

Work Program PRP4.2 Particulate Emissions from Coal Trains

Prepared for

**Australian Rail Track
Corporation Ltd**

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Final

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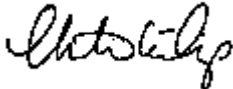
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Glossary

| Term | Definition |
|--|--|
| km | kilometre |
| m | metre |
| PM | Particulate matter (fine dust) |
| PM _{2.5} and PM ₁₀ | Particulate matter less than 2.5 or 10 microns, respectively |
| TSP | Total suspended particles |

1. Introduction

Australian Rail Track Corporation Ltd (ARTC) commissioned Katestone Environmental Pty Ltd (Katestone) to prepare a Work Program on its behalf in accordance with PRP4.2 Particulate Emissions from Coal Trains. PRP4.2 is reproduced in full in Appendix A.

1.1 PRP Actions

The key actions required by PRP 4.2 are as follows:

Action 4.2A

The licensee will conduct a monitoring program to determine whether:

- Trains operating on the Hunter Valley rail network are associated with elevated particulate matter concentrations; and*
- Loaded coal trains operating on the Hunter Valley rail network have a stronger association with elevated particulate matter concentrations than unloaded coal trains or other trains on the network (and by inference contributing to ambient rail corridor particulate levels).*

Timeframe – *For a continuous period of at least 30 days between 1 November 2012 and 18 January 2013.*

Action 4.2B

A revised work program for the monitoring program must be submitted to the EPA. Monitoring must be consistent with that work program. The revised work program must be based on the previous EPA approved work plan submitted by ARTC in compliance with Action 4.1B above from PRP 4.1, and account for the learnings from and limitations identified with the pilot program. The licensee will also publish the work program on its website.

Timeframe – *The licensee must submit the work program to the EPA within four weeks of inclusion of the PRP on the licence. The licensee must publish the work program on its website within four weeks of the EPA providing written comment to the licensee on the draft work program.*

Action 4.2C

On completion of the monitoring program required by 4.2A the licensee will submit to the EPA for comment a report on the results of the monitoring.

Timeframe – *On or prior to 15 March 2013.*

Action 4.2D

The licensee will submit a final report on the monitoring program required by 4.2A to the EPA. The report must address any comments provided by the EPA and include a “plain English” Executive Summary at the start of the document. The licensee will also publish the final report in full on its website.

Timeframe – *The report will be submitted to the EPA and published on the licensee’s website within four weeks of the EPA providing written comment to the licensee on the draft report.*

1.2 Background and learnings from pilot program

In 2011, the EPA issued a varied ARTC's licence (EPL3142) to include PRP4.1 Particulate Emissions from Coal Trains. PRP4.1 required ARTC to conduct a pilot dust monitoring program to:

- *Determine whether loaded coal trains operating on the Hunter Valley rail network are a source of particulate matter emissions.*
- *Determine whether loaded coal trains operating on the Hunter Valley rail network are a larger cause or source of particulate matter emissions than unloaded coal trains or other trains on the network.*

To address the requirements of the PRP, a monitoring program was conducted at Mayfield and Metford from 13 February 2012 to 20 March 2012. A report of the pilot monitoring program was issued by Environ in September 2012.

The following learnings from the pilot program are relevant to the conduct of further monitoring work by ARTC in the rail corridor:

- Results of monitoring that were conducted at Mayfield were unreliable due to:
 - The lack of a wayside monitor and; hence, the use of the 4TRAK monitoring system to identify train pass-bys results in a likely misalignment of the times of dust measurements and train pass-bys. In particular, the 4TRAK system suffers from the following inadequacies:
 - It cannot provide train lengths
 - It cannot provide train speeds
 - It records pass-by time rounded to the nearest minute
 - Slower train speeds of coal trains entering the port and queuing of trains at Mayfield results in few single pass-bys and; hence, a relatively small number of data points could be included in the analysis
- An averaging period for dust concentration that is shorter than 30 seconds would improve the accuracy of measurements of all trains and particularly those that have short pass-by times. This shorter averaging period would only be of value where accurate train pass-by information was also available
- To achieve greater data resolution, data would need to be downloaded remotely on a frequent basis

2. Objective

The objective of this Work Program is to specify the work that will be completed to address the requirements of PRP4.2. The work program will be used to guide the conduct of the monitoring program and in particular:

- Monitoring Methodology
- Assessment Methodology and statistical techniques
- Reporting requirements
- Limitations and Assumptions
- Publication

The revised work program has been based on the previous EPA approved work plan submitted by ARTC in compliance with Action 4.1B from PRP 4.1. The revised work program has accounted for the learnings from and limitations identified in the pilot program. The licensee will also publish the work program on its website.

