Appendix 5

Air Quality Assessment

(Total No. of pages including blank pages = 24)

This page has intentionally been left blank

16 March 2015

610.14985-R1 Letter Report 16Mar2015.docx

R.W. Corkery & Co. Pty Limited
Level 1, 12 Dangar Road
PO Box 239
Brooklyn
NSW 2083

Attention: Chris Dickson

Dear Chris

New Berrima Quarry
S75W Modification
Air Quality Assessment

Thank you for commissioning SLR Consulting Australia Pty Ltd (SLR) to provide an updated assessment of the potential air quality impacts associated with the proposed site layout changes for the New Berrima Clay / Shale Quarry. This letter report outlines the agreed scope of work, approach and findings of our review. We trust the following information is sufficient to meet the requirements of the reviewing authority, however should you require any further information please do not hesitate to contact us.

1 Background

In 2010, SLR (formerly Heggies Pty Ltd) was commissioned by R.W Corkery & Co. Pty Ltd (RWC) to undertake an Air Quality and Greenhouse Gas Assessment for a proposed New Berrima Clay / Shale Quarry, on the “Mandurama” property, east of New Berrima. This assessment included a quantitative air dispersion modelling study, based on estimated particulate emissions for the proposed on-site activities and is referred to as the “2010 AQIA” in this letter. The quarry received development approval in July 2012 as Project Approval PA08_0212, although construction or any activities at the quarry have not yet been initiated.

Since the initial air quality assessment was performed (2010 AQIA), the Proponent has identified a resource within the Project Site, containing higher quality materials than contained within the approved extraction area and is now seeking a modification to the existing approval to enable access to this resource. The modified Project (the Proposal) would include the following components:

- Relocation of the extraction area to a location within the clay/shale resource boundary, with access to higher quality materials than the approved extraction area;
- Construction of appropriately located visibility barriers (constructed progressively); and
- Relocation and replacement of water management / sedimentation dams and related water diversion structures.

Plans showing the locations and extents of the original and modified extraction areas are presented in **Figure 1**.

SLR Consulting Australia Pty Ltd 2 Lincoln Street Lane Cove NSW 2066 Australia
(PO Box 176 Lane Cove NSW 1595 Australia) T: +61 2 9427 8100 F: +61 2 9427 8200
E: sydney@slrconsulting.com www.slrconsulting.com
ABN 29 001 584 612

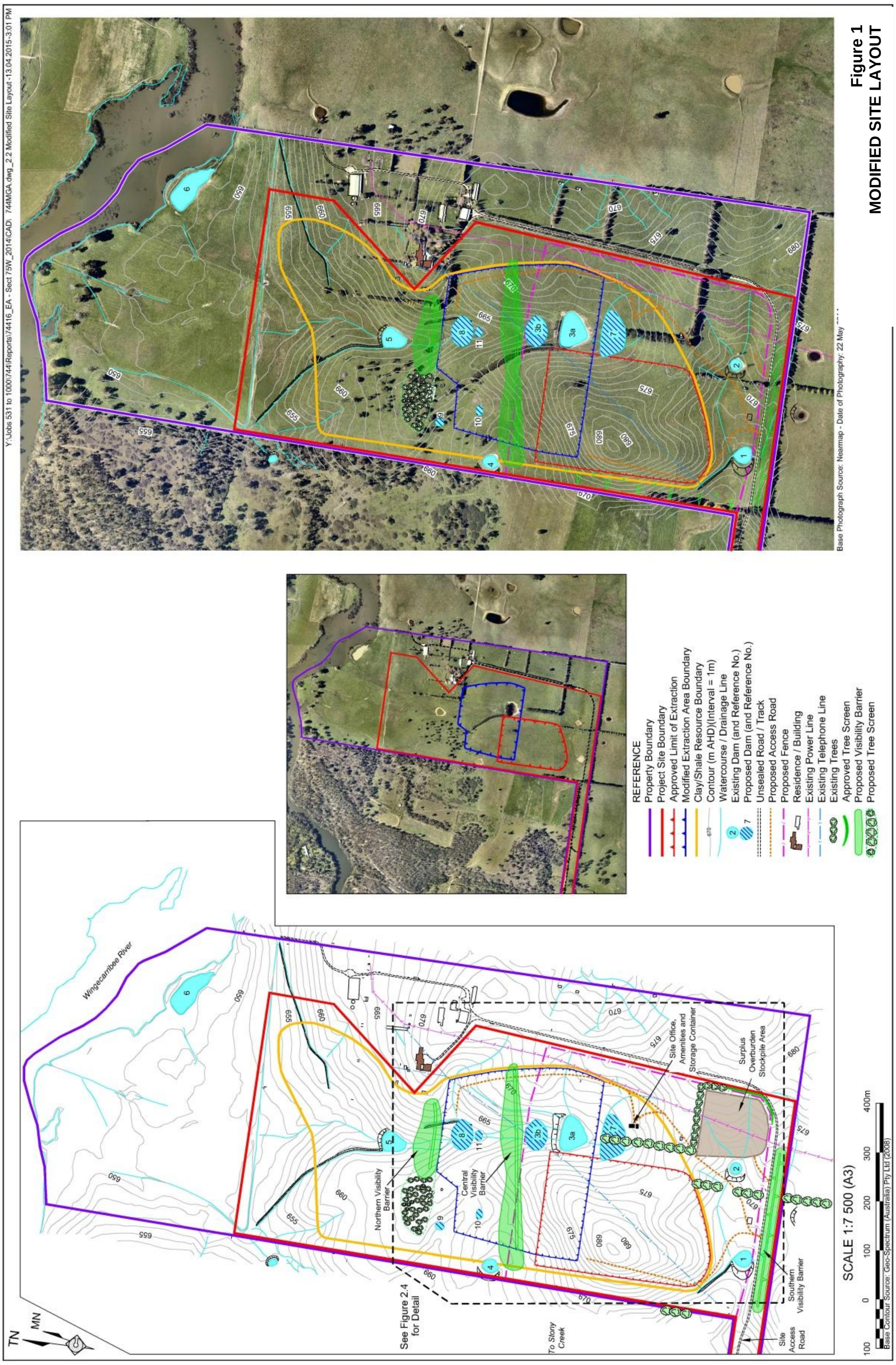


Figure 1
MODIFIED SITE LAYOUT
REFERENCE
Property Boundary
Project Site Boundary
Approved Limit of Extraction
Modified Extraction Area Boundary
Clay/Shale Resource Boundary
Contour (m AHD)(Interval = 1m)
Watercourse / Drainage Line
Existing Dam (and Reference No.)
Proposed Dam (and Reference No.)
Unsealed Road / Track
Proposed Access Road
Proposed Fence
Residence / Building
Existing Power Line
Existing Telephone Line
Existing Trees
Approved Tree Screen
Proposed Visibility Barrier
Proposed Tree Screen
Wingecarribee River
Northern Visibility Barrier
Central Visibility Barrier
Southern Visibility Barrier
Site Office, Amenities and Storage Container
Surplus Overburden Stockpile Area
See Figure 2.4 for Detail
To Stony Creek
Site Access Road
SCALE 1:7 500 (A3)
TN
MN

The Proposal would not result in changes to the following approved quarry components.

