



Narrabri Mine

**Environmental
Assessment**

MAIN REPORT

APPENDICES

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1 INTRODUCTION

This document is an Environmental Assessment (EA) for a proposed modification to the Narrabri Mine (NM), an underground coal mining operation which operates in accordance with Project Approval 08_0144.

The NM is operated by Narrabri Coal Operations Pty Ltd (NCOPL) on behalf of the Narrabri Joint Venture, which consists of Whitehaven Coal Limited (Whitehaven) (70%), Upper Horn Investments (Australia) Pty Ltd (7.5%), Electric Power Development Co. Ltd (7.5%), EDF Trading (7.5%), and Daewoo International Corporation and Korea Resources Corporation (7.5%).

The Stockpile Extension Modification (the Modification) is sought under section 75W of the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979* (EP&A Act).

1.1 OVERVIEW OF THE EXISTING/APPROVED NARRABRI MINE

The NM is located approximately 28 kilometres (km) south-east of Narrabri and approximately 65 km north-west of Gunnedah in the Gunnedah Basin, NSW (Figure 1).

Stage 1 of the NM was originally approved under Part 3A of the EP&A Act in 2007 and involved initial site establishment activities and continuous miner mining operations.

Project Approval 08_0144 for Stage 2 of the NM was issued in 2010 and allowed the mine to convert to a longwall mining operation.

Project Approval 08_0144 has been modified on two occasions since it was issued:

- March 2011 – to update subsidence management conditions in Project Approval 08_0144; and
- December 2011 – to allow for one-off road transport of coal to the Tarrawonga Coal Mine.

Project Approval 08_0144 allows for the production and processing of up to 8 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal for a period of 21 years. ROM coal is processed at the NM to produce thermal and PCI product coal. Product coal is transported from the NM by rail to Newcastle.

The existing/approved NM general arrangement is shown on Figure 2.

1.2 OVERVIEW AND JUSTIFICATION FOR THE MODIFICATION

NCOPL is planning on increasing ROM coal production in 2015 from the current production rate of approximately 5.5 Mtpa up to the approved maximum production rate of 8 Mtpa.

As part of planning for the increased ROM coal production rate, NCOPL conducted a review of the capacity of the existing/approved coal storage and handling infrastructure.

This review identified that the design of the existing ROM and product coal stockpiles assumed steady state ROM coal production and coal loading at 8 Mtpa. The design did not therefore take into account fluctuations in ROM coal production and train loading associated with operational requirements (e.g. longwall changeovers, train schedules).

An increase in the capacity of the ROM and product coal stockpiles is therefore required to allow production to reach the approved maximum rate (i.e. 8 Mtpa of ROM coal) allowing for fluctuations associated with operational requirements. The Modification would allow for the efficient storage, handling and loading of coal at the NM.

The Modification would not include any other significant changes to the existing/approved NM.

