the year to calculate the control efficiency.

For the purposes of determination of control efficiency, we define an uncontrolled haul road as:

“A section of at least 150 m of an active haul road where no water has been applied for at least 12 hours prior to monitoring and hasn’t been treated with chemical suppressant. Less than 0.3 mm of precipitation has been recorded at the closest meteorological station in the preceding 12 hours and ambient conditions during monitoring do not act to suppress dust (rainfall, fog, mist, high humidity, low evaporation, low wind speeds).”

3 RESULTS

In accordance with condition U1, two rounds of REX monitoring have been completed during July 2013 and February 2014. The results of the monitoring are shown in following sections:

- Dust control efficiency achieved on the sampling days (Section 3.1)
- Dust concentrations measured (Section 3.2)
- Additional site data, including meteorological conditions, operational factors and the results of silt and moisture sampling (Section 3.3)
- Site specific relationships between these data (Section 3.4)

3.1 Dust Control Efficiency

The average control efficiency achieved during the monitoring was calculated as 92 %. Average control efficiency achieved during each sampling campaign and the range by circuit is shown in Table 3.1.

<table>
<thead>
<tr>
<th>Monitoring Round</th>
<th>Sampling Date</th>
<th>Number of circuits of the active mine</th>
<th>Average Control Efficiency</th>
<th>Range of Control Efficiency by circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23 July 2013</td>
<td>6</td>
<td>89 %</td>
<td>79 % - 98 %</td>
</tr>
<tr>
<td>2</td>
<td>4 February 2014</td>
<td>5</td>
<td>94 %</td>
<td>93 % - 96 %</td>
</tr>
</tbody>
</table>

Table 3.1: Summary of REX control efficiencies
3.2 Dust Concentrations Measured

The average PM$_{10}$ concentration measured during each sampling campaign is shown in Table 3.2.

<table>
<thead>
<tr>
<th>Monitoring Round</th>
<th>Sampling Date</th>
<th>Average controlled PM$_{10}$ concentration (mg/m$^3$)</th>
<th>Maximum average uncontrolled PM$_{10}$ concentration (mg/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23 July 2013</td>
<td>0.140</td>
<td>1.270</td>
</tr>
<tr>
<td>2</td>
<td>4 February 2014</td>
<td>0.070</td>
<td></td>
</tr>
</tbody>
</table>

3.3 Additional Site Data

A summary of the meteorological conditions, as recorded by the site meteorological station operating during the sampling day, for the day of each monitoring event is presented in Table 3.3. The average control efficiency achieved during each day has been included for comparison.

<table>
<thead>
<tr>
<th>Parameter (units)</th>
<th>Round 1</th>
<th>Round 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Wind Speed (m/s)</td>
<td>2.1 m/s</td>
<td>3.7 m/s</td>
</tr>
<tr>
<td>Average Temperature (°C)</td>
<td>8.6 °C</td>
<td>26.8 °C</td>
</tr>
<tr>
<td>Average Relative Humidity (%)</td>
<td>68.9 %</td>
<td>40.4 %</td>
</tr>
<tr>
<td>Average Solar Radiation [W/m$^2$]</td>
<td>114.3 W/m$^2$</td>
<td>289 W/m$^2$</td>
</tr>
<tr>
<td>Total Rainfall (mm)</td>
<td>0.00 mm</td>
<td>0.00 mm</td>
</tr>
<tr>
<td>Average control efficiency (%)</td>
<td>89 %</td>
<td>94 %</td>
</tr>
</tbody>
</table>

Four and a half years of meteorological data (January 2009 – April 2014) from the Tarrawonga Mine site meteorological station were analysed to determine the seasonal variation in meteorology at the site. Figure 3.1 to Figure 3.4 shows the following:

- Average monthly temperature compared to average temperature on sampling day (Figure 3.1)
- Average monthly humidity compared to average humidity on sampling days (Figure 3.2)
- Average monthly solar radiation compared to average solar radiation on sampling days (Figure 3.3)
- Total monthly rainfall by year (Figure 3.4)

The analysis shows that the sampling days where monitoring was completed are representative of changing seasonal conditions across the year.
Figure 3.1: Average monthly temperature (°C) from January 2009 – April 2014 compared to average temperature on sampling day

Figure 3.2: Average monthly humidity (%) from January 2009 – April 2014 compared to average humidity on sampling day
Figure 3.3: Average monthly solar radiation from January 2009 – April 2014 compared to average solar radiation on sampling day

Figure 3.4: Total monthly rainfall (mm) from January 2009 – April 2014
In accordance with condition U1, additional operational data were collected for the periods of monitoring and are summarised in Figure 3.4. The majority of operational parameters do not change between monitoring periods.