- Quarry life – 31 March 2042 (*Condition 2(5)*).
- Maximum extraction rate – 150 000tpa (*Condition 2(7)*).
- Hours of Operation (*Condition 3(6)*).

SLR has been commissioned to review the proposed changes to the on-site activities and to provide an assessment of the potential implications of these changes on the air quality impacts predicted in the 2010 AQIA. This review has included the following tasks:

- Review the Project emissions inventory to determine the distribution of particulate emissions (TSP and PM_{10}) between the approved extraction area, wind erosion and haul road emissions sources.
- Review the predicted maximum incremental and cumulative particulate concentrations at each of the identified sensitive receptors.
- Perform a qualitative assessment of the likely incremental and cumulative change in predicted impacts at each receptor, based on the relocation of the extraction area, taking into account the predicted and measured air quality concentrations/dust deposition levels.
- Assess the likely air quality mitigation effects of the proposed visibility barriers and any other air quality management measures proposed to be employed on site and not included in the 2010 AQIA dispersion modelling exercise.
- Review the range of emissions controls that will be employed at the Project Site and how these accord with best management practice.

2 Impact of the Proposal

2.1 Emissions Estimation

In order to predict off-site particulate concentrations likely to be associated with operations at the Project Site, the 2010 AQIA used published emission estimation methods from USEPA AP-42 documentation and the Australian Government National Pollution Inventory (NPI) document, *Emission Estimation Technique Manual (EETM) for Mining* (NPI 2001). This EETM has since been updated (NPI, 2012) and as part of this review the implications of changes to the relevant emission factors used in the 2010 AQIA emission inventory have been assessed, as well as changes in the proposed site operations.

The emission factors used in the 2010 AQIA are summarised for each of the identified dust-generating sources in **Table 1**. **Table 2** lists the changes in the emission factors recommended for use in the *EETM for Mining* (2012). While the emission factors for bulldozer operations have remained unchanged, all other source types have modified emission factors, and in the case of wind erosion and scrapers, the units of the emission factors have also changed.

Table 1 Emission Factors Used in the 2010 AQIA Assessment based on NPI Emission Estimation Technique Manual (2001)

Source	Emission Factor Equation		Emission Factor		
	TSP	**PM_{10}**	**TSP**	**PM_{10}**	**Units**
Wind erosion from stockpiles	$EF = 1.9 \times \left(\frac{s}{1.5}\right) \times 365 \times \left(\frac{365-p}{235}\right) \times \left(\frac{f}{15}\right)$ s = silt content = 19% p = number of days when rainfall is > 0.25 mm = 133 days f = % of time that wind speed at the mean height of the stockpile is greater than 5.4 m/s = 36.4%	= 50% of TSP estimate	21,069	10,534	kg/ha/year
Scraper on topsoil	$EF = k \times s^a W^b$ k = 0.0000076; a = 1.3; b = 1.4 s = silt content = 19.5% W = vehicle mass = 51.5 tonnes	$EF = k \times s^a W^b$ k = 0.00000132; a = 2.4; b = 2.5 s = silt content = 19.5% W = vehicle mass = 51.5 tonnes	4.641	1.609	kg/VKT
Bulldozer on topsoil	$EF = k \times \frac{s^{1.2}}{M^{1.3}}$ k = 2.6; a = 1.2; b = 1.3 s = silt content = 19.5% M = moisture content = 5%	$EF = k \times \frac{s^{1.2}}{M^{1.3}}$ k = 0.34; a = 1.5; b = 1.4 s = silt content = 19.5% M = moisture content = 5%	11.333	3.076	kg/hr
Bulldozer on shale	$EF = k \times \frac{s^{1.2}}{M^{1.3}}$ k = 2.6; a = 1.2; b = 1.3 s = silt content = 25% M = moisture content = 5%	$EF = k \times \frac{s^{1.2}}{M^{1.3}}$ k = 0.34; a = 1.5; b = 1.4 s = silt content = 25% M = moisture content = 5%	15.270	4.465	kg/hr
Truck loading (front-end loader)	$E = k \times 0.0016 \times (U/2.2)^{1.3} \times (M/2)^{-1.4}$ k = 0.74 U = mean wind speed = 4.7 m/s	$E = k \times 0.0016 \times (U/2.2)^{1.3} \times (M/2)^{-1.4}$ k = 0.35 U = mean wind speed = 4.7 m/s	0.0009	0.0004	kg/tonne
Wheel-generated dust – despatch and overburden trucks	$EF = k_i \times (s/12)^A \times \left(\frac{(W/3)^B}{(M/0.2)^C}\right)$ k = 2.82; A = 0.8; B = 0.5; C = 0.4 s = road silt content = 5.6% W = weight of trucks = 40 tonnes M = moisture content = 5%	$EF = k_i \times (s/12)^A \times \left(\frac{(W/3)^B}{(M/0.2)^C}\right)$ k = 0.733; A = 0.8; B = 0.4; C = 0.3 s = road silt content = 5.6% W = weight of trucks = 40 tonnes M = moisture content = 5%	1.544	0.428	kg/VKT

Table 2 Revised Emission Factors based on NPI Emission Estimation Technique Manual (2012)

Source	Emission Factor Equation		Emission Factor		
	TSP	PM_{10}	TSP	PM_{10}	Units
Wind erosion from stockpiles	New default factor	New default factor	0.40	0.20	kg/ha/hour
Scraper on topsoil	New default factor	New default factor	0.029	0.0073	kg/tonne topsoil
Bulldozer on topsoil	No change	No change	11.333	3.076	kg/hr
Bulldozer on shale	No change	No change	15.270	4.465	kg/hr
Truck loading (front-end loader)	New default factor	New default factor	0.025	0.012	kg/tonne
Wheel-generated dust – despatch and overburden trucks	$EF = k_i \times (s/12)^A \times \left(\frac{(W \times 1.1023)}{3}\right)^B$ k = 1.38; A = 0.7; B = 0.45 s = road silt content = 5.6% W = weight of trucks = 40 t	$EF = k_i \times (s/12)^A \times \left(\frac{(W \times 1.1023)}{3}\right)^B$ k = 0.423; A = 0.9; B = 0.45 s = road silt content = 5.6% W = weight of trucks = 40 t	2.713	0.714	kg/VKT

Table 3 summarises the peak hourly and annual emission estimates used in the 2010 AQIA and compares them to the emission estimations calculated using the updated emission factors. The activity data used in the emissions calculations for the Proposal have also been reviewed and updated where required to reflect the revised extraction area layout. Specifically, the changes are:

- Scraper emissions have been estimated based on 18,000 m^2 being cleared to a depth of 15 cm over a three month period (Stage 1);
- The distance travelled by haul trucks carrying product from the excavation area off site has been increased by 20% to account for the slightly longer distance to the northern side of the excavation area;
- The distance travelled by haul trucks carrying overburden from the excavation area to the Surplus Overburden Stockpile Area has been increased from 0.6 km to 0.8 km.

The numbers of truck trips have been assumed to remain the same. The control factor of 50% for road watering has also been retained, which is based on a water application rate of 1 L/m^2/application with time between applications of two hours (watering up to 5 occasions per day) (Corkery, 2012). The 30% control factor for the bulldozer emission estimates has also been retained to take into consideration the windbreak effect of the amenity bund around the bulldozer when ripping and pushing up shale within the quarry.

