Duralie Extension Project, Study of Dust Emissions from Rail Transport

Prepared for

Duralie Coal Pty Ltd

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Final

Prepared by

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Glossary

Term	Definition
DEM	Dust extinction moisture level is the moisture level at which the small particles in the matrix of the product are cohesively bound together in such a manner in which it is unlikely that the small particles are able to be liberated (i.e. be a source of dust). This is a function of the coal type and each coal has an individual DEM level which is determined by analysis and testing.
Dust deposition rate	The amount of dust that deposits over an area of 1 square metre per month. This is a common measure of nuisance dust and has units of g/m^2/month.
ktpa	Kilotonnes per annum
$\mu g/m^3$	Micrograms per cubic metre
Mtpa	Million tonnes per annum
NEPM(Air)	National Environment Protection (Ambient Air Quality) Measure 1998
NEPC	National Environment Protection Council
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres
Saltation	Occurs due to airflow across a particle laden surface when particles begin to move and bounce in the layer close to the interface between the particle surface and the flow of air.
TSP	Total suspended particulates

Executive Summary

Katestone Environmental and Introspec Consulting were commissioned by Duralie Coal Pty Ltd to prepare a study of dust emissions from rail transport in accordance with Schedule 3, Condition 21A of the Project Approval for the Duralie Extension Project (08_0203) issued by The Land and Environment Court of New South Wales under Section 75J of the Environmental Planning and Assessment Act 1979.

Condition 21A requires Duralie Coal Pty Ltd to submit a study which:

- *assesses the scale, nature and significance of dust emissions from laden coal trains*
- *identifies reasonable and feasible mitigation measures that could be implemented to reduce dust emissions from laden trains*
- *recommends the implementation of any specific measures*

The following investigations have been conducted to address the requirements of Condition 21A:

- *Site inspection and review of the Duralie Extension Project*
- *Review the history of complaints relating to dust emissions from laden coal trains*
- *Identification of the significance of dust emissions from laden coal trains*
- *Review of literature relating to dust emissions from laden trains*
- *Laboratory testing of Duralie coal to investigate dustiness*
- *Cost benefit analysis of potential dust controls*
- *Recommendations for control of emissions from laden coal trains*

The NSW Environment Protection Authority, the Department of Planning and Infrastructure and local landowners were consulted in relation to the methodology of the assessment. The Department of Planning and Infrastructure endorsed the appointment of Katestone Environmental and Introspec Consulting to undertake the study.

The study has concluded the following:

- *Coal dust can be emitted from the following sources in the coal rail system:*
  - *Coal surface of loaded wagons*
  - *Coal leakage from doors of loaded wagons*
  - *Wind erosion of spilled coal in corridor*
  - *Residual coal in unloaded wagons and leakage of residual coal from doors*
  - *Parasitic load on sills, shear plates and bogies of wagons*

- *The coal surface of the wagons of laden coal trains is likely to be the most significant source of rail generated dust in the case of the Duralie Extension Project*

- *Dispersion modelling of coal dust emissions from coal trains conducted for the Duralie Extension Project as part of the air quality impact assessment and for other similar existing coal rail systems showed that ground-level concentrations of dust were unlikely to exceed recognized health and amenity based air quality standards*

- *A peer review of the air quality impact assessment that was conducted for the Duralie Extension Project concluded that the assessment was prepared in a competent manner and the assessment provides a suitable basis for conditioning and approval*

- *An inspection of the Duralie and Stratford Coal Mine rail loading and unloading facilities identified the following:*
    - *An effective two-stage water spray system is installed at Duralie Coal Mine that provides thorough wetting of the coal surface after loading and prior to rail transport*
    - *The generous capacity of the Bradken wagons used at Duralie Coal Mine allows minimal projection of the coal profile above the wagon top, thereby further reducing the effect on dust emission of air flow over the coal surface*
    - *No excessive drainage of water was observed from wagon doors during and after loading at the Duralie Coal Mine. It therefore appears that the Duralie coal is not free draining and that the surface moisture is likely to be retained in the coal matrix for the maximum likely travel time between Duralie and Stratford Coal Mines*
    - *Very little dust was observed to be emitted during unloading coal at the Stratford Coal Mine rail unloading facility*

- *Laboratory testing of Duralie coal types has been conducted that demonstrates that:*
    - *The dust extinction moisture level (DEM) of Duralie coals is significantly less than the moisture content of coal when extracted from the mine. It is unlikely that the as mined coal surface moisture level would fall below the DEM level during the short travel time from the Duralie Coal Mine to the Stratford Coal Mine*
    - *Under normal rail transport operating conditions of the Duralie Coal Mine, a reduction in dust emission of approximately 99% would be achieved by the application of water in the manner undertaken at the mine*

- *Based on physical inspection of the process and laboratory analysis undertaken, the two-stage water spray system is very effective in reducing dust levels from the surface of loaded wagons. Inspections and a review of previous studies indicate that dust from other parts of the rail operations is likely to be very minimal*

- *Of 527 complaints received by Gloucester Coal in relation to the Duralie and Stratford Coal Mines from 2002 to 2011, two were possibly related to dust issues associated with the railing coal between the mines*

- *A review of the available literature in terms of the cost effectiveness of dust emission controls for coal transport indicates that water application or veneering are the most cost-effective and practical techniques. Modification of wagons to introduce lids was not found to be a practical solution and this practice is relatively unproven in the industry. Monitoring studies conducted adjacent to three rail systems in Queensland found that there were no potential for health or amenity impacts when assessed against current air quality standards*

- *At best, the use of chemical surface veneering or wagon lids would reduce dust emissions by approximately 65 g of coal dust per trip (i.e. from all wagons during the 20 km trip from the Duralie Coal Mine to the Stratford Coal Mine), in comparison with the current practice of watering (i.e. the reduction would be immaterial)*

- *The current dust mitigation practice of two-stage watering at the Duralie rail loadout facility was found to be appropriate for controlling potential dust emissions from laden trains and no further controls are recommended*

1. Introduction

Katestone Environmental and Introspec Consulting were commissioned by Duralie Coal Pty Ltd (DCPL) to prepare a study of dust emissions from rail transport in accordance with Schedule 3, Condition 21A of the Project Approval (08_0203) for the Duralie Extension Project issued by The Land and Environment Court of New South Wales under Section 75J of the *Environmental Planning and Assessment Act 1979*.

Condition 21A is reproduced below:

21A Within 3 months of the date of this approval, the Proponent shall submit a study of the dust emissions from the laden trains associated with the Project to the Director-General. This study must:

(a) be carried out by a suitably qualified and experienced expert whose appointment has been endorsed by the Director-General;

(b) include consultation with the OEH, the Department and the residents in close proximity to the railway line;

(c) assess the scale, nature and significance of the dust emissions of the laden trains;

(d) identify any reasonable and feasible mitigation measures that could be implemented to reduce the dust emissions from these trains;

(e) recommend the implementation of any specific measures; and

(f) be accompanied by the Proponent's response to any recommendations in the study.

If, following review of the study, the Director-General directs the Proponent to implement additional mitigation measures to reduce the dust emissions of the laden trains associated with the Project, then the Proponent shall implement these measures to the satisfaction of the Director-General and, within one month of such direction, update the Air Quality & Greenhouse Gas Management Plan for the Project to include a detailed program for the implementation of these measures and monitoring of compliance.

This report presents the outcomes of the following investigations:

- Site inspection and review of the Duralie Extension Project
- Review of complaints history
- Identification of the significance of dust emissions from laden trains
- Review of literature relating to dust emissions from laden trains
- Laboratory testing of Duralie coal to investigate dustiness
- Cost benefit analysis of potential dust controls
- Recommendations for control of emissions from laden trains

This report will be followed by a letter from Duralie Coal Pty Ltd addressed to the Director-General of the Department of Planning and Infrastructure (DP&I), in accordance with Schedule 3, Condition 21A(f), of the Project Approval that requires DCPL to provide a response to recommendations of this report.

2. Scope of works

Katestone Environmental and Introspec Consulting have implemented the following scope of works to address the requirements of Condition 21A:

A. Prepared a statement of the proposed methodology for submission to the OEH and the Department of Planning and Infrastructure for comment (addressed condition 21A(b)).

B. The coal loading facilities at the Duralie Coal Mine were inspected and a review of the Duralie Extension Project was conducted to evaluate the potential effect of coal storage and loading practices on coal dustiness properties in the wagons. Laboratory simulation requirements were also determined (addressed condition 21A(c)).

C. Complaints history was analysed to identify all complaints relating to dust perceived to be associated with railing coal from the Duralie Coal Mine to the Stratford Coal Mine. The aim of this review was to determine the significance of the issue and the way the community experiences coal dust from laden wagons (addressed condition 21A(c)).

D. The significance of dust emissions from laden coal trains was determined from the following (21A(c)):
    a. A detailed peer review of the air quality assessment of transport of coal from the Duralie Extension Project to the Stratford Coal Mine considering the air quality assessment prepared by Heggies (2009). The peer review considered the following:
        i. Quantification of dust emission rates
        ii. Characterisation for site conditions, meteorology, terrain and land-use
        iii. Dispersion modelling methodology
        iv. Interpretation of modelling results and comparison with air quality standards.
    b. The results of monitoring and modelling conducted for existing and proposed major coal rail systems in Australia was conducted (including QR Coal Loss Management Project Environmental Evaluation and the Surat Basin Rail Project).
    c. Laboratory testing was conducted to determine the following for coal from the Duralie Coal Mine:
        i. Dust extinction moisture level (DEM)
        ii. Whether the coal is free draining
        iii. Dustiness in the wind tunnel under worst-case rail conditions for:
            1. Untreated coal
            2. Coal with surface moistened with water
            3. Coal with surface treated with a chemical dust suppressant

E. Possible dust control measures were identified that could reduce dust emissions from laden trains. Consideration was given to the cost and benefits of various control options including surface treatment with chemical dust suppressant and covering wagons. The feasibility of the dust control measures was be determined based on the costs and benefits of each (21A(d)).

F. Where relevant, recommendations have been made for the implementation of specific measures that are required to minimise the emission of dust from laden trains (21A(e)).

3. Consultation

Condition 21A(b) requires a study of dust emissions from laden trains to be prepared in consultation with the Environment Protection Authority (EPA), the DP&I and the residents in close proximity to the railway line. DCPL, with the assistance of Katestone Environmental and Introspec Consulting, wrote to OEH and the Department of Planning and Infrastructure. The letter outlined the proposed methodology for the investigation and requested feedback. The letter provided to landowners in proximity to the railway line between Duralie and Stratford Coal Mines also included a summary of the preliminary findings of the study.

A copy of the letters that were sent to relevant parties is included in Appendix A.

In response, DCPL received correspondence from the DP&I directing that the study considers the relevant section of the Land and Environment Court's judgement for the Duralie Extension Project, in particular, consideration of the installation of covers on loaded wagons. In response, these issues are specifically addressed in Section 10.

On 19 January 2012, the Department of Planning and Infrastructure wrote to DCPL endorsing the appointment of the Mr Simon Welchman of Katestone Environmental and Mr John Planner of Introspec Consulting to undertake the study (addressed Condition 21A(a)). A copy of the letter from the Department of Planning and Infrastructure is reproduced in Appendix B.

4. Background to the Duralie Extension Project

The Duralie Extension Project involves the continuation of open pit mining operations at the Duralie Coal Mine within ML 1427 and ML 1646, and extends the life of the Duralie Coal Mine by approximately nine years.

The general arrangement of the Project has been designed to maximise the utilisation of existing infrastructure at the Duralie Coal Mine. The main activities associated with the development of the Project would include continued development of open pit mining operations to facilitate a ROM coal production rate of up to approximately 3 Mtpa.