3. Monitoring Methodology

3.1 Overview

To achieve the objective of PRP 4.2, a continuous dust monitoring station will be installed to measure dust levels in the rail corridor adjacent to tracks carrying various types of trains. The time that the train passes the monitoring station will be recorded in addition to other details of each train so that any change in dust levels associated with the train pass-by can be accurately quantified.

Dust concentration data will be grouped by train type and a statistical analysis will be used to determine the change in dust concentration associated with each train type and the significance of the change relative to the no trains group and relative to each train type. The influence of meteorological conditions on measurements will also be investigated.

3.2 Monitoring location

Selection of monitoring locations has been based on the pilot program work plan (Environ, 2011) and findings (Environ, 2012) of the pilot program. The pilot program identified two preferred monitoring locations following a detailed study of possible monitoring locations. Monitoring was conducted at both locations, namely: Mayfield and Metford. Given the constraints identified in conducting the pilot program and the findings (Section 1.2), further monitoring will not be conducted at Mayfield; in particular:

- Relatively few (44%) pass-bys were single trains
- Train speeds were relatively slow
- Significant difficulties in relating train pass-bys to monitoring data

The monitoring site at Metford will be located in the same location as was used for the pilot study. The location is shown in Figure 1. A photograph of the site is shown in Figure 2. The dust monitoring equipment and anemometer will be mounted at approximately 4 metres above track height and a horizontal distance of approximately 3 metres from the tracks.

There are a number of substantial advantages of the Metford site that are evident from the pilot program:

- The site is located so it is passed by trains travelling on both the Hunter Valley and North South rail lines
- Relatively few multiple pass-bys (10%)
- Good distribution of train types
- Greater number of coal train pass-bys due to speed and fewer multiple pass-bys

The disadvantages of this site were noted in the work plan for the pilot program (Environ, 2011). The disadvantages are not likely to compromise the achievement of the objective of the PRP.

A second site will not be included in this program because:

- There is no existing alternative site in the Lower Hunter with a wayside monitor that would allow the learnings from the pilot program to be addressed
- Timing and cost constraints make the setting up of an alternative site with wayside monitor impractical
- Based on the pilot program, monitoring would need to be conducted for three times longer at Mayfield to achieve the same number of single train pass-bys as Metford, but with poorer reliability of outcome due to the constraints identified above

3.3 Dust monitoring equipment

Dust monitoring will be conducted using a light scattering laser photometer that is capable of measuring at a frequency of greater than once every 10 seconds. The equipment will be capable of measuring:

- Total Suspended Particulates (TSP)
- Particulates with aerodynamic diameter less than 10 micrometres (PM₁₀)
- Particulates with aerodynamic diameter less than 2.5 micrometres (PM_{2.5})

The internal clock of the dust monitoring equipment will be synchronised with the wayside monitoring equipment.

3.4 Meteorological monitoring equipment

Wind speed and wind direction will be monitored using a weather station and datalogger with its internal clock synchronised with the wayside monitoring equipment. The anemometer will be mounted at the same height as the sample inlet of the dust monitor. The meteorological monitoring equipment will be capable of measuring the following parameters at a frequency greater than once every 10 seconds:

- Wind speed at 4 metres
- Wind direction at 4 metres

Rainfall data from the nearest monitoring station operated by the Bureau of Meteorology will be considered in the data analysis.

3.5 Train monitoring

The Metford monitoring site has a fixed wayside monitoring station for logging train movements. Data from this wayside monitoring station was successfully used in the pilot program. Data from the wayside monitoring station will be used to identify:

- Train consists/train types
- Pass-by time
- Train speed

An example of the data provided by the Metford wayside monitoring station is shown in Table 1