Table 3 shows that on an annual basis, the dust emission estimates have decreased based on the updated information. This is predominantly due to significant reductions in the wind erosion and scraper emission estimates due to changes in the recommended emission factors. However the haul road emissions have approximately doubled, principally due to the use of updated emission factors. In terms of peak hourly emissions, the total site TSP and PM_{10} emission estimate have decreased slightly.

Table 3 Revised Estimated Particulate Emissions Compared to 2010 AQIA

Source	Emission Factors			Activity Data				Control Factor	Hourly Emissions (kg/hr)		Annual Emissions (kg/annum)	
	TSP	PM_{10}	Units	Hectares	VKT/hr	Hours/year	Tonnes/hr		TSP	PM_{10}	TSP	PM_{10}
2010 Air Quality Impact Assessment												
Wind erosion from stockpiles	21,069	10,534	kg/ha/year	1.5	-	-	-	0%	3.61	1.80	31,604	15,801
Scraper on topsoil	4.641	1.609	kg/VKT	-	5.0	2,600	-	0%	23.20	8.05	60,331	20,917
Bulldozer on topsoil	11.333	3.076	kg/h	-	-	1,300	-	0%	11.33	3.08	14,733	3,999
Bulldozer on shale	15.270	4.465	kg/h	-	-	1,300	-	30%	10.69	3.13	13,896	4,063
Truck loading (front-end loader)	0.0009	0.0004	kg/t	-	-	2,600	200	0%	0.18	0.08	458	217
Vehicle movements – despatch trucks	1.544	0.427	kg/VKT	-	22.7	2,340	-	50%	17.50	4.84	40,956	11,336
Vehicle movements – overburden trucks	1.544	0.427	kg/VKT	-	0.6	2,340	-	50%	0.46	0.13	1,081	299
TOTAL SITE EMISSIONS									**67**	**21**	**163,059**	**56,632**
Revised Emission Factors and Activity Data												
Wind erosion from stockpiles	0.40	0.20	kg/ha/hr	1.5	-	-	-	0%	0.60	0.30	5,256	2,628
Scraper on topsoil	0.029	0.007	kg/tonnes	-	-	2,600	8.0	0%	0.23	0.06	603	152
Bulldozer on topsoil	11.333	3.076	kg/h	-	-	1,300	-	0%	11.33	3.08	14,733	3,999
Bulldozer on shale	15.270	4.465	kg/h	-	-	1,300	-	30%	10.69	3.13	13,896	4,063
Truck loading (front-end loader)	0.025	0.012	kg/t	-	-	2,600	200	0%	5.00	2.40	13,000	6,240
Vehicle movements – despatch trucks	2.713	0.714	kg/VKT	-	22.7	2,340	-	50%	36.90	9.71	86,337	22,723
Vehicle movements – overburden trucks	2.713	0.714	kg/VKT	-	0.9	2,340	-	50%	1.22	0.32	2,849	750
TOTAL SITE EMISSIONS									**66**	**19**	**136,674**	**40,554**

2.2 Predicted Off-Site Impacts

The following discussion provides a qualitative assessment of the likely impacts on the off-site TSP, PM_{10} and deposited dust levels predicted in the 2010 AQIA based on the changes in the emission inventory for the proposed site activities as presented in **Table 3**. For reference, contour plots showing the particulate levels predicted in the 2010 AQIA are included in **Attachment A**.

2.2.1 Annual Average TSP and PM_{10} Concentrations

Maximum off-site annual average TSP and PM_{10} concentrations predicted at all sensitive receptors assessed in the 2010 AQIA were well below the relevant criteria levels. Given this, and the significant decrease in the estimated total site annual emission rates for TSP and PM_{10}, it is expected that the off-site annual average concentrations presented in the 2010 AQIA would be conservative over-estimates of actual impacts. In addition, the 2010 AQIA utilised the AUSPLUME dispersion model, which is likely to over-predict the downwind concentrations and would add to the conservative nature of the assessment.

While the locations of the extraction-related activities will move further north, the combined emission estimates for these sources (specifically, the scraper, bulldozer and truck loading emissions) have decreased by approximately 50% for both TSP and PM_{10}. For the receptors located to the north of the site, this reduction in the estimated extraction-related emission rates would be expected to more than compensate for the estimated increase in emissions due to truck movements in this part of the site.

For receptors located to the south of the site, the increase in estimated annual emissions from the truck movements in this part of the site may result in an increase in the annual average TSP and PM_{10} concentrations. However the annual average TSP and PM_{10} concentrations predicted at receptors R2 and R3S in the 2010 AQIA due to the proposed quarry were 3 - 7 $\mu g/m^3$ and 1 - 2 $\mu g/m^3$ respectively. These values are far below the relevant OEH air quality criteria of 90 $\mu g/m^3$ and 30 $\mu g/m^3$ respectively. Even if these predictions were to double, and assuming the background concentrations of 19.2 $\mu g/m^3$ TSP and 12.8 $\mu g/m^3$ PM_{10} adopted in the 2010 AQIA, the predicted cumulative impacts would still be well below the relevant criteria.

2.2.2 24-hour PM_{10} Concentrations

In the 2010 AQIA, modelling of 24-hour average PM_{10} concentrations indicated the potential for exceedances of the relevant OEH criterion of 50 $\mu g/m^3$ at two sensitive receptors (R3N and R19) located approximately 1.2 km and 1.6 km to the east-northeast of the proposed extraction area respectively. This modelling study was based on the use of a contemporaneous background PM_{10} dataset compiled from measurements recorded by the Oakdale air quality monitoring station in 2007, located 60 km to the north of the Project Site. These exceedances were associated with a day when the background 24-hour average PM_{10} concentration was elevated (49.2 $\mu g/m^3$). The predicted incremental impacts associated with the proposed on-site activities on this day were very low (e.g. 1.4 $\mu g/m^3$ at R19).

As presented in **Table 3**, the updated emission inventory for the proposed on-site activities shows a decrease in the estimated total peak hourly emission rates for PM_{10}. On this basis it would be expected that the maximum off-site 24-hour PM_{10} concentrations would decrease correspondingly. While the locations of the extraction-related activities will move to the northeast, closer to R3N and R19, the combined hourly emission estimates for these sources have decreased by approximately 40% for both TSP and PM_{10} and these reductions would be expected to more than compensate for the estimated increase in emissions due to truck movements in this part of the Project Site.

For receptors located to the south of the Project Site (i.e. R2 and R3S), the increase in estimated hourly emissions from the truck movements at the southern end of the Project Site has the potential to result in an increase in the maximum 24-hour average PM_{10} concentrations. However no significant cumulative impacts were predicted for these receptors in the 2010 AQIA, which indicates that background levels are generally low when winds are blowing from the northwest – northeast. A detailed analysis of the model output showed that the incremental 24-hour average PM_{10} concentrations were predicted to be ≤10 $\mu g/m^3$ for 97% of the time at receptor R2 and 98.1% of the time at receptor R3S.

Given this, the fact that the peak hourly total site PM_{10} emission estimates have essentially remained the same, and that the extraction activities will move further north, it is considered unlikely that significant adverse impacts would be predicted at receptors R2 and R3S as a result of the Proposal. As noted above, the 2010 AQIA also utilised the AUSPLUME dispersion model, which is likely to over-predict the downwind concentrations and add to the conservative nature of the assessment.