The following run-of-mine (ROM) coal types are produced at the Duralie Coal Mine and are transported to the Stratford Coal Mine:

- Clareval Coking
- Clareval Thermal
- Weismentel Coking
- Weismentel Thermal

4.1 Rail system used by existing Duralie Coal Mine

The rail transport route from the Duralie Coal Mine to Stratford Coal Mine is via the North Coast Railway as shown on Figure 1. A single train is used to provide a shuttle service for coal along the 20 km route between the Duralie and Stratford Coal Mines. The train comprises a locomotive at front and rear, thirty four wagons of 100 tonnes gross weight and coal mass 72-73 tonnes per wagon. The train uses new Bradken wagons, which are stated to be quieter in operation than older wagons that were used previously. The Bradken wagons are shown in Figure 2.

Sized ROM coal from the Duralie Coal Mine is loaded into wagons and transported to the Stratford Coal Mine where the coal is unloaded and processed in the Stratford Coal Mine CHPP.

Rail loading and transport services are provided by a rail contractor that supplies a dedicated train service and co-ordinates all loading, unloading and train movements with the Australian Rail Track Corporation (ARTC). Existing rail infrastructure includes a rail siding off the North Coast Railway, coal loadout bin and associated conveyor systems.

4.2 Proposed Duralie Extension Project rail system

In order to facilitate the increase in ROM coal production associated with the Duralie Extension Project, the total capacity of the ROM coal train has been increased from approximately 2,000 tonnes to approximately 2,500 tonnes. It is expected that the number of train movements would increase from approximately three movements per day to approximately four movements per day when averaged over an annual period.

The existing rail infrastructure at the Duralie Coal Mine would be suitable for the increase in train capacity and movements required for the Project without alteration. In addition, the ARTC has advised DCPL that the existing rail network would remain suitable for the proposed increase in train capacity and movements required for the Project.

As part of the Project, the existing locomotives that service the Duralie Coal Mine would be replaced by quieter locomotives. DCPL has committed to replacing the existing locomotives on the Duralie Coal Mine ROM coal transport train with GL class locomotives (or equivalent), which are quieter than the existing locomotives from Year 2 of the Project (or sooner, subject to contract arrangements). Currently there is one GL class locomotive in place, and one GL class equivalent locomotive in place.

5. Air quality regulatory framework

The *Protection of the Environment Operations Act 1997* (POEO Act) provides a framework for the:

- Development of Protection of the Environment Policies
- Licensing by EPA of activities that are defined under Schedule 1 of the POEO Act
- Development of regulations and guidelines that promulgate impact assessment criteria and emission standards for industry
- Definition of offences and penalties in relation to air pollution under Sections 124-129
- Provision of a mechanism for public participation in the environmental assessment of activities that may be licensed by OEH, in conjunction with the *Environmental Planning and Assessment Act 1979* (EP&A Act)

Under Sections 124-129 of the POEO Act it is an offence to cause air pollution as a result of a failure to conduct an activity, deal with materials or maintain equipment in a proper and efficient manner. The POEO Act also makes it an offence to exceed the limits specified in a regulation made under the POEO Act or to cause offensive odour.

The Duralie Coal Mine includes scheduled activities under the POEO Act.

Particulate matter emissions generated by the project should not exceed the criteria listed in Table 1 at any residence on privately-owned land or on more than 25 percent of any privately-owned land. These limits are based on the EPA's criteria that are specified in the Approved Methods for Modelling (DEC, 2005).

Table 1 Assessment criteria relevant to coal mining in NSW

Pollutant	Criteria	Units	Averaging period
Particulates as TSP	90	µg/m³	Annual
Dust deposition rate	2 increment 4 total	g/m^2/month	Annual
Particulates as PM_{10}	50 30	µg/m³ µg/m³	24-hour Annual

The following operating conditions are also imposed that require DCPL to:

(a) implement best practice air quality management on site, including all reasonable and feasible measures to minimise the off-site odour, fume and dust emissions generated by the project, including any emissions from spontaneous combustion;

(b) minimise any visible air pollution generated by the project;

(c) regularly assess the real-time air quality monitoring and meteorological forecasting data and relocate, modify and/or stop operations on site to ensure compliance with the relevant conditions of this approval, to the satisfaction of the Director-General.

The Land and Environment Court of New South Wales approved the Duralie Extension Project subject to various conditions in addition to Condition 21A that is the subject of this report. For example, Conditions 17 to 21 contain a number of conditions relating to air quality, including criteria, management plan requirements and conditions stipulating that additional mitigation measures are reviewed under certain conditions.

6. Significance of coal dust emissions from coal trains

6.1 Literature review

In 2007, Queensland Rail commissioned Connell Hatch, Katestone Environmental and Introspec Consulting to prepare an Environmental Evaluation of fugitive coal dust emissions from trains travelling on the Moura, Blackwater and Goonyella coal transport systems in response to a Notice issued by the Queensland Environmental Protection Agency.

The primary scope of the QR Environmental Evaluation was to:

a) *Identify all potential sources of coal dust emissions from QR trains in Central Queensland on land described as rail lines connecting coal mines in the Bowen and Callide Basins with ports at Dalrymple Bay, Hay Point and Gladstone*

b) *Quantify the potential risk of environmental harm posed by each dust source*

c) *Identify the factors and circumstances that contribute to dust emissions and/or impacts from each source. Consideration should be given to (but not limited to) issues such as coal type, coal properties and meteorological conditions.*

d) *Based on the findings from the above, identify locations within QR's Central Queensland operations where proximity of railway lines to communities may give rise to higher risk of environmental harm due to fugitive coal dust*

e) *Identify ways to reduce the risk being caused by coal dust emissions and assess each for practicability, effectiveness and cost, in relation to the mitigation of environmental impacts of fugitive coal dust emissions*

From a literature review, the QR Environmental Evaluation concluded that a realistic estimate of the uncontrolled emission rate of coal dust from coal wagons was 9.6 g/km/wagon.

Coal dust can be emitted from the following sources in the coal rail system:

- Coal surface of loaded wagons
- Coal leakage from doors of loaded wagons
- Wind erosion of spilled coal in corridor
- Residual coal in unloaded wagons and leakage of residual coal from doors
- Parasitic load on sills, shear plates and bogies of wagons

Each of these is discussed in the following sub-sections.

6.1.1 Coal surface of loaded wagons

The coal surface of loaded coal wagons constitutes the largest exposed coal surface to air currents. With 34 wagons per train leaving Duralie Coal Mine, there is likely to be about 1,000 m^2 of coal surface per train that is exposed to the air. The magnitude of coal dust emissions from this source will depend on a number of factors, but most importantly on the level of exposure of the open surface to air moving at high speeds and the inherent dustiness of the material.

Previous studies undertaken for Queensland Rail indicate that the final few wagons emit more dust than others due to the slipstream or the forward wagons and the first few wagons behind the locomotive tend to emit less (Connell Hatch, 2008).

6.1.2 Coal leakage from doors of loaded wagons

Coal can leak from the drop doors of the coal wagons during transit, depending on the width of the door gaps. The amount of coal dust falling from doors will depend on the nature of the coal being transported (e.g. moisture level, particle sizes) and the vibrational forces acting on the wagons. Dust particles falling from the doors may become entrained in the aerodynamic wake induced by the movement of the train.

There is no quantitative data for the relative contribution of door leakage to coal dust emissions to be quantified. It is likely that its contribution to environmental impacts removed from the transit line is relatively small compared to lift-off from wagons because:

- The relatively small surface area of release compared to the open surface of the coal wagons
- The release height is relatively close to the ground and
- Air movement will be predominantly in the direction of the tracks with very little opportunity for cross winds to entrain the particles due to the shielding effect of the wagon structure

Some coals contain up to 18% of moisture. Water can drain out of the doors and carry with it some particles of coal. In this instance the coal is likely to fall directly into the ballast. Once in the ballast, the coal dust is unlikely to be re-entrained into the ambient air because of the shielding effect of the large ballast particles. Little, if any, is likely to be carried far from the transit line.

6.1.3 Spilled coal on or near the railway line

Coal can be spilt from the tops of wagons. This can occur due to a combination of poor, uneven loading or overloading at the coal loader and the rocking and tipping of wagons in transit and on bends.

6.1.4 Residual coal in or on unloaded wagons

Empty coal wagons returning to the mine may be a potential source of coal dust emissions if there is residual coal in the wagons. This residual coal can dry and can become entrained in the air currents that develop in the empty wagons as the trains travel back to the mine.

Some of this coal will fall into the wagon above the drop doors and if emitted will fall through the gap in the doors. As discussed above, the coal that falls through the drop doors is likely to remain in the ballast.

The QR Environmental Evaluation estimated that unloaded trains contribute about 4% to total dust emissions associated with coal trains.

6.1.5 Parasitic load

Coal dust can be emitted by the parasitic load that is carried by the wagons. The parasitic load is coal that is spilt on the sills, shear plates and bogies of the wagons during loading. Parasitic load can also occur due to coal ploughing that can occur during unloading the

wagons. Coal ploughing occurs when the rate of wagon unloading is too fast for the discharge pits at the unloading facility. This results in the build-up of coal above the discharge grates and the wagons travelling through the built up coal. Coal ploughing results in coal being carried on the wagon bogies.

6.2 Monitoring and modelling studies conducted elsewhere

Various air quality studies have been commissioned in Queensland by QR Limited to investigate the potential for adverse air quality impacts due to trains carrying coal. At least six ambient air quality monitoring studies were conducted between 1993 and 2008 to specifically investigate and quantify concentrations of TSP, PM_{10} and dust deposition rates adjacent to rail lines carrying coal. The rail corridors studied included the Moura, Blackwater and Goonyella Systems. These three rail systems carry a substantially greater volume of coal over substantially greater distances than that carried between the Duralie and Stratford Coal Mines.

On the Goonyella system, there is an average of 21 trains per day travelling to the terminals and then returning to the mines. Each loaded train carries an average of 9,565 tonnes of coal. This results in a weekly average of 140 trains en route to the terminals.

On the Blackwater system, there is an average of 18.1 trains per day travelling to unloading facilities and then returning to mines. Each loaded train carries an average of 6,749 tonnes of coal. There is an average of 124 trains per week travelling to and from the unloading points.

On the Moura system, there is an average of 7 trains per day travelling to the unloading facilities and then returning to the mines. Each loaded train carries an average of 4,183 tonnes of coal. There is an average of 45.8 trains per week travelling to and from the unloading points.

The studies commissioned by QR Limited did not find the potential for health impacts outside of the rail corridor as assessed against current air quality standards due to coal dust emissions from trains. These studies did not find the potential for amenity impacts outside of the rail corridor due to coal dust emissions from trains when assessed against current air criteria for nuisance.

Although atypical, observations and photographs taken during the QR Environmental Evaluation showed that visible dust was emitted by some coal trains operating in Queensland and that dust was observed to travel beyond the rail corridor. It was also found that many Queensland mines did not practice load profiling and did not apply water or chemical surface veneer treatments to the surface of coal wagons. Such occurrences suggested that, for some Queensland trains coal dust emissions were not effectively controlled, leaving open the possibility that a claim could be made that QR Limited had breached the General Environmental Duty under the Queensland *Environmental Protection Act 1994* because QR Limited had not taken "…all reasonable and practical measures…" to minimise harm.

From a review of resident complaints and other observations it was noted that there existed a community perception that "nuisance" dust levels were generated from coal train operations in Queensland.

Studies conducted by QR Limited at Callemondah in 2007 and for the QR Environmental Evaluation at locations along the Moura, Goonyella and Blackwater Systems, indicated that

the effect of coal dust emissions on short-term ambient dust concentrations was measurable at 15 metres from the rail centreline.