Table 1 Example of data provided by the Metford wayside monitoring station

| Trn_Site_Initials | Trn_Time | Trn_Direction | Trn_Locomotives | Trn_Carriages | Length | Carr_Count | Carr_Speed | Carr_Mass_Sum | Carr_Mass_Avg |
|-------------------|--------------------|---------------|-----------------|---------------|---------|------------|------------|---------------|---------------|
| UC | 22/02/2012 0:28:23 | Up | 3 | 92 | 1,476.3 | 94 | 38.5 | 12,895.3 | 137.2 |
| UC | 22/02/2012 1:01:11 | Up | 3 | 91 | 1,542.1 | 92 | 50.0 | 12,699.4 | 138.0 |
| UC | 22/02/2012 1:18:03 | Up | 3 | 85 | 1,377.3 | 85 | 41.8 | 11,444.0 | 134.6 |
| UC | 22/02/2012 1:53:57 | Up | 3 | 80 | 1,293.5 | 83 | 40.8 | 9,857.8 | 118.8 |
| UC | 22/02/2012 2:21:33 | Up | 2 | 74 | 1,275.8 | 73 | 46.4 | 10,363.5 | 142.0 |
| UC | 22/02/2012 2:48:45 | Up | 2 | 74 | 1,272.6 | 76 | 38.1 | 10,812.0 | 142.3 |
| UC | 22/02/2012 3:05:05 | Up | 1 | 94 | 1,476.3 | 95 | 39.4 | 12,955.9 | 136.4 |

4. Assessment Methodology

4.1 Data management and analysis

Where practical, the following parameters will be logged at a frequency of greater than once every 10 seconds and stored:

- Total Suspended Particulates (TSP)
- Particulates with aerodynamic diameter less than 10 micrometres (PM₁₀)
- Particulates with aerodynamic diameter less than 2.5 micrometres (PM_{2.5})
- Wind speed at 4 metres
- Wind direction at 4 metres

Meteorological parameters will be vector averaged in accordance with AS3580.14.1.

It is intended that all data will be remotely downloaded using a 3G data modem at least once per day and stored on Katestone's office network. The data will be backed-up from Katestone's network to a third party off-site server on a daily basis.

4.2 Assessment of contribution by train type

Dust concentration data (as TSP, PM₁₀ and PM_{2.5}) will be grouped according to the following categories related to train types:

- Loaded coal
- Unload coal
- Freight
- Passenger
- Multiple pass-by

Dust concentrations measured in the absence of a single or multiple train pass-by will also be grouped.

Grouped dust concentration data will be subjected to statistical analysis (ISO200988:2007) to determine the magnitude and significance of differences in the datasets. The following statistics will be reported for each grouped dataset:

- Average
- Median
- Standard deviation
- Upper confidence level on average (95%)
- Lower confidence level on average (95%)
- 5th percentile
- 95th percentile
- Maximum concentration

The grouped data will also be analysed using graphical techniques such as:

- Timeseries plots
- Box and whisker plots
- Cumulative frequency distribution plots

4.3 Assessment of contribution by other variables

The pilot program did not identify significant influences of other variables such as wind speed on dust concentrations associated with each train type. However, for comparative purposes, the following analyses will be completed and included as an appendix to the monitoring report unless the outcomes are significantly different to the pilot program:

- Train speed
- Wind speed
- Wind direction

Data grouped by train type will be further subdivided into the speed and direction categories that were used in the report of the pilot program. Grouped and subdivided data will be subjected to the same statistical analysis as detailed in Section 4.2.

5. Limitations

Limitations of the program include:

- In general, the light scattering photometers that are available to measure continuous dust concentrations cannot measure a true TSP size fraction
- The Metford dust monitor is located at unequal distances from the coal and main rail lines
- The Metford wayside monitor does not record train type if the train is travelling less than 30 km/hr. Train type may be inferred by the line that it is travelling on and the train length
- Pass-by duration will be determined by the speed and train length recorded by the wayside monitor. This assumes constant train speed and does not account for acceleration or deceleration of the train. In cases of accelerating and decelerating trains, this may lead to a minor error in train pass-by time

6. Publication

Action 4.2B requires the ARTC to publish the work program on its website within four weeks of the EPA providing written comment to the licensee on the draft work program.

7. References

AS3580.1.1 – 2007 Methods for sampling and analysis of ambient air Part 1.1 Guide to siting air monitoring equipment, Standards Australia, 2007

AS3580.14.1 – 2011 Methods for sampling and analysis of ambient air Part 14 Meteorological monitoring for ambient air quality monitoring applications, Standards Australia, 2011

Environ, 2011, Work Plan PRP4 Coal Dust Emissions from Locomotive Loads, Prepared for ARTC Limited, Prepared by Environ Australia Pty Ltd, Project Number: AS130298, November 2011

Environ, 2012, Pollution Reduction Program (PRP) 4 – Particulate Emissions from Coal Trains, Prepared for Australian Rail Track Corporation, Prepared By Environ Australia Pty Ltd, Project Number: AS130301A, September 2012