2.2.3 Monthly Dust Deposition Rates

Annual average monthly dust deposition rates predicted at the nearest sensitive receptors in the 2010 AQIA were below the OEH guideline of 2 g/m^2/month (incremental impact).

Given the significant decrease in the estimated total site annual emission rates for TSP, it is expected that the off-site annual average monthly deposition rates presented in the 2010 AQIA would be conservative over-estimates of actual impacts.

3 Dust Management

3.1 Proposed Control Measures

The Air Quality Management Plan (AQMP) for the New Berrima Quarry is currently in draft form. The dust management measures contained within the draft AQMP are presented in **Table 4**.

As discussed in **Section 2.1** and shown in **Table 3**, the emission inventory prepared for the quarry includes the following control factors:

- 50% control of emissions from unsealed haul roads by watering of roads; and
- 30% control of emissions from the bulldozer working on shale to take into consideration the windbreak effect of the amenity bund.

The visual amenity bunds would also assist in reducing emissions from truck loading and vehicle movements within the extraction area by reducing wind speeds across the site. The vegetative (tree) screens will also assist in this regard, and the foliage will act by filtering dust from the air, particularly under northwesterly wind conditions. The effects of these control measures has not been accounted for the in the 2010 AQIA or the revised emission inventory, hence the emission estimates are expected to be conservative over-estimates.

The major emission sources identified in the revised emission inventory are the haul road emissions and the bulldozer emissions. These sources contribute just over 85% of the total site annual TSP emissions. A review of potential control measures for these sources is provided in the following sections.

Table 4 Proposed Dust Control Measures

Source	Control Procedures	Personnel Responsible
General	• Visually inspect operations for visible dust and adjust operations to reduce visible dust.	Quarry supervisor
Clearing Operations	• Disturb only the minimum area necessary for quarrying and related operations.	Quarry Supervisor
	• Maintain water sprays/water truck on stockpiles to minimise the generation of dust, as required.	Quarry Supervisor All personnel
Soil Stripping	• Maintain water sprays/water truck on stockpiles to minimise the generation of dust, as required.	Quarry Supervisor All personnel
Topsoil Stockpiles	• Revegetate long term topsoil stockpiles.	Quarry Supervisor
Loading of clay/shale	• Minimise the drop heights between front-end loader buckets and truck carrying quarry materials.	Quarry Supervisor and Equipment Operators
Internal Roads	• All unsealed roads and trafficked areas will be watered, as required, to minimise the generation of dust.	Quarry Supervisor
	• Enforce a speed limit of 40 km/hr on the site access road and 20 km/hr on all unsealed roads within the Site.	All personnel
	• All roads will have edges clearly defined with marker posts or equivalent to control their locations.	Quarry Manager
	• Development of minor roads or tracks will be limited and the locations of these clearly defined.	Quarry Manager
	• Obsolete roads will be ripped and re-vegetated.	Quarry Manager
Product Stockpiles	• Maintain product handling areas / stockpiles in a moist condition as required to minimise wind-blown and traffic-generated dust.	Quarry Manager
Transportation Product	• Maximise truck capacities to reduce the number of movements necessary to transport products.	Quarry Manager
	• Cover all loads with tarps prior to leaving site.	Quarry Supervisor
Rehabilitation	• Establish the interim or final landform as soon as areas become available for rehabilitation.	Quarry Manager
	• Revegetate interim or final landforms as soon as conditions are favourable.	Quarry Manager
	• Apply dust suppressants if conditions are not favourable for the establishment of vegetation.	Quarry Supervisor

3.2 Review of Potential Control Measures

Katestone Environmental Pty Ltd completed a benchmarking study in year 2010 for coal mining in NSW detailing the International Best Practice Measures to prevent and/or minimise emissions of particulate matter from coal mining (Katestone 2010, hereafter "the Katestone report"). In the absence of any such study for controlling particulate emissions from hard rock quarries, it is considered appropriate to adopt the best practice measures from the Katestone report.

3.2.1 Haul Roads

The haul roads proposed for the transportation of clay and shale from the extraction area to the product stockpile area and off-site will be unpaved. A summary of potential control measures for minimising particulate emissions from haul roads, and their effectiveness, is provided in **Table 5** (Katestone, 2010).

As noted above, the 2010 AQIA incorporated surface watering on the haul roads within the dispersion modelling, based on an assumed 50% reduction in particulate emissions from this source. This control factor was based on a water application rate of 1 L/m^2/application with time between applications of two hours (watering up to 5 occasions per day). A review of water availability and water storage capacity concluded that this watering rate was achievable by the site (Corkery, 2012 (*attached to this letter for reference*)). The restriction of vehicle speeds to 40 km/hr on the site access road and 20 km/hr on all unsealed roads within the site will also reduce emissions, as shown by **Table 5**. As this has not been accounted for in the 2010 AQIA modelling study or revised inventory, it can be expected that the haul road emissions presented in **Table 3** are conservative over estimates of the actual emissions that may be expected.

Table 5 Best Practice Control Measures - Haul Roads

Control Type	Control Measure	Effectiveness
Vehicle Restrictions	Reduction from 75 km/hr to 50 km/hr	40-75%
	Reduction from 65 km/hr to 30 km/hr	50-85%
	Grader speed reduction from 16 km/hr to 8 km/hr	75%
Surface Treatments	Watering (standard procedure)	10-74%
	Watering Level 2 (>2 l/m²/hr)	75%
	Watering twice a day for industrial unpaved road	55%
	Hygroscopic salts	Av. 45% over 14 days
		82% within 2 weeks
	Lignosulphonates	66-70% over 23 days
	Polymer emulsions	70% over 58 days
	Tar and bitumen emulsions	70% over 20 days
Other	Use larger vehicles rather than smaller vehicles to minimise number of trips	90t to 220t: 40% [a]
		140t to 220t: 20% [a]
		140t to 360t: 45% [a]
	Use conveyors in place of haul roads	>95% [a]

Source: Katestone 2010, Table 66

3.2.2 Bulldozers

Katestone (2010) presents a comprehensive summary of an options appraisal conducted by Connell Hatch for the control of particulate emissions from bulldozers at the RG Tanna Coal Terminal. Options considered in the study included:

- Minimising travel speed and travel distance;
- Stabilising bulldozer travel routes and use of water or suppressants on travel routes;
- Manage material moisture to ensure coal is sufficiently moist when working; and
- Modify design of the bulldozer to minimise emissions.

A summary of the potential control measures for minimising particulate emissions from bulldozers, and their effectiveness, is provided in **Table 6** (Katestone, 2010).

Table 6 Best Practice Control Measures – Bulldozers

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

Source: Katestone (2010), Table 76

As noted above, the 2010 AQIA incorporated a 30% reduction in particulate emissions from the bulldozer when operating on shale based on the shielding effect of the amenity bund. As the use of windbreaks is not specifically addressed in the Katestone report for bulldozer emissions, this is discussed further in **Section 3.2.3**. The use of water sprays is also identified as an effective control measure and the use of the water truck/sprays on the stockpiles and access roads (as per the draft AQMP) at the New Berrima Quarry would assist in reducing emissions from this source.