The QR Environmental Evaluation found that there was a low risk of adverse impacts on flora, fauna, crops and livestock due to emissions of TSP from coal wagons in Queensland. Even within the rail corridor, dust deposition rates were measured to be well below thresholds that have been shown in literature studies to have little or no effect on crops and livestock.

Dispersion modelling of coal dust emissions from coal trains operating in a number of locations around Queensland, including at Mount Larcom and Grasstree (Connell Hatch, 2008) and in the Surat Basin (Surat Basin Rail, 2009), have shown that ground-level concentrations of PM_{10} were unlikely to exceed the standards at 10 metres from the tracks or at residential locations.

6.3 Peer review of Duralie Extension Project rail air quality study

An air quality impact assessment was conducted as part of the application for approval of the Duralie Extension Project. The technical report of the air quality impact assessment was Appendix D of the Duralie Extension Project Environmental Assessment and was conducted by Heggies Australia:

> Heggies (2009), Appendix D, Duralie Extension Project, Air Quality Assessment, Report 8034-R3, Prepared for Gloucester Coal, Heggies Australia, November 2009

A detailed peer review of the air quality assessment of the Duralie Extension Project was conducted with particular attention give to the aspects relating to railing coal between the Duralie and Stratford Coal Mines. The peer review considered the following:

i. Quantification of dust emission rates
ii. Characterisation for site conditions, meteorology, terrain and land-use
iii. Dispersion modelling methodology
iv. Interpretation of modelling results and comparison with air quality standards.

The following conclusions were reached as a result of the peer review:

- Quantification of dust emissions from wagons carrying coal was consistent with contemporary practice and would provide a conservative estimate of potential emissions of coal dust (e.g. the emission rate was consistent with the QR Environmental Evaluation [Section 6.1]). The assessment conservatively did not take account of the reduction in emissions associated with the application of water to the surface of wagons.
- Characterisation of site conditions, meteorology, terrain and land-use are appropriate. Methodologies are consistent with the Approved Methods for Modelling. Whilst, some differences between observed and modelled meteorological conditions are evident, these are likely to be, in part, due to the fact that the periods of modelled and monitored data used to evaluate the model are different.
- The methodology that was used to characterise dispersion meteorology is consistent with the Approved Methods for Modelling. The CAL3QHCR transport dispersion model was used for the assessment. This model is an acceptable model for the situation.
- Dispersion modelling results are consistent with findings of similar studies conducted in Queensland, allowing for differences in rail traffic. The overall modelled outcome is likely to be very conservative, given that emission reductions associated with

watering have not been accounted for in estimating emissions. Actual concentrations of TSP, PM_{10} and dust deposition rates associated with the railing of coal between Duralie Coal Mine and Stratford Coal Mine are likely to be significantly lower than predicted.

- Overall it is concluded that the air quality assessment of potential impacts from railing coal associated with the Duralie Extension Project has been prepared in a competent manner and the results provide a suitable basis for conditioning and approval.

7. Site inspection

Mr John Planner of Introspec Consulting inspected the Duralie and Stratford Coal Mines on 3 January 2012. The following aspects of mine operation were observed:

- A complete train loading operation at the Duralie Coal Mine loadout, and departure from Duralie. An empty train arrived at the site and loading from the Duralie Coal Mine rail loadout commenced at approximately 10.00am. The train was loaded while moving at 0.6 km per hour.

- As each wagon was loaded, water was applied to the coal surface as shown in Figure 3. The water flow rate was approximately 1.5 litres per second. When loading a wagon the spray was applied for approximately 60 seconds, delivering approximately 90 litres of water to the surface of coal in the wagon. Based on a typical coal surface area per wagon of 30 square metres, the application rate was therefore approximately 3 litres per square metre of coal surface.

- When the fully loaded train departed from Duralie Coal Mine, it passed under the rail loadout, where the coal surface was re-wetted by a second spray system with a water flow rate of approximately 1.5 litres per second. With a faster departure train travel speed, water was applied to each wagon for approximately 8 seconds, which delivered a further 12 litres of water per wagon, or 0.4 litres per square metre.

- The above water application rates may vary, dependant on variation of train travel speed. Ponding of water on coal surface was evident indicating a very high wetting level following coal loading is shown in Figure 4.

- The fully loaded train, which earlier departed from Duralie Coal Mine, was observed to arrive at the Stratford Coal Mine. Unloading to the rail loadout commenced at approximately 12.00 noon. The operation is shown in Figure 5. Very little dust emission was observed.

8. Laboratory test program

8.1 Methodology

8.1.1 Test program objectives

Laboratory testing was conducted to determine the following coal characteristics for typical coal types from the Duralie Coal Mine:

a. Dust extinction moisture level (DEM)
b. Whether the coal is free draining
c. Dust emission from the coal surface under worst-case rail transport conditions for:
    - Untreated coal
    - Coal with surface moistened with water
    - Coal with surface treated with a chemical dust suppressant

8.1.2 Dust extinction moisture level test procedure

The dust extinction moisture level for each of the coal types was determined using the procedure provided in Australian Standard (AS) 4156.6-2000 Coal Preparation Part 6: Determination of dust/moisture relationship for coal.

The dust extinction moisture level (DEM) is defined as the moisture level at which dustiness is reduced to a level of 10. At this moisture level for the tested coal type, only minor dust emission could be expected during bulk handling operations such as conveying, stacking and reclaiming.

The tests were conducted in the laboratories of TUNRA Bulk Solids Handling Research Associates.

8.1.3 Simulated rail transport dust emission tests

A series of simulated rail transport dust emission tests were conducted on samples of coal representing the various types of coal from the Duralie Coal Mine.

The tests were also conducted in the laboratories of TUNRA Bulk Solids Handling Research Associates.

The test program was conducted to determine the observed dust lift-off in the wind tunnel under simulated rail conditions for:

- Untreated coal surface
- Coal surface treated with water
- Coal surface treated with two chemical dust suppressants

Coal samples were prepared with a moisture content of 3% - 5%, which is much lower than the Duralie ROM coal moisture levels (8% - 9%), with the following surface treatments:

- Untreated coal surface
- Coal surface treated with water at 3 litres per square metre
- Coal surface treated with chemical dust suppressant supplied by DuPont Australia at 1 litre per square metre
- Coal surface treated with chemical dust suppressant supplied by Vital Chemical at 1 litre per square metre

Chemical dust suppressant supplied by DuPont Australia comprised 4% chemical in water. Chemical dust suppressant supplied by Vital Chemical comprised 3% chemical in water.

The sample trays were placed in an oven at 30 – 35 degrees Celsius for two hours. The sample trays were then placed in a wind tunnel exposed to wind speed of 20 metres per second for four hours.

The wind speed of 20 metres per second was selected as typical maximum wind speed likely to occur over the surface of coal in wagons during rail transport. This wind speed was determined by Introspec Consulting during a series of wind tunnel tests and computer modeling conducted for Queensland Rail.

8.1.4 Simulated rail transport coal moisture drainage test

A simulated rail transport coal moisture drainage test was conducted to determine the water drainage rate for Duralie Coal (Clareval ROM Coking Coal). The objective was to confirm the site observation that there will be minimal water flow from wagon doors, which may discharge coal fines to rail track ballast from trains during travel from Duralie to Stratford.

The tests were conducted in the laboratories of Dept. Civil, Surveying & Environmental Engineering University of Newcastle NSW.

The following test procedure was followed:

1. Dry the coal sample
2. Increase the water content to 7%
3. Place the coal sample in a 300mm HDPE pipe having a length of 1 metre
4. Add 0.35 litres water to the top surface of the coal sample
5. Measure water loss at intervals over a 24hr period

8.2 Laboratory test results

8.2.1 Dust extinction moisture level tests

The results of the dust extinction moisture level tests are shown in Figure 6 to Figure 9. Coal moisture levels are plotted against the arithmetic horizontal axis and dustiness levels are shown on the logarithmic vertical axis.

Dust extinction moisture levels for coal types from the Duralie Coal Mine were determined to be:

- Clareval Coking – 4.1%
- Clareval Thermal – 4.6%
- Weismentel Coking – 4.1%

- Weismentel Thermal – 4.3%

8.2.2 Results of simulated rail transport dust emission tests

The results of the simulated rail transport dust emission tests are shown in Table 2 to Table 5. Temperature conditions in the laboratory during the test program ranged from 22 to 26 degrees Celsius. Humidity conditions in the laboratory during the test program ranged from 55% to 75%.

Table 2 Dust lift-off in grams from the surface of Clareval Coking ROM Coal under simulated rail transport conditions following alternative coal surface treatment options

Sample pre-treatment moisture content	Veneer treatment	Lift-off Speed (m/s)	Duration (hours)	Drying Time (min)	Drying Temp (C)	Dust Lift-Off (g)
5.0%	nil	20	4	120	30-35	77.53
5.0%	water	20	4	120	30-35	1.50
5.0%	Dusgon 6005 @ 4%	20	4	120	30-35	0.00
5.0%	CDS 300 @ 3%	20	4	120	30-35	0.00

Dust lift-off from the untreated Duralie coal type Clareval Coking ROM Coal was observed to be 77.5 grams (Table 2). When water was applied to the surface at the Duralie coal loader application rate, dust lift-off was reduced by 98% to almost nil, and is therefore considered to be a very effective treatment option.

When both chemical surface veneer options were applied to the surface, dust lift-off was reduced to nil, and both are therefore considered to be very effective treatment options.

Table 3 Dust lift-off in grams from the surface of Clareval Thermal ROM Coal under simulated rail transport conditions following alternative coal surface treatment options

Sample pre-treatment moisture content	Veneer treatment	Lift-off Speed (m/s)	Duration (hours)	Drying Time (min)	Drying Temp (C)	Dust Lift-Off (g)
3.0%	nil	20	4	120	30-35	178
3.0%	water	20	4	120	30-35	0.0
3.0%	Dusgon 6005 @ 4%	20	4	120	30-35	7.0
3.0%	CDS 300 @ 3%	20	4	120	30-35	7.0

Dust lift-off from the untreated Duralie coal type Clareval Thermal ROM Coal was observed to be 178 grams (Table 3). When water was applied to the surface at the Duralie coal loader application rate, dust lift-off was reduced to nil, and is therefore considered to be a very effective treatment option.

When both chemical surface veneer options were applied to the surface, dust lift-off was reduced by 96% to almost nil, and are therefore considered to be very effective treatment options. It is noted that for the Duralie coal type Clareval Thermal ROM Coal, watering was a more effective treatment option than chemical surface veneer. This is an unusual result and may be due uneven application to the coal sample of the chemical surface veneer solution during the test procedure. Notwithstanding, the application of water and the chemical surface veneers were all shown to be very effective treatment options.

Table 4 Dust lift-off in grams from the surface of Weismentel Coking ROM Coal under simulated rail transport conditions following alternative coal surface treatment options

Sample pre-treatment moisture content	Veneer treatment	Lift-off Speed (m/s)	Duration (hours)	Drying Time (min)	Drying Temp (C)	Dust Lift-Off (g)
3.0%	nil	20	4	120	30-35	141
3.0%	water	20	4	120	30-35	7.0
3.0%	Dusgon 6005 @ 4%	20	4	120	30-35	0.0
3.0%	CDS 300 @ 3%	20	4	120	30-35	0.0

Dust lift-off from the untreated Duralie coal type Weismentel Coking ROM Coal was observed to be 141 grams (Table 4). When water was applied to the surface at the Duralie coal loader application rate, dust lift-off was reduced by 95% to almost nil, and is therefore considered to be a very effective treatment option.