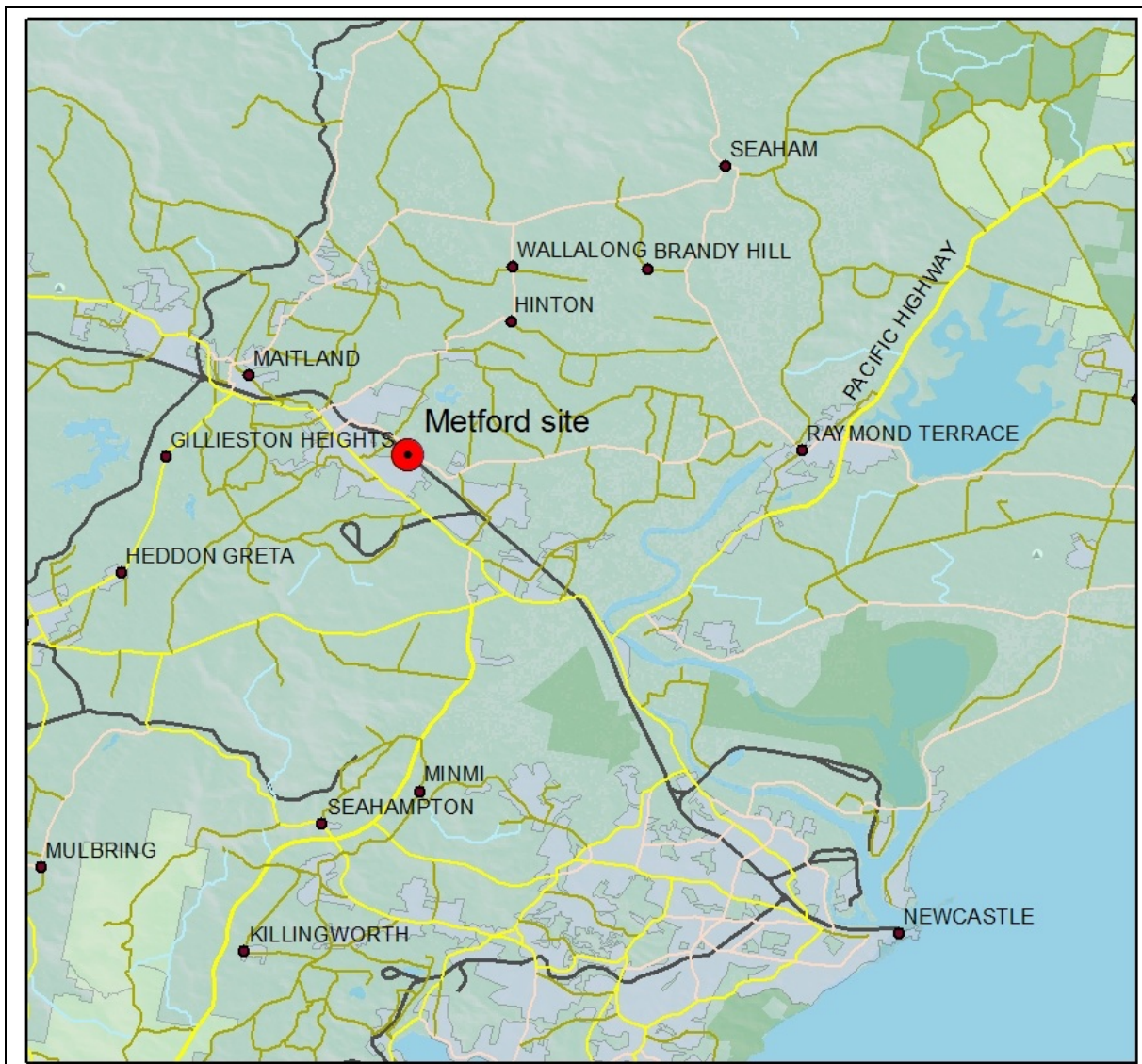


Figure 1 Site plan showing Metford monitoring location

| | | |
|----------------------------------|------------------------------------|------------------------------|
| Location: Metford, NSW | Data source: GIS | |
| Type: Site plan | Prepared by: Kyle Wright | Date: October 2012 |



Figure 2 Metford dust and meteorological monitoring station

| | | |
|----------------------------------|--------------------------------------|--------------------------------|
| Location: Metford, NSW | Data source: Environ, 2012 | |
| Type: Photograph | Prepared by: Environ | Date: September 2012 |

Appendix A Pollution Reduction Program (PRP) 4.2

U2 PRP 4 Particulate Emissions from Coal Trains

U2.1 The licensee is required to comply with PRP 4.2 outlined in U2.4 below by completing each described action in the program within the set timeframe.