3.2.3 Wind Erosion from Stockpiles

The Katestone report does not provide best management practices for wind erosion of non-coal stockpiles. In the absence of such measures, the best practice measures for coal stockpiles have been reviewed. It is acknowledged that the nature of material stockpiled will have a significant effect on the wind erosion profile, in addition to other factors. Generally, stockpiles provide a surface for the generation of wind-eroded material and the subsequent propagation of particulate matter emissions. In addition to stockpile dimensions, emissions generated by wind erosion from stockpiles are also dependent on the frequency of disturbance of the exposed surface. Over time, the surface of an undisturbed stockpile will become depleted of erodible material and emissions of particulate matter will reduce. However, the nature of product stockpiles is that they are frequently disturbed, causing fresh surface material to be exposed restoring the erosion potential (Katestone, 2010).

A summary of the potential control measures for minimising particulate emissions from wind erosion from coal stockpiles, and their effectiveness, is provided in **Table 7** (Katestone, 2010). The use of vegetative wind breaks are estimated to reduce emissions by 30% and the use of water sprays by 50%.

As noted above, a 30% reduction due to the sheltering effect of the amenity bund was applied to the bulldozer working on shale. To provide a conservative assessment, and to account for any activities occurring on-site outside of the areas sheltered by the amenity bund, this control factor was not applied to bulldozers working on overburden, product/overburden loading or the product stockpile area. The draft AQMP also provides for the use of water sprays to control emissions from the stockpile area which was not included in the 2010 AQIA emission estimates or the revised inventory. This will add to the conservative nature of the assessment.

Table 7 Best Practice Control Measures – Wind Erosion of Coal Stockpiles

Control Type	Control Measure	Effectiveness
Avoidance	Bypassing stockpiles	100% reduction in wind erosion for coal bypassing stockpiles
Surface stabilisation	Water spray	50%
	Chemical wetting agents	80-99% 85% 90%
	Surface crusting agent	95%
	Carry over wetting from load in	80%
Enclosure	Silo with bag house	100% 95-99% 99%
	Cover storage pile with a tarp during high winds	99%
Wind speed reduction	Vegetative wind breaks	30%
	Reduced pile height	30%
	Wind screens/wind fences	>80% 75-80%
	Pile shaping/orientation	<60%
	Erect 3-sided enclosure around storage piles	75%

Source: Katestone 2010, Table 72

4 Conclusions

The main conclusions of this review are as follows:

- The proposed modification to the extraction area is not anticipated to have a significant impact on the dust emissions that would be emitted from the site.
- A detailed review of the emission inventory compiled for the 2010 AQIA has shown that updates to the published emission factors recommended for use in estimating potential dust emissions from the activities proposed to be undertaken on site have resulted in a decrease in the estimated total site emissions. There has also been a significant change in the contribution of specific activities to the total Project Site emissions, with unpaved haul road emissions becoming the potentially most significant source.
- Maximum off-site annual average TSP and PM_{10} concentrations predicted at the nearest sensitive receptors in the 2010 AQIA were well below the relevant criteria levels. Given this, and the significant decrease in the estimated total site annual emission rates for TSP and PM_{10}, it is expected that the off-site annual average concentrations presented in the 2010 AQIA would be well below the relevant assessment criteria, even with the locations of the extraction-related activities moving further north and the increased significance of the haul road emissions.
- In the 2010 AQIA, modelling of 24-hour average PM_{10} concentrations indicated the potential for exceedances of the relevant OEH criterion of 50 µg/m^3 at two sensitive receptors (R3N and R19) located to the northeast of the Project Site. These exceedances were associated with a day when the background 24-hour average PM_{10} concentration was abnormally high (49.2 µg/m^3). The predicted incremental impacts associated with the proposed on-site activities on this day were very low (e.g. 1.4 µg/m^3 at R19). The updated emission inventory for the proposed on-site activities shows a slight decrease in the estimated total peak hourly emission rates for PM_{10}. On this basis it would be expected that the maximum off-site 24-hour PM_{10} concentrations would decrease slightly. While the locations of the extraction-related activities will move to the northeast, closer to R3N and R19, the combined hourly emission estimates for these sources have decreased by approximately 40% for

both TSP and PM_{10}. These reductions would be expected to more than compensate for the estimated increase in emissions due to truck movements in this part of the site.

- Annual average monthly dust deposition rates predicted at the nearest sensitive receptors in the 2010 AQIA were below the OEH guideline of 2 g/m^2/month (incremental impact) and given the significant decrease in the estimated total site annual emission rates for TSP, it is expected that the off-site annual average monthly deposition rates presented in the 2010 AQIA would be conservative over-estimates of actual impacts.
- A review of the proposed dust control measures included in the draft AQMP has been performed. There are a number of dust control measures proposed for the site that have not been incorporated into the emission inventory and the modelling performed in the 2010 AQIA, including the use of a vegetative screen to control wind erosion from the product stockpile, and vehicle speed reductions. Given this, and the use of the AUSPLUME model which would be expected to result in conservative predictions of off-site dust levels, it is expected that the TSP and PM_{10} concentrations, and dust deposition rates, predicted for the nearest sensitive receptors in the 2010 AQIA will be conservative over estimates of the levels that would actually occur.

5 References

Corkery, 2012 — *Water Requirement for Berrima Clay/Shale Quarry*, email transmission from R.W. Corkery & Co, 7 June 2012.

Heggies, 2010 — Air Quality Impact assessment for the New Berrima Clay/Shale Quarry, ref 10-7182

Katestone, 2010 — *NSW Coal Mining Benchmarking Study: International Best Practice Measures to* prevent *and/or Minimise Emissions of Particulate Matter from Coal Mining*, prepared for Department of Environment, Climate Change and Water KE1006953, Katestone Environmental Pty Ltd, December 2010.

NPI 2001 — *National Pollutant Inventory Emission Estimation Technique Manual for Mining*, Version 2.3, Environment Australia, December 2001.

NPI 2012 — *National Pollutant Inventory Emission Estimation Technique Manual for Mining*, Version 3.1, Department of Sustainability, Environment, Water, Population and Communities, January 2012.

Yours sincerely

KIRSTEN LAWRENCE
Principal

Appendix A

Figure A-1 Predicted Annual Average TSP Concentrations Due to Proposed Site Activities
As Presented in the 2010 Air Quality Impact Assessment
***Background TSP estimated at 19.2* µg/m^3, OEH Criterion = 90 µg/m^3**
(contours in µg/m^3)