When both chemical surface veneer options were applied to the surface, dust lift-off was reduced to nil, and are therefore considered to be very effective treatment options.

Table 5 Dust lift-off in grams from the surface of Weismental Thermal ROM Coal under simulated rail transport conditions following alternative coal surface treatment options

Sample pre-treatment moisture content	Veneer treatment	Lift-off Speed (m/s)	Duration (hours)	Drying Time (min)	Drying Temp (C)	Dust Lift-Off (g)
3.0%	nil	20	4	120	30-35	184
3.0%	water	20	4	120	30-35	0.0
3.0%	Dusgon 6005 @ 4%	20	4	120	30-35	0.0
3.0%	CDS 300 @ 3%	20	4	120	30-35	0.0

Dust lift-off from the untreated Duralie coal type Weismentel Thermal ROM Coal was observed to be 184 grams (Table 5). When water was applied to the surface at the Duralie coal loader application rate, dust lift-off was reduced to nil, and is therefore considered to be a very effective treatment option.

When both chemical surface veneer options were applied to the surface, dust lift-off was reduced to nil, and are therefore considered to be very effective treatment options.

8.3 Interpretation of results

8.3.1 Duralie rail loading operation

An effective water spray system is installed at Duralie Coal Mine loadout that provides thorough wetting of the coal surface after loading to wagons and prior to rail transport. Approximately 90 litres water is applied to the coal surface in each wagon. Based on a typical coal surface area per wagon of 30 square metres, the application rate is approximately 3 litres per square metre of coal surface.

When a fully loaded train departs from Duralie Coal Mine, the coal surface is also re-wetted by a second spray system with a water application rate of approximately 0.4 litres per square metre.

The current coal surface wetting procedure should be an effective measure to minimise dust emission during rail transport of Duralie coal types to Stratford, as the coal surface is likely to retain sufficient moisture content during the typical travel time.

8.3.2 Dust emission during rail transport from Duralie to Stratford

A series of simulated rail transport dust emission laboratory tests were conducted on samples of the four coal types from the Duralie Coal Mine.

Dust lift-off from the untreated Duralie coal types was observed to be between 77 grams and 185 grams. When water was applied to the surface, dust lift-off was reduced by 95% - 100%. It should be noted that the 95% reduction was determined under simulation of conservative rail operational conditions, including delayed departure from the Duralie Coal Mine site, lower than normal coal moisture content, and summer conditions (i.e. drying temperatures of 30-35^{o}C).

It is therefore likely that under normal rail transport operating conditions a reduction in dust emission, following application of water to the coal surface, is more likely to be in the order of 99%.

The result confirms that for the limited rail travel time from Duralie to Stratford, it is unlikely that the coal surface moisture level will fall below the DEM level of 4.1% to 4.6%, the dust extinction moisture levels determined for the four Duralie coal types.

The current coal surface wetting procedure is considered to be an effective measure to minimise dust emission during rail transport of Duralie coal types to Stratford.

When both tested chemical surface veneer options were applied to the coal surface, dust lift-off was reduced by 96% - 100%. Chemical surface veneer is considered to be a very effective treatment option, but at a higher cost than treatment by water alone. The additional cost of chemical surface veneer above that for the application of water alone could be in the order of $0.05 per tonne of coal.

Chemical surface veneer options are considered to be a very effective treatment option for rail travel distance involving travel times beyond the time taken for the coal surface to dry to a level less than the coal type dust extinction moisture level. As described above, this is not expected to occur for coal transported between the Duralie and Stratford Coal Mines.

Coal load profile can also be a factor in dust emission from coal in rail wagons. The load profile achieved by the rail loader at Duralie Coal Mine is similar to the ideal profile recommended for Queensland Rail (Connell Hatch, 2008) operations to minimise dust emission.

The generous capacity of the Bradken wagons allows minimal projection of the coal profile above the wagon top, thereby further reducing the effect of air flow over the coal surface. The generous capacity of the Bradken wagons also reduces the extent of parasitic coal spilt

Based on the data presented above, the application of water to the surface of the Duralie Coal Mine wagons would reduce dust emissions compared with an uncontrolled situation by 6.5 kg/train journey (with total uncontrolled emissions calculated using the QR Environmental Evaluation emission factor of 9.6 g/km/wagon, 34 wagons per train and 20 km per trip). The application of chemical surface veneer treatment would, at best, further reduce dust emissions by 0.065 kg/train journey.

Chemical surface veneer treatment could be considered as an alternative in the unlikely event that excessive dust emission is reported with the current use of water alone.

8.3.3 Consideration of possible leakage of coal fines from coal wagon doors during rail transport from Duralie to Stratford

With the application of a large volume of water to the surface of coal during rail loading at Duralie Coal Mine, consideration has been given to possible leakage of water through wagon doors which could discharge coal fines to rail track ballast from trains during travel from Duralie to Stratford.

No excessive drainage of water was observed from wagon doors during and after the Duralie loading operation during the site inspection. On the basis of this observation it may be assumed that the observed coal type is not “free draining”, and that the surface moisture will be retained for the maximum likely rail travel time. It is unlikely that discharge of coal fines to rail track ballast will occur from trains during travel from Duralie to Stratford.

The possibility of water drainage from rail wagon doors was further investigated by laboratory simulation of a typical Duralie coal type during rail transport. No moisture loss was observed from the lower section of the HDPE pipe at the end of the 24 hour period for Clareval Coking ROM Coal.

The test result confirms the site observation that there was minimal water flow from wagon doors. Hence, coal fines are unlikely to be carried by wagon drainage into the rail track ballast as a result of trains transporting Duralie coal from Duralie to Stratford.

Experience from examination of dust emission sources from rail transport of coal in Queensland indicated that dust emission from track ballast was extremely minimal. It is therefore concluded that no measurable dust emission will be expected due to leakage from rail wagon doors during travel from Duralie to Stratford.

8.3.4 Impact of dustiness/moisture relationship for Duralie and Stratford coal types on dust emission during handling operations

Dust extinction moisture levels for the four coal types produced by the Duralie Coal Mine were found to range from 4.1% to 4.6%. This is low by comparison with the typical ROM moisture content of 8% - 9%, as advised by DCPL.

The results indicate that minimal dust emission can be expected from the tested coal type during bulk handling operations, including conveying, stacking and reclaiming. However the surface of stockpiles can lose moisture rapidly under the influence of sun and wind, requiring replacement by regular application of water spray.

8.3.5 Dust emission during Stratford rail un-loading operation

Very little dust emission was observed during unloading of Clareval Coking ROM coal to the rail unloading bin, as shown in Figure 5.

The observation is supported by the typical moisture content of Duralie coal types of 8% - 9% noted to be well above the dust extinction moisture levels determined to range from 4.1% to 4.6%.

The site inspection of rail unloading and laboratory test results all indicate that minimal dust emission can be expected from the tested coal type during bulk handling operations, including conveying, stacking and reclaiming.

9. Complaint history

DCPL provided a complaint log of environmental complaints received about the Stratford Coal Mine and the Duralie Coal Mine over the period 2002 to 2011. A total of 527 complaints were received during this period.

The complaints have been divided into five categories based on the nature of the complaint. The number of complaints in each category is shown in Figure 10.

A total of three complaints were received from 2002 to 2011 at Duralie Coal Mine that related to air quality emissions from trains. One of those complaints was related to odour and the other two were dust complaints. The dust complaints were ambiguous with regard to whether the origin was the mine site or trains.

10. Potential train dust emission mitigation strategies

A number of measures for mitigating coal dust emissions during rail transit have been identified in the literature (Connell Hatch, 2008) that could theoretically be applied to rail transport of coal, including:

- Coal surface veneering using chemical dust suppressants or water at the wagon coal surface
- Improved coal loading techniques at the mine to reduce parasitic load on horizontal wagon surfaces and reduce over-filling and hence spillage during transport
- Introduce a mechanism to remove parasitic coal from wagons before leaving the mine site
- Load profiling to create a consistent surface of coal in each wagon.
- Improved unloading techniques to minimise coal ploughing and parasitic load on wagons
- Limit the capacity of the line (by reducing speed)
- Wagon design adjustment
    - Apply lids/covers to wagons
    - Apply deflector/container boards to edges of wagons
    - Adjust the wagon doors to contain leakage
- Wash wagons after unloading to reduce the amount of residual coal in unloaded wagons

The cost-effectiveness and practicality of these techniques was determined in a study for Queensland Rail (Connell Hatch, 2008). In summary, this study found that chemical surface veneering is the most practical and cost-effective means of controlling dust emissions. The use of water as a dust suppressant was evaluated based on the assumption that water application facilities would be at 2 hourly intervals along the rail networks. Hence, it scored relatively poorly from the perspective of practicability. However, in the context of the Duralie Coal Mine, the cost-effectiveness and practicality of the use of water to suppress dust is considered better than that for veneering, considering the following:

- Effectiveness of water application in reducing dust emissions from Duralie coal
- High as-mined moisture level compared to the DEM
- The relatively short rail journey
- The relatively low cost of water for the mine

The information presented above, indicates the cost of chemical surface veneer to be $0.05 per tonne of coal transported. At best, the marginal benefit in terms of dust control of chemical surface veneer relative to water would be 65 g of coal dust per trip. The marginal cost of the additional TSP and PM_{10} abated is estimated at $1.9 million per tonne of TSP and $3.8 million per tonne of PM_{10} on the basis that 50% of dust emitted is PM_{10}.

Redesign of wagons to include deflector or container boards, or adjustment of wagon doors would involve significant costs, with the effectiveness of further containment likely to be marginal. The near-ideal coal profile produced by the Duralie Coal Mine loadout, from a dust emissions perspective, makes profiling or deflector boards near the edge of the wagons unnecessary. Adjustment of the drop doors is unlikely to affect entrained coal dust, as coal leaked from the doors drops straight into the ballast.

The emissions due to parasitic load are judged to be minimal based on observations made at the Duralie Coal Mine and considering the design of the loadout.

Whilst wagon lids are likely to reduce coal dust emissions from wagons, they cannot be considered in isolation of other issues, particular the untried nature of retrofitted lids and the likely significant capital cost. There are many potential operational impacts and costs associated with implementing wagon lids that cannot be estimated without a thorough detailed investigation. Such an investigation would need to consider the operational decisions, reliability of lids and the suitability in the context of existing loading and unloading facilities at very intricate level of detail.

Considering the performance of the existing measures, a more detailed cost benefit assessment is not considered to be warranted for this study.

11. Conclusions

Katestone Environmental and Introspec Consulting were commissioned by Duralie Coal Pty Ltd to prepare a study of dust emissions from rail transport in accordance with Schedule 3, Condition 21A of the Project Approval for the Duralie Extension Project (08_0203) issued by The Land and Environment Court of New South Wales under Section 75J of the EP&A Act.