The transport of coal to the Port of Newcastle has the potential to contribute to ambient particulate levels in urban areas. Through a variety of forums, communities in the Lower Hunter and along the rail corridor express concern that coal trains are a significant source of fine particulates.

The coal industry intends to substantially increase the quantity of coal transported by rail to the port of Newcastle by 2015-2020. The increase in coal transport may cause an increase in ambient particulate levels.

Currently there is limited reliable data to indicate whether coal trains and rail transport increase ambient particle levels in urban areas in the lower Hunter. Ongoing monitoring is required to assess the extent to which coal trains and rail freight transport contribute or increase ambient particulate levels in the lower Hunter.

PRP 4.2 requires the licensee to continue the monitoring program commenced in PRP 4.1 (as outlined in U2.2-U2.3) to determine whether coal trains and rail transport generally are contributing to ambient particulate levels in the lower Hunter Valley.

U2.2 Action 4.1A

The licensee will implement a monitoring program to determine whether:

- Loaded coal trains operating on the Hunter Valley rail network are a source of particulate matter emission; and
- Loaded coal trains operating on the Hunter Valley rail network are a larger cause or source of particulate matter emissions than unloaded coal trains or other trains on the network (and by inference contributing to ambient particulate levels).

Action 4.1B

The licensee will submit a detailed work plan for a pilot monitoring program to the EPA for approval.

The pilot monitoring program must include the following elements:

1. The use of real time particulate monitoring devices, such as a light scattering laser photometer, to determine in real time levels of TSP (total suspended particulates), PM10 and PM2.5.
2. The installation of particulate monitoring devices at a minimum of two locations along the Hunter Valley rail network, including, unless otherwise agreed by EPA one location representative of an urban area between Warrabrook and Islington. The locations will need to be chosen to capture the movements of loaded coal trains and at a minimum, unloaded coal trains, but preferably freight trains, grain trains and passenger trains as well.
3. The monitoring of the following information in the vicinity of the chosen locations:
 - Train type, direction and speed, loaded or unloaded (not for the background monitor); and
 - Meteorological conditions (including wind speed and wind direction)
4. The particulate monitoring devices will be positioned at an appropriate distance from the track to adequately capture particulate emissions from passing trains.

Timeframe - Within six weeks of inclusion of the PRP on the licence

Action 4.1C

The pilot program, in accordance with the approved monitoring work plan, will be implemented for a period of one month to determine the efficacy of the monitoring program and whether further monitoring is required.

Timeframe - Within four weeks of EPA approving the work plan

U2.3 **Action 4.1D**

The licensee will submit a final report on the pilot monitoring program to the EPA. The report must address the EPA's written formal comments provided on the draft report titled *Pollution Reduction Program (PRP) 4 – Particulate Emissions from Coal Trains* and include a "plain English" Executive Summary at the start of the document. The licensee will also publish the final report in full on its website.

Timeframe – The report will be submitted to the EPA and published on the licensee's website as soon as possible, but by no later than the 28th of September 2012.

U2.4 **Action 4.2A**

The licensee will conduct a monitoring program to determine whether:

- Trains operating on the Hunter Valley rail network are associated with elevated particulate matter concentrations; and
- Loaded coal trains operating on the Hunter Valley rail network have a stronger association with elevated particulate matter concentrations than unloaded coal trains or other trains on the network (and by inference contributing to ambient rail corridor particulate levels).

Timeframe – For a continuous period of at least 30 days between 1 November 2012 and 18 January 2013.

Action 4.2B

A revised work program for the monitoring program must be submitted to the EPA. Monitoring must be consistent with that work program. The revised work program must be based on the previous EPA approved work plan submitted by ARTC in compliance with Action 4.1B above from PRP 4.1, and account for the learnings from and limitations identified with the pilot program. The licensee will also publish the work program on its website.

Timeframe – The licensee must submit the work program to the EPA within four weeks of inclusion of the PRP on the licence. The licensee must publish the work program on its website within four weeks of the EPA providing written comment to the licensee on the draft work program.

Action 4.2C

On completion of the monitoring program required by 4.2A the licensee will submit to the EPA for comment a report on the results of the monitoring.

Timeframe – On or prior to 15 March 2013.

Action 4.2D

The licensee will submit a final report on the monitoring program required by 4.2A to the EPA. The report must address any comments provided by the EPA and include a "plain English" Executive Summary at the start of the document. The licensee will also publish the final report in full on its website.

Timeframe – The report will be submitted to the EPA and published on the licensee's website within four weeks of the EPA providing written comment to the licensee on the draft report.