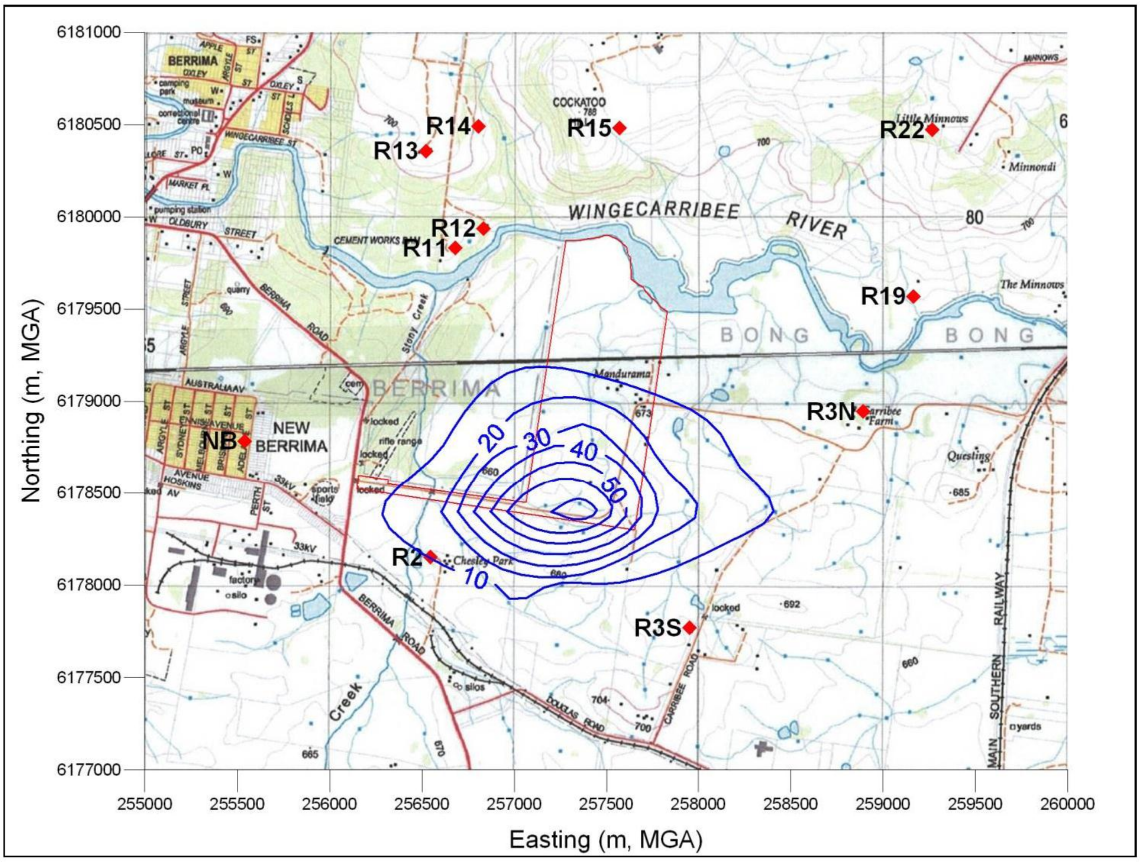


Figure A-2 Predicted Annual Average PM_{10} Concentrations Due to Proposed Site Activities
As Presented in the 2010 Air Quality Impact Assessment
***Background PM_{10} estimated at 12.8* µg/m^3, OEH Criterion = 30 µg/m^3**
(contours in µg/m^3)

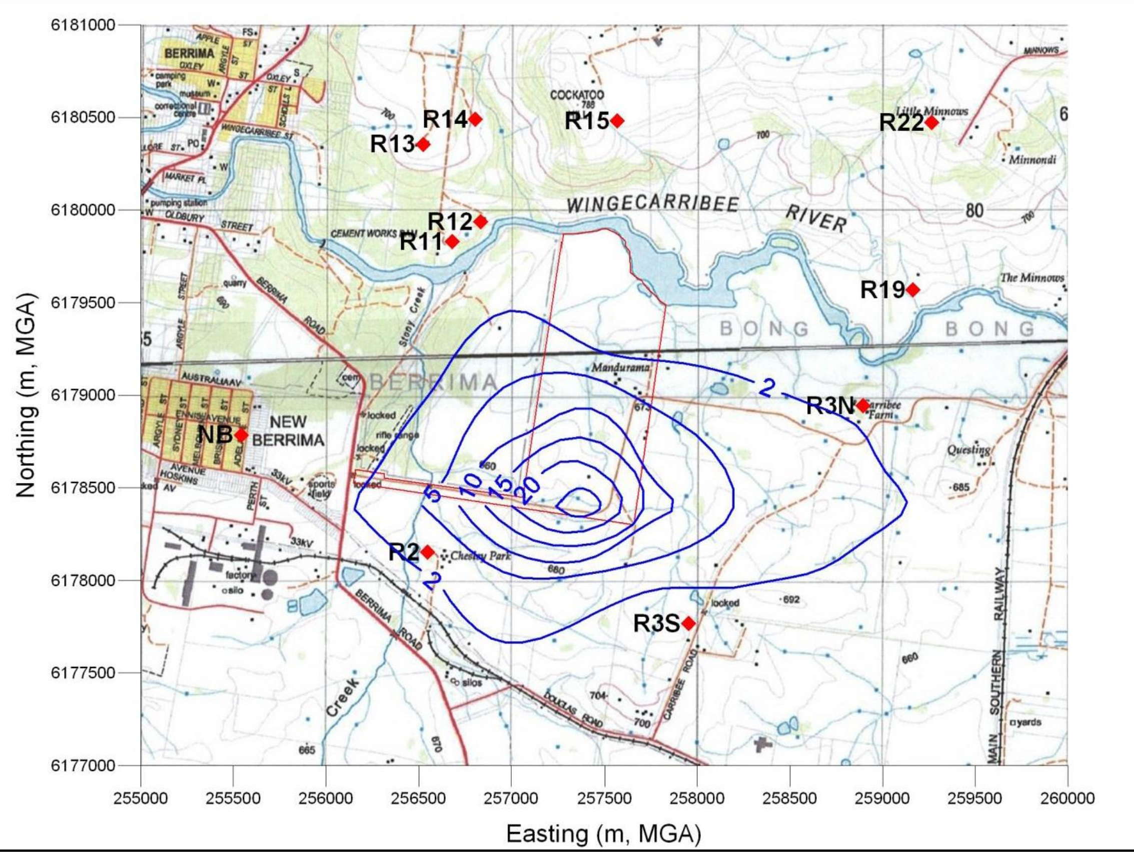


Figure A-3 Predicted 24-hour Average PM_{10} Concentrations Due to Proposed Site Activities
As Presented in the 2010 Air Quality Impact Assessment
OEH Criterion = 50 μg/m³
(contours in μg/m³)