Condition 21A requires Duralie Coal Pty Ltd to submit a study which:

- assesses the scale, nature and significance of dust emissions from laden trains
- identifies reasonable and feasible mitigation measures that could be implemented to reduce dust emissions from laden trains
- recommends the implementation of any specific measures

The study has concluded the following:

- Coal dust can be emitted from the following sources in the coal rail system:
    - Coal surface of loaded wagons
    - Coal leakage from doors of loaded wagons
    - Wind erosion of spilled coal in corridor
    - Residual coal in unloaded wagons and leakage of residual coal from doors
    - Parasitic load on sills, shear plates and bogies of wagons

- The coal surface of the wagons of laden coal trains is likely to be the most significant source of rail generated dust in the case of the Duralie Extension Project

- Dispersion modelling of coal dust emissions from coal trains conducted for the Duralie Extension Project as part of the air quality impact assessment and for other similar existing coal rail systems showed that ground-level concentrations of dust were unlikely to exceed recognized health and amenity based air quality standards

- A peer review of the air quality impact assessment that was conducted for the Duralie Extension Project concluded that the assessment was prepared in a competent manner and the assessment provides a suitable basis for conditioning and approval

- An inspection of the Duralie and Stratford Coal Mine rail loading and unloading facilities identified the following:
    - An effective two-stage water spray system is installed at Duralie Coal Mine that provides thorough wetting of the coal surface after loading and prior to rail transport
    - The generous capacity of the Bradken wagons used at Duralie Coal Mine allows minimal projection of the coal profile above the wagon top, thereby further reducing the effect on dust emission of air flow over the coal surface
    - No excessive drainage of water was observed from wagon doors during and after loading at the Duralie Coal Mine. It therefore appears that the Duralie coal is not free draining and that the surface moisture is likely to be retained in the coal matrix for the maximum likely travel time between Duralie and Stratford Coal Mines
    - Very little dust was observed to be emitted during unloading coal at the Stratford Coal Mine rail unloading facility

- Laboratory testing of Duralie coal types has been conducted that demonstrates that:
    - The dust extinction moisture level (DEM) of Duralie coals is significantly less than the moisture content of coal when extracted from the mine. It is unlikely that the as mined coal surface moisture level would fall below the DEM level during the short travel time from the Duralie Coal Mine to the Stratford Coal Mine
    - Under normal rail transport operating conditions of the Duralie Coal Mine, a reduction in dust emission of approximately 99% would be achieved by the application of water in the manner undertaken at the mine

- Based on physical inspection of the process and laboratory analysis undertaken, the two-stage water spray system is very effective in reducing dust levels from the surface of loaded wagons. Inspections and a review of previous studies indicate that dust from other parts of the rail operations is likely to be very minimal

- Of 527 complaints received by Gloucester Coal in relation to the Duralie and Stratford Coal Mines from 2002 to 2011, two were possibly related to dust issues associated with the railing coal between the mines.

- A review of the available literature in terms of the cost effectiveness of dust emission controls for coal transport indicates that water application or veneering are the most cost-effective and practical techniques. Modification of wagons to introduce lids was not found to be a practical solution and this practice is relatively unproven in the industry. Monitoring studies conducted adjacent to three rail systems in Queensland found that there were no potential for health or amenity impacts when assessed against current air quality standards.

- At best, the use of chemical surface veneering or wagon lids would reduce dust emissions by approximately 65 g of coal dust per trip (i.e. from all wagons during the 20 km trip from the Duralie Coal Mine to the Stratford Coal Mine), in comparison with the current practice of watering (i.e. the reduction would be immaterial)

- The current dust mitigation practice of two-stage watering at the Duralie rail loadout facility was found to be appropriate for controlling potential dust emissions from laden trains and no further controls are recommended

12. Recommendations

Laboratory testing has determined that the dust extinction moisture levels (i.e. the level above which only minor dust lift-off is observed) for the four coal types produced by the Duralie Coal Mine range from 4.1% to 4.6%. As such, when the moisture content of coal is above these levels, dust emissions are minor.

The moisture content of ROM coal types produced from the Duralie Coal Mine is approximately 8% - 9% when loaded to the wagons. In addition, ROM coal loaded to trains for transportation to the Stratford Coal Mine is currently watered, using water sprays, at the Duralie Coal Mine rail loadout. The coal surface is saturated with water to counteract the surface drying effect of sun and wind during the rail transport operation. The effectiveness of the procedure was verified by site observation and by simulated laboratory wind tunnel test procedures.

The current dust mitigation practice of watering of ROM coal at the Duralie Coal Mine rail loadout facility is appropriate for controlling potential dust emissions from laden trains transporting ROM coal from the Duralie Coal Mine to the Stratford Coal Mine and no further controls are recommended.

13. References

Connell Hatch (2008), Environmental Evaluation of Fugitive Coal Dust Emissions from Coal Trains, Final Report, Queensland Rail Limited

DEC (2005), Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, prepared by the NSW Environment Protection Authority (EPA), part of the Department of Environment and Conservation NSW (DEC), August 2005.

Heggies (2009), Appendix D, Duralie Extension Project, Air Quality Assessment, Report 8034-R3, Prepared for Gloucester Coal, Heggies Australia, November 2009.

Surat Basin Rail (2009), Surat Basin Rail Project Environmental Impact Statement, Surat Basin Rail Pty Ltd Joint Venture, February 2009.

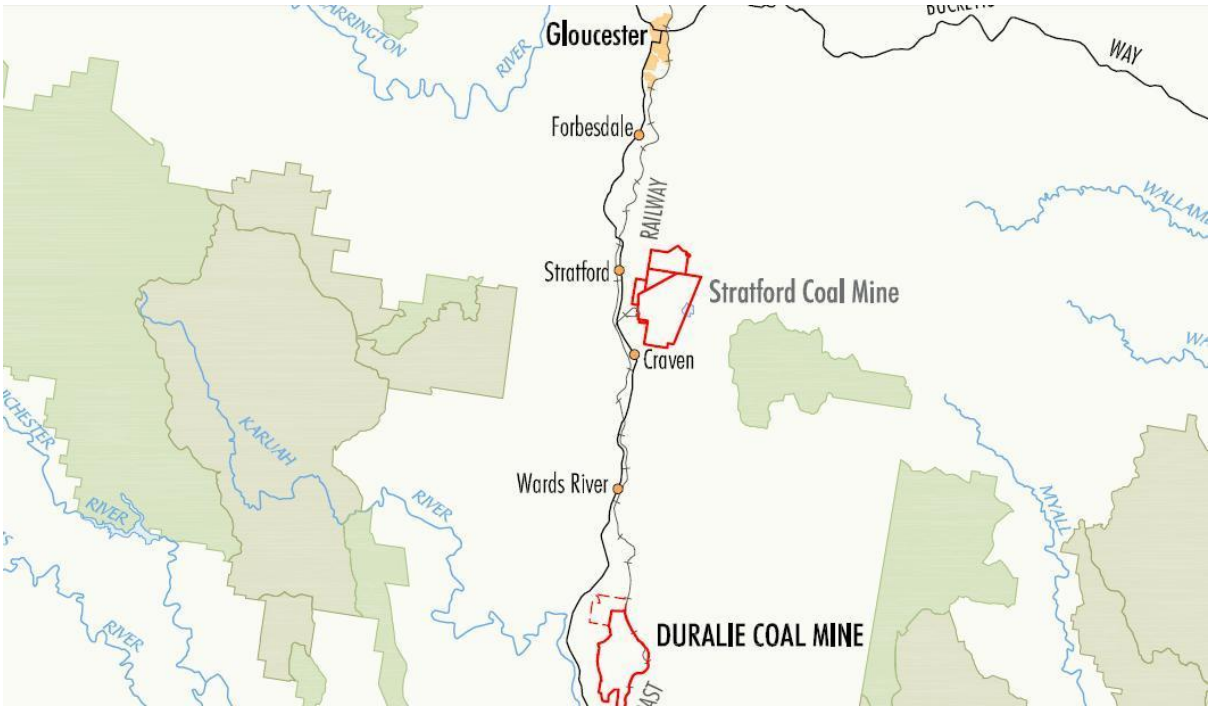

Figure 1 Map showing the Duralie and Stratford Coal Mines and the North Coast Railway Line

Location: Duralie and Stratford Coal Mines	**Data source:** Duralie Coal Project EIS	
Type: Map	**Prepared by:** Resource Strategies	**Date:** February 2012

Figure 2 Bradken Wagons used to transport coal from the Duralie Coal Mine to the Stratford Coal Mine

Location: North Coast Railway between Duralie and Stratford Coal Mines	**Data source:** Introspec Consulting	
Type: Photograph	**Prepared by:** John Planner	**Date:** January 2012

(a) Loading coal to wagon from Duralie Coal Mine Loadingout and application of water to coal surface

(b) High volume of water applied to coal surface during loading

Figure 3 Application of water to the surface of coal wagons at Duralie Coal Mine

Location: Duralie Coal Mine	**Data source:** Introspec Consulting	
Type: Photograph	**Prepared by:** John Planner	**Date:** January 2012

(a) Ponding of water on coal surface indicating high wetting level following loading

(b) Re-wetting of coal surface before departure of coal train from Duralie Coal Mine

Figure 4 Ponding of water on the surface of coal wagons and re-wetting of coal loads at Duralie Coal Mine

Location: Duralie Coal Mine	**Data source:** Introspec Consulting	
Type: Photograph	**Prepared by:** John Planner	**Date:** January 2012

Figure 5 Wagon unloading at the Stratford Coal Mine.

Location: Stratford Coal Mine	**Data source:** Introspec Consulting	
Type: Photograph	**Prepared by:** John Planner	**Date:** January 2012

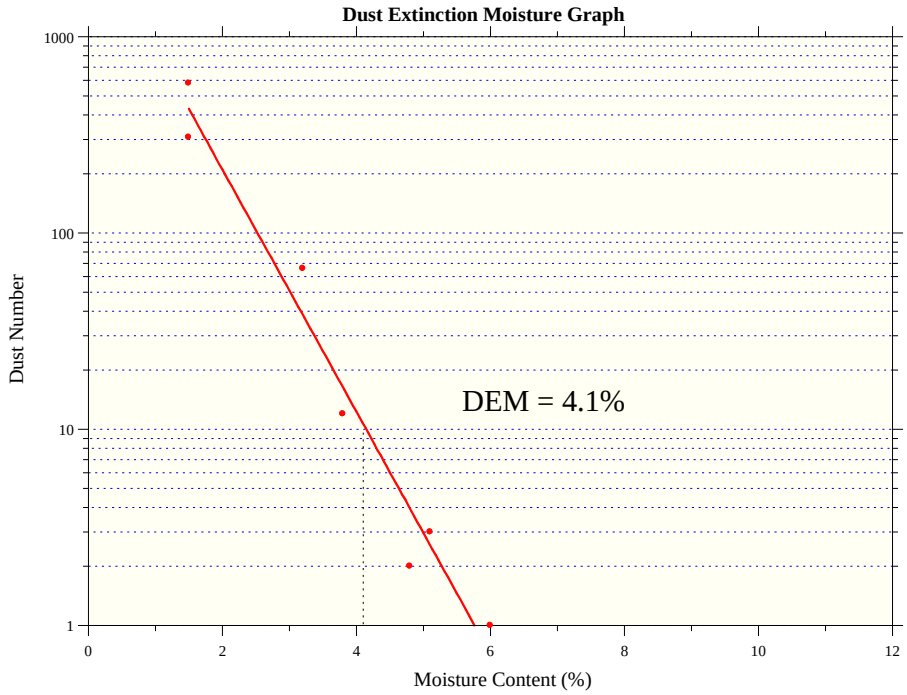

Figure 1.0 - Dust/Moisture Relationship Test
7757 Duralie Coal

Figure 6 Relationship between moisture content and dustiness, and dust extinction moisture content for Clareval Coking coal

Sample: Clareval Coking Coal	**Data source:** Introspec Consulting	
Type: DEM graph	**Prepared by:** John Planner	**Date:** February 2012