Table 3.4: Additional site data

<table>
<thead>
<tr>
<th>Site Data</th>
<th>Monitoring Round 1</th>
<th>Monitoring Round 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle movement routes</td>
<td>Ramp 3 pit to dump, Ramp 2 pit to dump</td>
<td>Ramp 3 pit to dump, Ramp 2 pit to dump</td>
</tr>
<tr>
<td>Loaded haul truck weight</td>
<td>CAT785C 102 tonne empty, 250 tonne gross operating weight, CAT789C 130 tonne empty, 317 tonne gross operating weight</td>
<td>CAT785C 102 tonne empty, 250 tonne gross operating weight, CAT789C 130 tonne empty, 317 tonne gross operating weight</td>
</tr>
<tr>
<td>Vehicle speed</td>
<td>Speed limit 60 km/h</td>
<td>Speed limit 60 km/h</td>
</tr>
<tr>
<td>Method of watering</td>
<td>Water</td>
<td>Water</td>
</tr>
<tr>
<td>Water application time</td>
<td>Not measured directly</td>
<td>Not measured directly</td>
</tr>
<tr>
<td>Water application volume</td>
<td>WAT860 (32,000L) &amp; WAT863 (32,000L)</td>
<td>WAT885 (32,000L), WAT868 (45,000L) &amp; WAT891 (13,000L)</td>
</tr>
<tr>
<td>Water application rate</td>
<td>Continuous or as required</td>
<td>Continuous or as required</td>
</tr>
</tbody>
</table>

During each sampling campaign a bulk sample of the road surface was collected in accordance with the surface sampling methodology (US EPA, 1993). The samples were analysed at the laboratory for silt and moisture content, these reports are included in Appendix A.

Table 3.5: Results of silt and moisture sampling

<table>
<thead>
<tr>
<th>Monitoring Round</th>
<th>Road Type</th>
<th>Control Level</th>
<th>Silt (%)</th>
<th>Moisture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temporary</td>
<td>Uncontrolled</td>
<td>6.7</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Temporary</td>
<td>Controlled</td>
<td>1.2</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>Permanent</td>
<td>Controlled</td>
<td>3.6</td>
<td>2.4</td>
</tr>
<tr>
<td>2</td>
<td>Temporary</td>
<td>Uncontrolled</td>
<td>2.3</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Temporary</td>
<td>Controlled</td>
<td>5.1</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Temporary</td>
<td>Controlled</td>
<td>6.7</td>
<td>2.2</td>
</tr>
</tbody>
</table>

3.4 Site Specific Relationships

No site specific relationships were evident when the average dust concentrations measured were compared against the other site specific parameters. All causal relationships were systematically explored but no parameters were significantly correlated when the control efficiency achieved was compared to meteorological data, operational parameters or silt and moisture content. The relationships were explored for each round and for each circuit of the mine.

Typically the dust concentrations measured is found to correlate with average temperature, relative humidity and solar radiation. These factors should be considered when managing haul road control measures.

4 CONCLUSION

Wheel-generated dust control efficiency was assessed at Tarrawonga Coal Mine on two occasions using a mobile dust monitoring system (REX). The dust control effectiveness was calculated as 89% on 23 July 2013 and 94 % 4 February 2014. On both occasions the site was maintaining an average dust control efficiency of greater than 80%.
A number of factors contribute to dust generation from haul roads. No relationships were evident from the data collected at Tarrawonga, when the data was compared to silt and moisture data, meteorological data and operational parameters.

However, the ACARP study has shown that consideration of site-specific operational factors is critical to minimising the level of dust generated from unsealed roads, including:

- Roads under construction.
- Roads recently graded.
- Coal operation areas.
- Roads adjacent to stockpiles.
- Highly-trafficked areas.

These management measures should be the focus for best practice management of haul road controls.