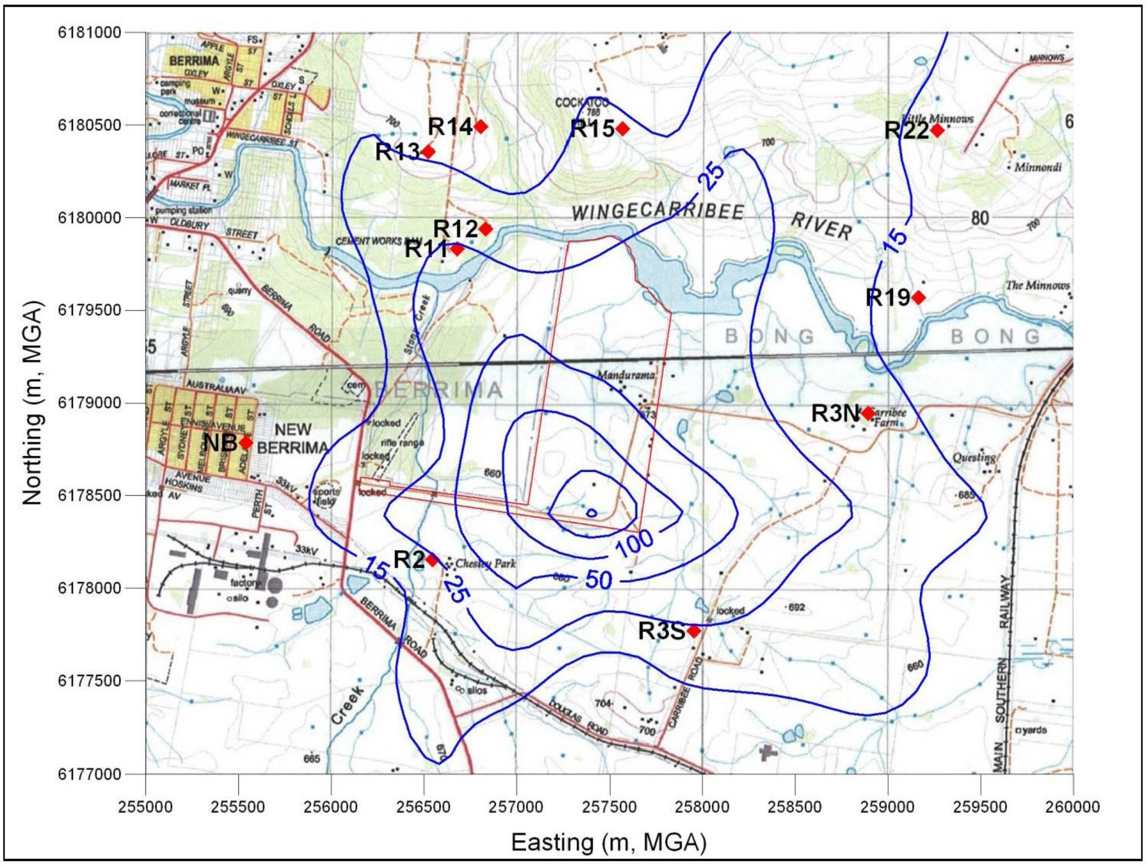
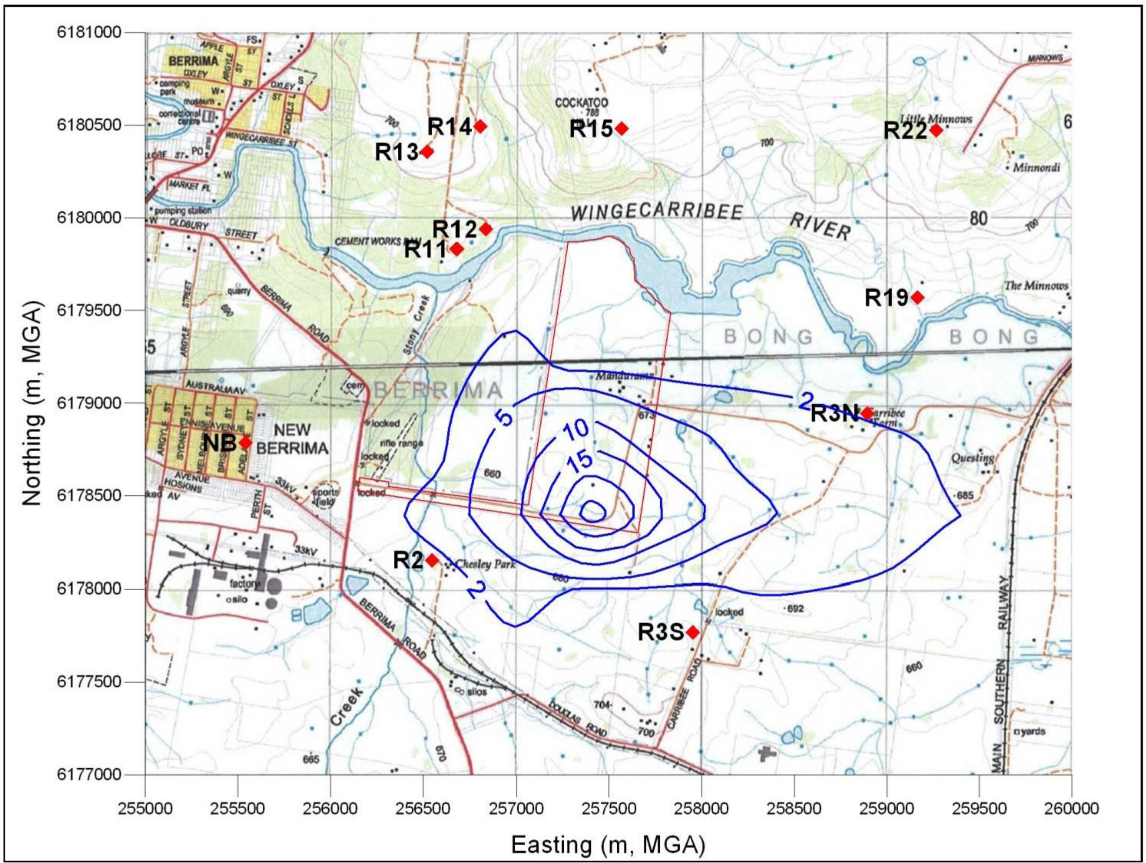


Figure A-4 Predicted Annual Average Dust Deposition Rates Due to Proposed Site Activities
As Presented in the 2010 Air Quality Impact Assessment
OEH Criterion = 2 g/m^2/month
(contours in g/m^2/month)



R.W. CORKERY & CO. PTY. LIMITED
Geological and Environmental Consultants
ABN: 31 002 033 712

Brooklyn Office:
1st Floor, 12 Dangar Road
BROOKLYN NSW 2083

Phone: (02) 9985 8511
Fax: (02) 9985 8208
Email: brooklyn@rwcorkery.com

Orange Office:
62 Hill Street
ORANGE NSW 2800

Phone: (02) 6362 5411
Fax: (02) 6361 3622
Email: orange@rwcorkery.com

Brisbane Office:
Suite 5, Building 3
Pine Rivers Office Park
205 Leitchs Road
BRENDALE QLD 4500
Mobile: 0437 858 511
Mobile: 0402 060 522
Email: brisbane@rwcorkery.com

EMAIL TRANSMISSION

TO:	David Mooney	EMAIL:	david.mooney@planning.nsw.gov.au
ORGANISATION:	Department of Planning and Infrastructure	DATE:	7 June 2012
COPY:	Austral, SLR, SEEC	REFERENCE:	744

NO. OF PAGES (including attachments): 4

SUBJECT: Re: Water Requirement for Berrima Clay/Shale Quarry

☐ *Confidential* ☐ *Please Reply* ■ *For Follow-up* ☐ *Urgent* ☐ *For your information*

MESSAGE: Greetings David,

I have reviewed the contents of the *Environmental Assessment* and the air quality and surface water assessments and established the following.

(i) There are indeed inconsistencies between both the air quality and surface water assessments.

(ii) The assumptions used by both the air quality and surface water assessments in reality will be not applicable to the operations.

I have discussed the assumptions with both SEEC and SLR Consulting Australia Pty Limited (formerly Heggies Pty Ltd) and established the following would be practical for the proposed quarry.

(a) Water application rates for dust suppression of $1L/m^2$/application with time between applications of 2 hours (watering up to 5 occasions per day).