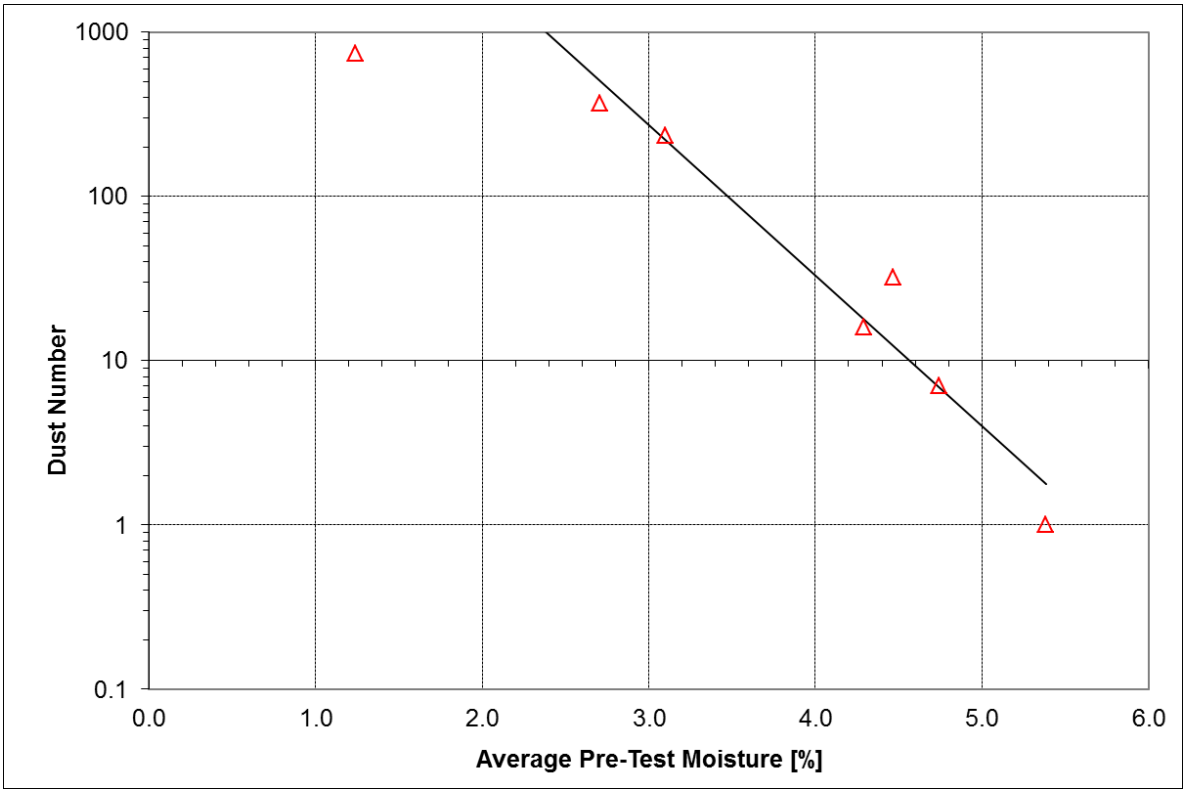

Figure 7 Relationship between moisture content and dustiness, and dust extinction moisture content for Clareval Thermal coal

Sample: Clareval Thermal Coal	**Data source:** Introspec Consulting	
Type: DEM graph	**Prepared by:** John Planner	**Date:** April 2012

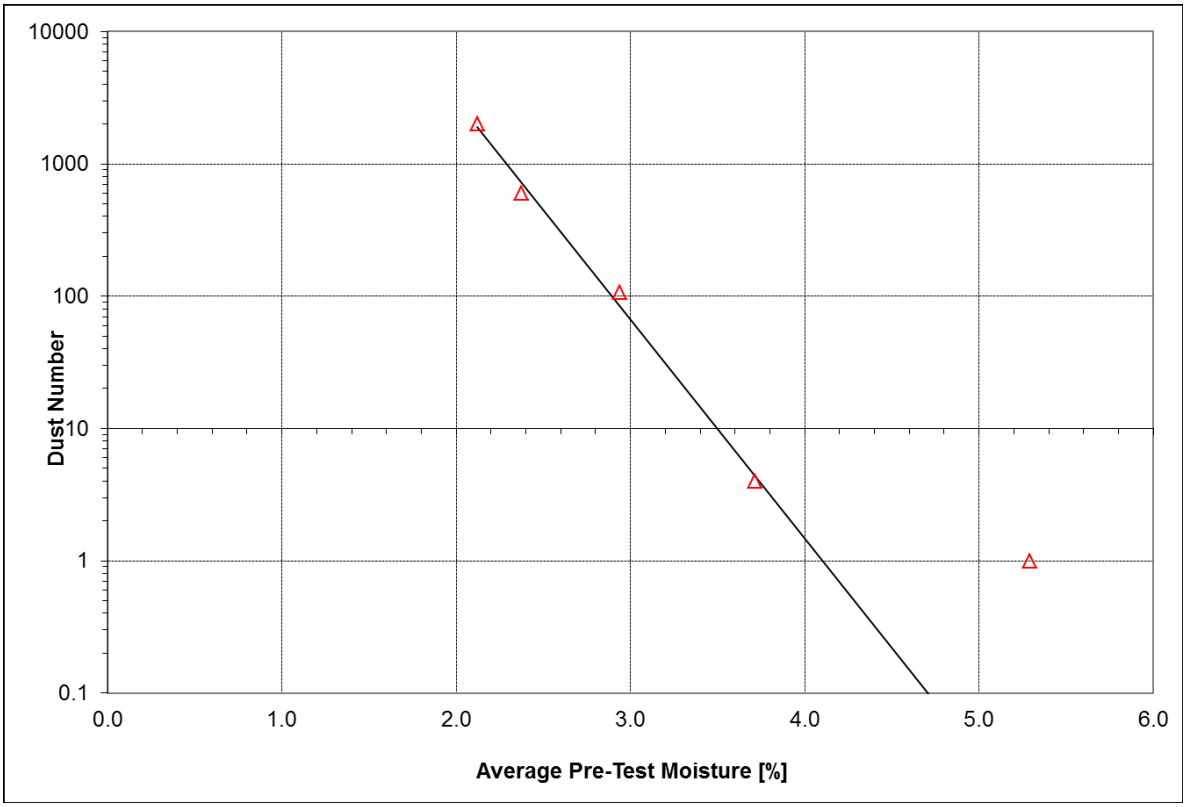

Figure 8 Relationship between moisture content and dustiness, and dust extinction moisture content for Weismental Coking coal

Sample: Weismental Coking Coal	**Data source:** Introspec Consulting	
Type: DEM graph	**Prepared by:** John Planner	**Date:** April 2012

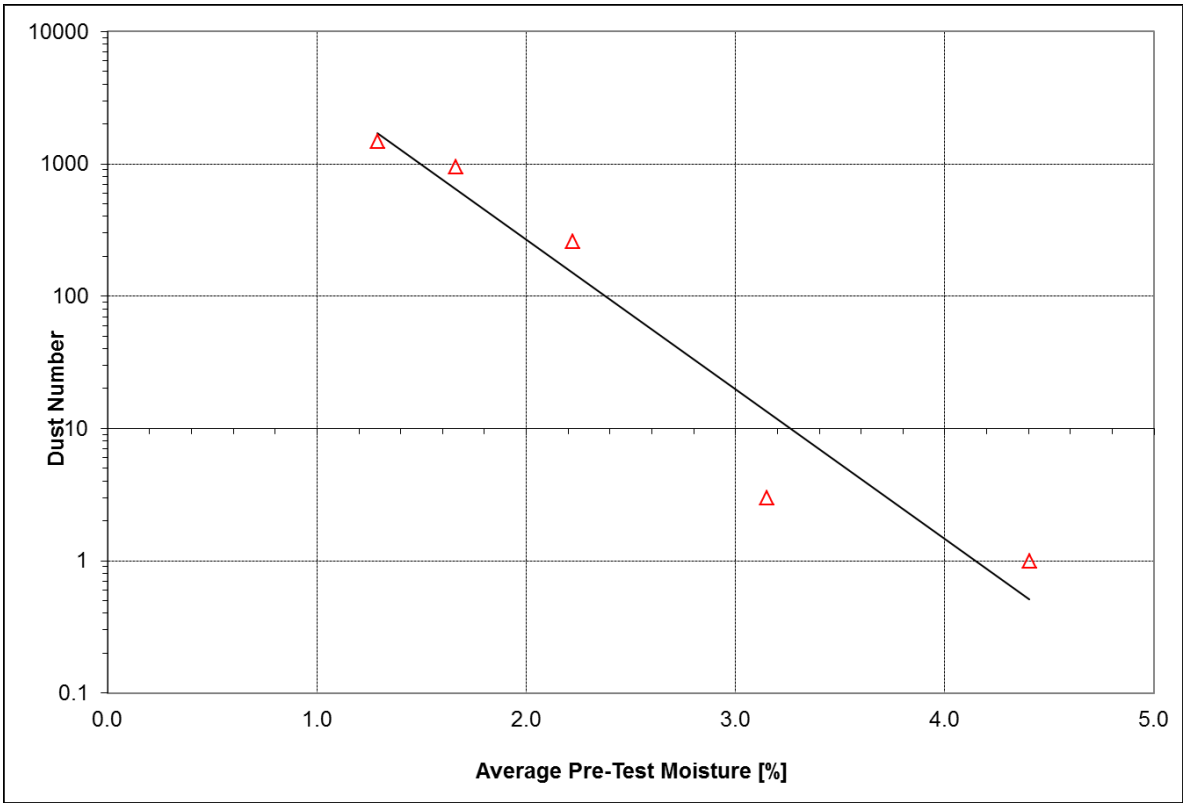

Figure 9 Relationship between moisture content and dustiness, and dust extinction moisture content for Weismental Thermal coal

Sample: Weismental Thermal Coal	**Data source:** Introspec Consulting	
Type: DEM graph	**Prepared by:** John Planner	**Date:** April 2012

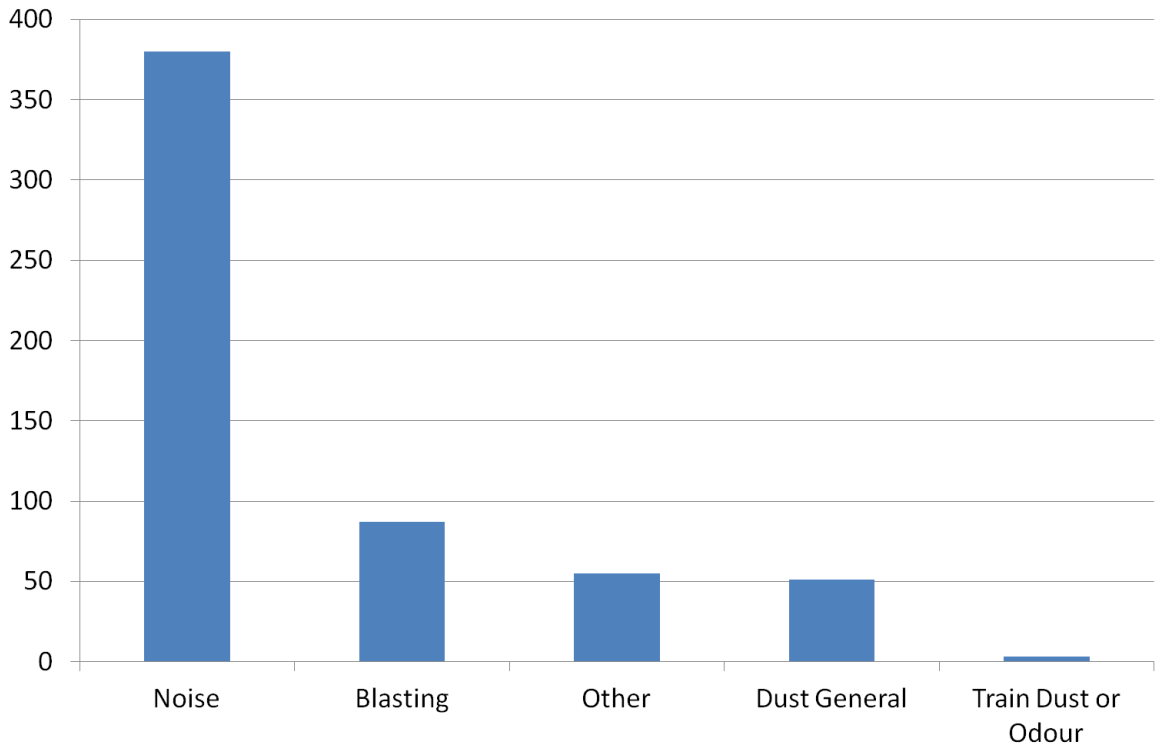

Figure 10 Number of complaints relating to Duralie Coal Mine and Stratford Coal Mine by category