5 REFERENCES


Appendix A  SILT AND MOISTURE SAMPLING RESULTS
## A.1 JULY 2013 SILT AND MOISTURE SAMPLING RESULTS

**Job Number:** L107252  
**Client:** Pacific Environment Limited  
**Reference/Order:** 7274  
**Project:** Tarrawonga

<table>
<thead>
<tr>
<th>Lab No</th>
<th>Sample ID</th>
<th>001</th>
<th>002</th>
<th>003</th>
</tr>
</thead>
<tbody>
<tr>
<td>DL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NQ668 - Moisture Determination of Bulk Samples

<table>
<thead>
<tr>
<th>Total Moisture ( @ 105°C)</th>
<th>%</th>
<th>0.1</th>
<th>1.3</th>
<th>0.60</th>
<th>2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NQ889 - Size Analysis of Misc. Material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ 31.5 mm</td>
<td>%</td>
<td>0.1</td>
<td>10.5</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>-31.5 to 16.0 mm</td>
<td>%</td>
<td>0.1</td>
<td>16.4</td>
<td>13.9</td>
<td>6.1</td>
</tr>
<tr>
<td>-16.0 to 8.0 mm</td>
<td>%</td>
<td>0.1</td>
<td>24.0</td>
<td>16.6</td>
<td>10.6</td>
</tr>
<tr>
<td>-8.0 to 4.0 mm</td>
<td>%</td>
<td>0.1</td>
<td>12.0</td>
<td>12.2</td>
<td>13.2</td>
</tr>
<tr>
<td>-4.0 to 0.85 mm</td>
<td>%</td>
<td>0.1</td>
<td>16.1</td>
<td>25.7</td>
<td>27.1</td>
</tr>
<tr>
<td>-0.85 to 0.425 mm</td>
<td>%</td>
<td>0.1</td>
<td>7.4</td>
<td>13.1</td>
<td>13.9</td>
</tr>
<tr>
<td>-0.425 to 0.150 mm</td>
<td>%</td>
<td>0.1</td>
<td>7.6</td>
<td>13.8</td>
<td>15.8</td>
</tr>
<tr>
<td>-0.150 to 0.075 mm</td>
<td>%</td>
<td>0.1</td>
<td>5.7</td>
<td>5.6</td>
<td>6.6</td>
</tr>
<tr>
<td>&lt; 0.075 mm</td>
<td>%</td>
<td>0.1</td>
<td>2.3</td>
<td>5.1</td>
<td>6.7</td>
</tr>
</tbody>
</table>

DL = Detection Limit  
LNR = Samples Listed not Received  
-- = Not Applicable  
nd = < DL  
db = Dry basis

**Sample Description Key (if req’d)**

- 001: 1. RAMP 3 UNCONTROLLED - HAUL RD  
- 002: 2. RAMP 2 UNCONTROLLED - HAUL RD  
- 003: 3. 300 DUMP CONTROLLED - HAUL RD
# A.2 FEBRUARY 2014 SILT AND MOISTURE SAMPLING RESULTS

**Job Number: 001104798**  
**Client: Pacific Environment Limited**  
**Reference/Order: 6961**  
**Project: ACARP TARRAWONGA**  

**Table:**  
<table>
<thead>
<tr>
<th>Analyte</th>
<th>Sample ID</th>
<th>DL</th>
<th>Road</th>
<th>Dust</th>
<th>Road</th>
<th>Dust</th>
<th>Overburden</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PC072 - Bulk Moisture Determination</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Moisture (at 105°C) %</td>
<td>0.1</td>
<td>2.1</td>
<td>8.3</td>
<td>2.4</td>
<td>5.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NQ899 - Size Analysis of Misc. Material</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ 31.5 mm %</td>
<td>0.1</td>
<td>nd</td>
<td>nd</td>
<td>nd</td>
<td>11.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-31.5 to 16.0 mm %</td>
<td>0.1</td>
<td>1.0</td>
<td>17.7</td>
<td>10.5</td>
<td>13.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-16.0 to 8.0 mm %</td>
<td>0.1</td>
<td>3.8</td>
<td>22.4</td>
<td>13.5</td>
<td>15.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-8.0 to 4.0 mm %</td>
<td>0.1</td>
<td>9.5</td>
<td>21.0</td>
<td>11.8</td>
<td>11.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-4.0 to 0.85 mm %</td>
<td>0.1</td>
<td>33.1</td>
<td>24.8</td>
<td>27.5</td>
<td>18.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.85 to 0.425 mm %</td>
<td>0.1</td>
<td>17.8</td>
<td>6.3</td>
<td>15.3</td>
<td>8.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.425 to 0.150 mm %</td>
<td>0.1</td>
<td>17.8</td>
<td>5.1</td>
<td>13.8</td>
<td>10.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.150 to 0.075 mm %</td>
<td>0.1</td>
<td>10.3</td>
<td>1.5</td>
<td>4.0</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.075 mm %</td>
<td>0.1</td>
<td>6.7</td>
<td>1.2</td>
<td>3.6</td>
<td>5.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**  
- **DL** = Detection Limit  
- **LNR** = Samples I tried not Received  
- **--** = Not Applicable  
- **nd** = < DL  
- **db** = Dry basis