(b) The location of the water application would be confined to an 850m section of the site access road, i.e. from the floor of the extraction area to the end of the unsealed section of the site access road. The width of the road covered would be approximately 4m. Overall, the surface area of the road requiring regular watering would be $3400m^2$.

(c) It would not be practical nor necessary to regularly apply water to the extraction area and overburden stockpile. The key area for dust suppression remains the unsealed roads between the active extraction area and the areas where materials are transported for placement on site or the site access road.

It is noted the air quality assessment conducted by SLR Consulting did not assume any watering within either the extraction area or on the overburden stockpile as this is not a practice normally undertaken in quarries. Rather, the emphasis for the air quality modelling was the unsealed road for a distance of 1.7km at a rate of $2L/m^2/hr$ over the 9 operational hours per day. This rate of water application was included in the model to achieve an emission reduction of 50%. SLR Consulting has provided additional information on the basis for the $2L/m^2/hr$ application rate and has established that this rate of water application is recommended within the National Pollutant Inventory Emission Estimation Technique Manual for Mining. This manual is generally

R.W. CORKERY & CO. PTY. LIMITED

8 June 2012 Page 2

used for large coal mine Projects where heavy and frequent traffic movements on off-road haul roads (and their substantive widths) are far in excess of those proposed for the New Berrima Project.

An alternate and more appropriate approach has been identified by SLR Consulting, i.e. through consideration of the following variables.

P	=	Potential Average Daytime Evaporation Rate (mm/day)
D	=	Average Hourly Daytime Traffic Data (veh/hr)
T	=	Time Between Applications (hrs)
I	=	Application Intensity (L/m^2)

The USEPA (1987) developed the following equation incorporating these inputs.

Control Efficiency (CE) = 100- (0.8xPxDxT/I).

The aim of this approach is to identify the watering regime required to achieve the 50% control efficiency on haul roads utilised within the Air Quality Assessment. Known values are the evaporation rates (sourced from the Goulburn TAFE BoM AWS [ID 070263]) and vehicle trips (7.6/hr).

The table below lists the results of the analysis for a constant 2 hour period between watering (i.e. 5 x per day) or a constant application rate of 1L/m^2/application.

CE=100-(0.8*P*D*T/I)
P = Potential Average Hourly Daytime Evaporation Rate (mm/hr)
Winter 1.4mm/day, Spring 3.9mm/day, Summer 5.3mm/day, Autumn 4mm/day (Goulburn TAFE - closest with evap data)
D = Average Hourly Daytime Traffic Rate (veh/hr) - 7.6 per hour (68 per day maximum over 9 hours)
T = Time Between Applications (hr) - Variable
I = Application Intensity (l/m2) - Variable
Assumed hourly evap from daily/12

Keeping T constant at 2 hours	Annual	Winter	Spring	Summer	Autumn
P	0.29	0.12	0.33	0.44	0.33
D	7.6	7.6	7.6	7.6	7.6
T	2	2	2	2	2
I	0.07	0.03	0.08	0.11	0.08
CE=100-(0.8*P*D*T/I)	50	50	50	50	50

Keeping I constant at 1 litre	Annual	Winter	Spring	Summer	Autumn
P	0.29	0.12	0.33	0.44	0.33
D	7.6	7.6	7.6	7.6	7.6
T	28	71	25	19	25
I	1	1	1	1	1
CE=100-(0.8*P*D*T/I)	50	50	50	50	50

The outcome from the above calculations is that in order to obtain controlled emissions from the proposed access road at a rate of 50% (the level assumed in the modelling originally undertaken in 2010), water application rates of <1L/m^2/2hrs are appropriate.

Based upon a very conservative 1L/m^2/application for 5 applications per day, the quality of water used would be 3400m^2 x 1 x 5L/m^2 = 17 000 litres. This amount is approximately 50% of the quantity of water nominated by SEEC in their water balance. Therefore the quantity of daily usage is highly conservative.

In light of the above estimate of daily usage, the annual usage would conservatively be in the order of 4.25ML/yr (17 000L x 250 days). In reality, trucks would not be in operation 250 days per year and on many days, the level of rainfall would remove the need for watering.

R.W. CORKERY & CO. PTY. LIMITED

SEEC has prepared a revised RATES model to establish the ability of the on-site dams (with a capacity of 4.59ML) to supply the original 33 400L/day. The results of the model outcomes are attached. Essentially a 4.59ML storage would be able to supply the nominated 33 400L/day for 98.7% of the time. Based on this outcome, it is proposed that the amount of 17 000L/day would be able to be supplied 100% of the time.

Conclusion

The practical water requirement for dust suppression at the New Berrima Quarry would be satisfied by the proposed dams on site for 100% of the time.

I trust this response satisfies the Department and that you are now in a position to proceed to determination of the application.

Should you have any questions about the information provided, please do not hesitate to contact me.

Regards

Rob Corkery

Attached: RATES Model Output (1 page)

R.W. CORKERY & CO. PTY. LIMITED

8 June 2012

SEEC
MORSE MCVEY

SEEC RATES IV Results
Site: New Berrima
Rain station: Moss Vale 68045

Total years:	99.33	Avg annual rainfall (mm):	954.57
Total days:	36278	Max daily rainfall (mm):	422
Total no of days when rain fell:	11614	Longest dry spell (days):	57
Avg days per year when rain fell:	116.9233867	Days when rain > S1 initial loss:	4380
Avg wet day rainfall (mm):	8.16	Avg days/yr rain > S1 initial loss:	44.09544

Input statistics:	**Model 1 (4.59ML storage)**		**Model 2 (2.9ML storage)**	
Capacity (L):	4590000		2900000	
Startup % full:	10		10	
Catchment area (sqm):	195000		195000	
Initial loss per day (mm):	5		5	
Runoff percentage:	60		60	
Apply use A on wet days (Y/N):	Y		Y	
Apply use B on wet days (Y/N):	N		N	
Revert to mains at threshold (Y/N):	N		N	
Mains reversion threshold (% full):	0		0	
Overflows into Storage 2 (Y/N):	N		N/A	
USAGE stats (L/day):	**Storage 1**		**Storage 2**	
Usage type:	**A**	**B**	**A**	**B**
January	2000	100200	2000	100200
February	2000	66800	2000	66800
March	2000	33400	2000	33400
April	2000	8350	2000	8350
May	2000	8350	2000	8350
June	2000	8350	2000	8350
July	2000	8350	2000	8350
August	2000	8350	2000	8350
September	2000	33400	2000	33400
October	2000	33400	2000	33400
November	2000	66800	2000	66800
December	2000	100200	2000	100200
Results:	**Storage 1**		**Storage 2**	
% of time demand met:	98.7		96.2	
% of demand supplied from mains:	0		0	
Longest time storage ran dry (days):	38		56	
Avg annual mains demand (L):	0		0	
Avg wet day overflow (L):	494562.71		501314.29	
Avg no of overflow events annually:	31.94402497		32.43733011	
Avg annual supply from rain in (L):	12985609		12336107	
Max daily overflow (L):	48755950		48755950	
Annual demand (L):	13329934.06		13329934.06	

Y:\Jobs 531 to 1000\744\Reports\74402_EA_2008\Letters\74402_05F12_Mooney_e_MD.docx