Data: Environmental complaints	**Data source:** Gloucester Coal	
Type: Plot	**Prepared by:** Anthony Parkinson	**Date:** February 2012

Appendix A

Copy of Letters sent to EPA, DP&I and Landowners

GLOUCESTER BASIN

Part of Gloucester Coal

23 January 2012

Environment Protection Agency
PO Box 488G
NEWCASTLE NSW 2300

Attention: Peter Hughes

Dear Peter

RE: DURALIE COAL MINE STUDY OF DUST EMISSIONS FROM LADEN TRAINS - PROPOSED METHODOLOGY

A study on dust emissions from laden trains transporting coal from the Duralie Coal Mine is required in accordance with Condition 21A, Schedule 3 of the Project Approval (08_0203) for the Duralie Extension Project issued by The Land and Environment Court of New South Wales (NSW) under Section 75J of the *Environmental Planning and Assessment Act 1979* on 10 November 2011. This letter provides a statement of the proposed methodology that would be implemented as part of this study. The methodology below is provided to the Environment Protection Agency (EPA) for the purposes of consultation, and any feedback would be appreciated.

Background

In January 2010, Gloucester Coal Limited prepared the Duralie Extension Project Environmental Assessment (EA). The Air Quality Assessment prepared for the EA included an assessment of potential air quality impacts associated with transporting run-of-mine (ROM) coal from the Duralie Coal Mine approximately 20 kilometres by rail to the Stratford Coal Mine, concluding that *"Maximum 24 hour concentrations of* [particulate matter with diameter less than 10 microns] *PM_{10} at 20 m from the rail centre line are predicted to be approximately 4 µg/m³..."* (Heggies, 2009). In comparison, the 24 hour criteria for PM_{10} is 50 µg/m³.

The Duralie Extension Project was approved by the Minister for Planning on 26 November 2010. A merits appeal against the Project Approval was heard by Chief Justice Preston in the Land and Environment Court of NSW in May and June 2011. On 10 November 2011, a new Project Approval was approved by the Land and Environment Court of NSW.

Condition 21A, Schedule 3 of the Project Approval was an additional condition imposed by the Land and Environment Court of NSW relating to dust emissions from laden trains leaving the Duralie Coal Mine. Condition 21A is reproduced below:

> *21A Within 3 months of the date of this approval, the Proponent shall submit a study of the dust emissions from the laden trains associated with the Project to the Director-General. This study must:*
>
> *(a) be carried out by a suitably qualified and experienced expert whose appointment has been endorsed by the Director-General;*

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(b) include consultation with the OEH, the Department and the residents in close proximity to the railway line;

(c) assess the scale, nature and significance of the dust emissions of the laden trains;

(d) identify any reasonable and feasible mitigation measures that could be implemented to reduce the dust emissions from these trains;

(e) recommend the implementation of any specific measures; and

(f) be accompanied by the Proponent's response to any recommendations in the study.

If, following review of the study, the Director-General directs the Proponent to implement additional mitigation measures to reduce the dust emissions of the laden trains associated with the Project, then the Proponent shall implement these measures to the satisfaction of the Director-General and, within one month of such direction, update the Air Quality & Greenhouse Gas Management Plan for the Project to include a detailed program for the implementation of these measures and monitoring of compliance.

Proposed Scope of works

Gloucester Coal has engaged Katestone Environment Pty Ltd and Introspec Consulting to prepare a study which would address the requirements of Condition 21A, Schedule 3 of Project Approval. A summary of the proposed scope of works for the study is provided below.

A. An inspection the coal loading facilities at the Duralie Coal Mine will be undertaken to evaluate the potential effect of coal storage and loading practices on coal dust emissions. In addition, a worst-case scenario for laboratory testing (refer below) will be determined.

B. Laboratory testing will be conducted to determine the following for coal from the Duralie Coal Mine:
   1. Dust extinction moisture level.
   2. Whether the coal is free draining.
   3. Wind tunnel test work under worst-case rail conditions for:
      a. Untreated coal.
      b. Coal with surface moistened with water.
      c. Coal with surface treated with a chemical dust suppressant.

C. A review of the complaints history relating to dust perceived to be associated with transportation of coal from the Duralie Coal Mine to the Stratford Coal Mine will be conducted. The purpose of the review will be to determine the way the community experiences coal dust from laden wagons.

D. The significance of dust emissions from laden coal trains will be determined from the following:
   1. A detailed peer review of the assessment of potential air quality impacts from rail transport in the Air Quality Assessment prepared for the EA. The peer review will consider the following:
      a. Quantification of dust emission rates.
      b. Characterisation of site conditions, meteorology, terrain and land-use.
      c. Dispersion modelling methodology.
      d. Interpretation of modelling results and comparison with air quality standards.

2. A review of the results of monitoring and modelling conducted for existing and proposed major coal rail systems in Australia (including QR Coal Loss Management Project Environmental Evaluation and the Surat Basin Rail Project).
3. Laboratory testing of coal from the Duralie Coal Mine, as described above.

E. Possible dust control measures for laden trains will be identified. Consideration will be given to the cost and benefits of various control options. The feasibility of the dust control measures will be determined by Gloucester Coal based on the costs and benefits of each.

F. Where relevant, recommendations will be made for the implementation of any specific measures that are required to minimise the emission of dust from laden trains.

G. A report will be produced that summarises the findings of the study.

Proposed Consultation

Feedback on the above methodology will also be sought from the Department of Planning and Infrastructure and residents in close proximity to the rail line. Gloucester Coal will also update interested parties with the findings of the study upon completion.

In accordance with Condition 21A, the study will be submitted to the Director-General by 10 February 2012.

Should the EPA have any comments on the proposed scope of works described above, please do not hesitate to contact the undersigned on (02) 6538 4208 or Tony.Dwyer@gcl.com.au.

Yours faithfully
GLOUCESTER COAL LTD

TONY DWYER
MANAGER - APPROVALS

GLOUCESTER BASIN

Part of Gloucester Coal

23 January 2012

Department of Planning and Infrastructure
GPO Box 39
SYDNEY NSW 2001

Attention: Howard Reed

Dear Howard

RE: DURALIE COAL MINE STUDY OF DUST EMISSIONS FROM LADEN TRAINS - PROPOSED METHODOLOGY

A study on dust emissions from laden trains transporting coal from the Duralie Coal Mine is required in accordance with Condition 21A, Schedule 3 of the Project Approval (08_0203) for the Duralie Extension Project issued by The Land and Environment Court of New South Wales (NSW) under Section 75J of the *Environmental Planning and Assessment Act 1979* on 10 November 2011. This letter provides a statement of the proposed methodology that would be implemented as part of this study. The methodology below is provided to the NSW Department of Planning and Infrastructure (DP&I) for the purposes of consultation, and any feedback would be appreciated.

Background

In January 2010, Gloucester Coal Limited prepared the Duralie Extension Project Environmental Assessment (EA). The Air Quality Assessment prepared for the EA included an assessment of potential air quality impacts associated with transporting run-of-mine coal from the Duralie Coal Mine approximately 20 kilometres by rail to the Stratford Coal Mine, concluding that *Maximum 24 hour concentrations of* [particulate matter with diameter less than 10 microns] *PM_{10} at 20 m from the rail centre line are predicted to be approximately 4 µg/m³*... (Heggies, 2009). In comparison, the 24 hour criteria for PM_{10} is 50 µg/m³.

The Duralie Extension Project was approved by the Minister for Planning on 26 November 2010. A merits appeal against the Project Approval was heard by Chief Justice Preston in the Land and Environment Court of NSW in May and June 2011. On 10 November 2011, a new Project Approval was approved by the Land and Environment Court of NSW.

Condition 21A, Schedule 3 of the Project Approval was an additional condition imposed by the Land and Environment Court of NSW relating to dust emissions from laden trains leaving the Duralie Coal Mine. Condition 21A is reproduced below:

> *21A Within 3 months of the date of this approval, the Proponent shall submit a study of the dust emissions from the laden trains associated with the Project to the Director-General. This study must:*
>
> *(a) be carried out by a suitably qualified and experienced expert whose appointment has been endorsed by the Director-General;*
>
> *(b) include consultation with the OEH, the Department and the residents in close proximity to the railway line;*

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(c) assess the scale, nature and significance of the dust emissions of the laden trains;

(d) identify any reasonable and feasible mitigation measures that could be implemented to reduce the dust emissions from these trains;

(e) recommend the implementation of any specific measures; and

(f) be accompanied by the Proponent's response to any recommendations in the study.

If, following review of the study, the Director-General directs the Proponent to implement additional mitigation measures to reduce the dust emissions of the laden trains associated with the Project, then the Proponent shall implement these measures to the satisfaction of the Director-General and, within one month of such direction, update the Air Quality & Greenhouse Gas Management Plan for the Project to include a detailed program for the implementation of these measures and monitoring of compliance.

Proposed Scope of works

Gloucester Coal has engaged Katestone Environment Pty Ltd and Introspec Consulting to prepare a study which would address the requirements of Condition 21A, Schedule 3 of Project Approval. A summary of the proposed scope of works for the study is provided below.

A. An inspection the coal loading facilities at the Duralie Coal Mine will be undertaken to evaluate the potential effect of coal storage and loading practices on coal dust emissions. In addition, a worst-case scenario for laboratory testing (refer below) will be determined.

B. Laboratory testing will be conducted to determine the following for coal from the Duralie Coal Mine:
   1. Dust extinction moisture level.
   2. Whether the coal is free draining.
   3. Wind tunnel test work under worst-case rail conditions for:
      a. Untreated coal.
      b. Coal with surface moistened with water.
      c. Coal with surface treated with a chemical dust suppressant.

C. A review of the complaints history relating to dust perceived to be associated with transportation of coal from the Duralie Coal Mine to the Stratford Coal Mine will be conducted. The purpose of the review will be to determine the way the community experiences coal dust from laden wagons.

D. The significance of dust emissions from laden coal trains will be determined from the following:
   1. A detailed peer review of the assessment of potential air quality impacts from rail transport in the Air Quality Assessment prepared for the EA. The peer review will consider the following:
      a. Quantification of dust emission rates.
      b. Characterisation of site conditions, meteorology, terrain and land-use.
      c. Dispersion modelling methodology.
      d. Interpretation of modelling results and comparison with air quality standards.

2. A review of the results of monitoring and modelling conducted for existing and proposed major coal rail systems in Australia (including QR Coal Loss Management Project Environmental Evaluation and the Surat Basin Rail Project).
3. Laboratory testing of coal from the Duralie Coal Mine, as described above.

E. Possible dust control measures for laden trains will be identified. Consideration will be given to the cost and benefits of various control options. The feasibility of the dust control measures will be determined by Gloucester Coal based on the costs and benefits of each.

F. Where relevant, recommendations will be made for the implementation of any specific measures that are required to minimise the emission of dust from laden trains.

G. A report will be produced that summarises the findings of the study.

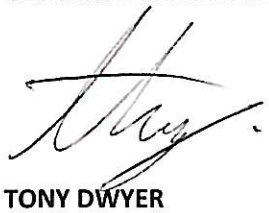
Proposed Consultation

Feedback on the above methodology will also be sought from the Environment Protection Authority and residents in close proximity to the rail line. Gloucester Coal will also update interested parties with the findings of the study upon completion.

In accordance with Condition 21A, the study will be submitted to the Director-General by 10 February 2012.

Should the DP&I have any comments on the proposed scope of works described above, please do not hesitate to contact the undersigned on (02) 6538 4204 or Tony.Dwyer@gcl.com.au.

Yours faithfully
GLOUCESTER COAL LTD



TONY DWYER
MANAGER - APPROVALS

GLOUCESTER BASIN

Part of Gloucester Coal

2 February 2012

Dear Sir/Madam,

RE: DURALIE COAL MINE STUDY OF DUST EMISSIONS FROM LADEN TRAINS - PROPOSED METHODOLOGY AND PRELIMINARY RESULTS

A study on dust emissions from laden trains transporting coal from the Duralie Coal Mine is required in accordance with Condition 21A, Schedule 3 of the Project Approval (08_0203) for the Duralie Extension Project issued by The Land and Environment Court of New South Wales (NSW) under Section 75J of the *Environmental Planning and Assessment Act 1979* on 10 November 2011.

This letter is provided to invite feedback on the methodology and preliminary findings of the study.

Background

In January 2010, Gloucester Coal Limited prepared the Duralie Extension Project Environmental Assessment (EA). The Air Quality Assessment prepared for the EA included an assessment of potential air quality impacts associated with transporting run-of-mine (ROM) coal from the Duralie Coal Mine approximately 20 kilometres by rail to the Stratford Coal Mine, concluding that "*Maximum 24 hour concentrations of* [particulate matter with diameter less than 10 microns] PM_{10} *at 20 m from the rail centre line are predicted to be approximately 4 µg/m³...*" (Heggies, 2009). In comparison, the 24 hour criteria for PM_{10} is 50 µg/m³.

The Duralie Extension Project was approved by the Minister for Planning on 26 November 2010. A merits appeal against the Project Approval was heard by Chief Justice Preston in the Land and Environment Court of NSW in May and June 2011. On 10 November 2011, a new Project Approval was approved by the Land and Environment Court of NSW.

Condition 21A, Schedule 3 of the Project Approval was an additional condition imposed by the Land and Environment Court of NSW relating to dust emissions from laden trains leaving the Duralie Coal Mine. Condition 21A is reproduced below:

> *21A Within 3 months of the date of this approval, the Proponent shall submit a study of the dust emissions from the laden trains associated with the Project to the Director-General. This study must:*
>
> *(a) be carried out by a suitably qualified and experienced expert whose appointment has been endorsed by the Director-General;*
>
> *(b) include consultation with the OEH, the Department and the residents in close proximity to the railway line;*
>
> *(c) assess the scale, nature and significance of the dust emissions of the laden trains;*
>
> *(d) identify any reasonable and feasible mitigation measures that could be implemented to reduce the dust emissions from these trains;*
>
> *(e) recommend the implementation of any specific measures; and*
>
> *(f) be accompanied by the Proponent's response to any recommendations in the study.*
>
> *If, following review of the study, the Director-General directs the Proponent to implement additional mitigation measures to reduce the dust emissions of the laden trains associated with the*

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Project, then the Proponent shall implement these measures to the satisfaction of the Director-General and, within one month of such direction, update the Air Quality & Greenhouse Gas Management Plan for the Project to include a detailed program for the implementation of these measures and monitoring of compliance.

Proposed Scope of works

Gloucester Coal has engaged Katestone Environment Pty Ltd (Katestone) to prepare a study that would address the requirements of Condition 21A, Schedule 3 of the Project Approval. Katestone has been endorsed by the Director-General of the DP&I as a suitably qualified and experienced expert for the study. A summary of the proposed scope of works for the study is provided below.

A. An inspection the coal loading facilities at the Duralie Coal Mine to evaluate the potential effect of coal storage and loading practices on coal dust emissions, and to determine laboratory testing requirements (refer below).

B. Laboratory testing of samples of ROM coal from the Duralie Coal Mine to determine:
   1. Dust extinction moisture level (i.e. the moisture content [% moisture] of the ROM coal, above which dust emissions are minor).
   2. Whether the coal is free draining (i.e. whether the coal will retain moisture if water is applied).
   3. Wind tunnel test work to determine emissions of dust for:
      a. Untreated coal.
      b. Coal with surface moistened with water.
      c. Coal with surface treated with a chemical dust suppressant.

C. A review of the complaints history relating to dust perceived to be associated with transportation of coal from the Duralie Coal Mine to the Stratford Coal Mine to determine the way the community experiences coal dust from laden wagons.

D. The significance of dust emissions from laden coal trains, determined from the following:
   1. The potential air quality impacts from rail transport in the Air Quality Assessment prepared for the EA.
   2. A review of the results of monitoring and modelling conducted for existing and proposed major coal rail systems in Australia (including QR Coal Loss Management Project Environmental Evaluation and the Surat Basin Rail Project).
   3. Laboratory testing of coal from the Duralie Coal Mine, as described above.

E. An analysis of the requirement for, or otherwise, of rail dust control measures for laden trains. Consideration will be given to the cost and benefits of various control options.

F. Where relevant, recommendations will be made for the implementation of any specific measures that are required to minimise the emission of dust from laden trains.

G. A report will be produced that summarises the findings of the study.

Preliminary Findings

Preliminary findings of the study include:

- The wagons transporting ROM coal from the Duralie Coal Mine to the Stratford Coal Mine have recently been replaced. When the new wagons are loaded, the coal load profile protrudes only a small amount over the top sill of the wagon (Plate 1). The coal load profile in the new wagons is lower than the previously used wagons. This reduces the amount of coal surface exposed to air movement during rail transport, thereby reducing potential dust emissions.
- A site inspection was conducted.
  - The current dust suppression practice of water spraying of the coal during loading at the Duralie Coal Mine was observed (Plate 2), with ponding of water on the coal surface indicating a high level of watering following the completion of loading the wagons (Plate 3).
  - Unloading of the coal at the Stratford Coal Mine was also observed, with the current dust suppression practice of misting sprays operational during the unloading (Plate 4). No dust emissions were observed.
- Laboratory testing determined that the dust extinction moisture level (i.e. the level above which minor dust lift-off is observed) for ROM coal from the Duralie Coal Mine was approximately 4.1% moisture content. As such, when the moisture content of coal is above 4.1%, dust emissions are minor. The moisture content of ROM coal from the Duralie Coal Mine is approximately 8-9% when loaded to the wagons.
- Wind tunnel testing of dust lift-off was undertaken to simulate transport of the coal from the Duralie Coal Mine via rail. With no treatment, dust lift-off was observed to be 77.5 grams, with the moisture content of the sample coal being 5%. When water was applied to the surface of the coal sample, at the same application rate that occurs at the Duralie Coal Mine coal loader (Plate 2), dust lift-off was reduced by 98% to almost nil, and is therefore considered to be a very effective treatment option.

Further Consultation

As a resident noted as being in close proximity of the railway line, should you have any comments regarding the methodology and preliminary findings of the Duralie Rail Dust Study please do not hesitate to contact Rachael Windrum, Manager – Community Liaison, on (02) 6538 4201 or Rachael.Windrum@gcl.com.au by 8 February 2012.

The Duralie Rail Dust Study is due for completion on 10 February 2012, and will be available on the Gloucester Coal website (http://www.gloucestercoal.com.au/). Should you wish to obtain a hard copy of the Duralie Rail Dust Study, or should you have any queries regarding the results of the study please do not hesitate to contact Rachael.

Plate 1: Wagons loaded with coal from the Duralie Coal Mine with surface profile slightly above the sill of the wagon

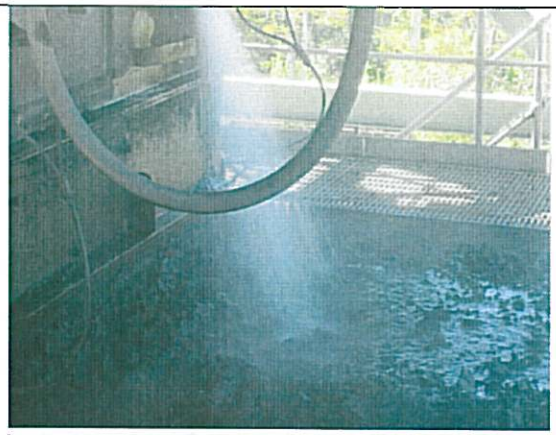

Plate 2: Water applied to coal surface during loading

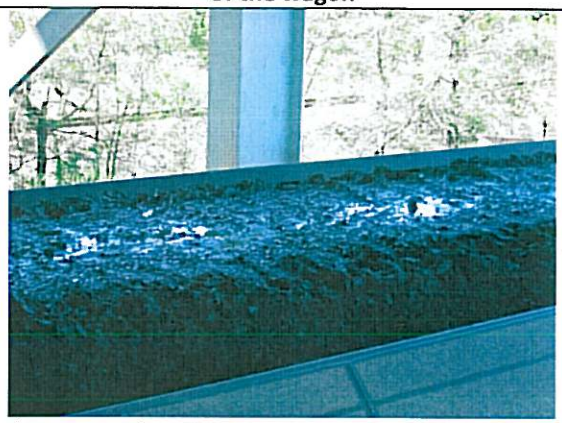

Plate 3: Ponding of water on coal surface indicating high wetting level following water spraying during loading

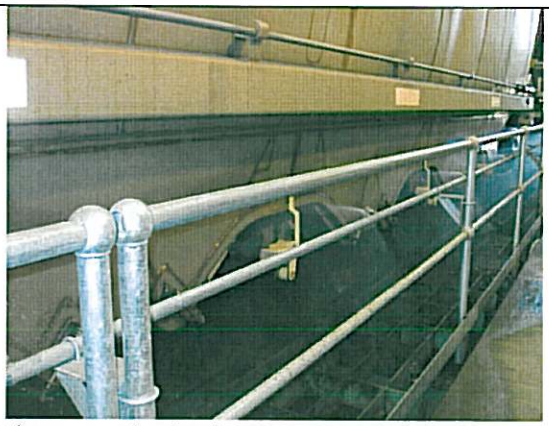

Plate 4: Coal unloading at the Stratford Coal Mine with misting sprays and no dust emission observed

Source Plates 1-4: Introspec Consulting (2012)

Yours faithfully
GLOUCESTER COAL LTD

TONY DWYER
MANAGER - ENVIRONMENT & APPROVALS

Appendix B

Letter of Endorsement of Study Team Received from DP&I

NSW GOVERNMENT | Planning & Infrastructure

Contact: Colin Phillips
Phone: (02) 9228 6483
Fax: (02) 9228 6466
Email: colin.phillips@planning.nsw.gov.au

Mr Tony Dwyer
Manager - Approvals
Gloucester Coal Ltd
PO Box 168
GLOUCESTER NSW 2422

Dear Mr Dwyer

Duralie Coal Mine Community Consultative Committee

I refer to your letter of 18 January 2012 requesting the endorsement of Mr Simon Welchman and Mr John Planner to undertake the study of dust emissions from laden trains associated with the project.

I wish to inform you that the Director-General has endorsed the appointment of these experts in accordance with condition 21A of schedule 3 of the project approval (08_0203)

If you wish to discuss this matter further, please contact Colin Phillips.

Yours sincerely,

Howard Reed 19.1.12

Howard Reed
A/Director
Mining and Industry Projects
as Delegate for the Director-General

RECEIVED
25 JAN 2012
BY:.....