1.3 CONSULTATION

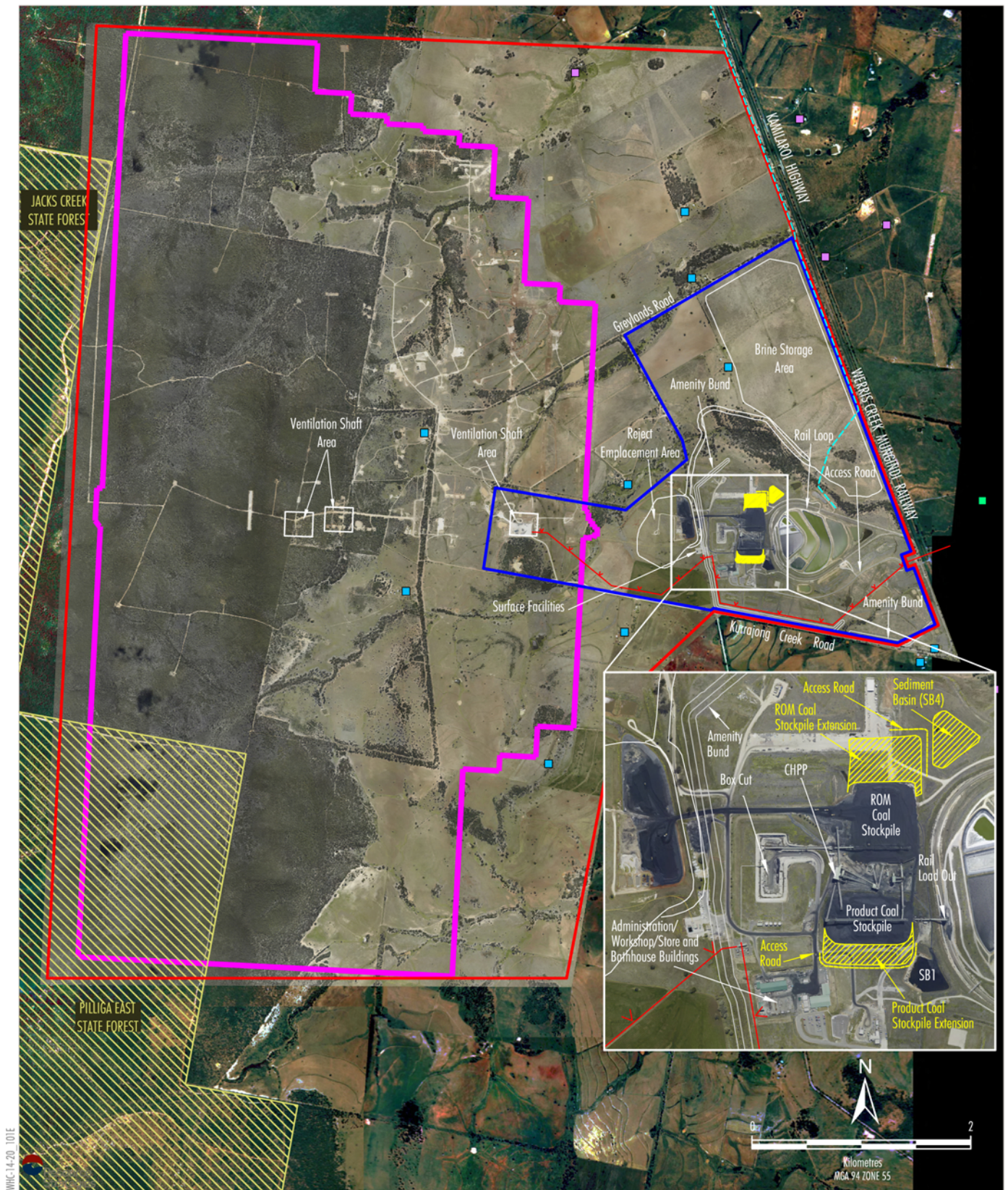
Consultation has been conducted with the local community, key NSW Government agencies and the Narrabri Shire Council (NSC) during the preparation of this EA. A summary of this consultation is provided below.

It is anticipated that consultation with the local community, key NSW Government agencies and the NSC will continue during the public exhibition of this EA and the assessment of the proposal by the NSW Government.

Local Community

A Community Consultative Committee (CCC) for the NM is in place and provides a mechanism for ongoing communication between NCOPL and the local community.

NCOPL provided an overview of the Modification at the CCC meeting held on 11 March 2015.



- LEGEND**
- State Forest
 - Mining Lease Boundary (ML 1609)
 - Pit Top Area
 - Underground Mining Area
 - Approved Surface Development (Not Constructed)
 - Modified Surface Development
 - Water Pipeline
 - Electricity Transmission Line
 - Mine-owned Dwelling
 - Private Dwelling
 - Private Dwelling - NCOPL Agreement


NARRABRI MINE
 Existing/Approved and Modified
 Narrabri Mine General Arrangement

Source: R.W. Corley & CO Pty Ltd (2009), NSW Trade & Investment (2015) and NCOPL (2015)

Figure 2

NSW Government Agencies

NCOPL continues to consult with relevant NSW Government agencies on a regular basis in relation to the current NM operations.

NCOPL met with the Department of Planning and Environment (DP&E) and Environment Protection Authority (EPA) on 5 February 2015. An overview of the proposed Modification was provided and key assessment requirements and outcomes and the proposed timing for EA lodgement were discussed.

NCOPL provided the DP&E and EPA with an update on the progress with key assessments and their outcomes on 16 March 2015.

Narrabri Shire Council

The NM is located within the Narrabri local government area (LGA).

The NSC has been updated on the Modification through its involvement in the CCC (see above).

Appendices A and B provide supporting information as follows:

Appendix A Noise Assessment.

Appendix B Air Quality Assessment.

1.4 STRUCTURE OF THIS DOCUMENT

This EA comprises a main text component and supporting studies. An overview of the main text sections is presented below:

- | | |
|-----------|--|
| Section 1 | Provides an overview of the existing/approved NM, an overview and justification for the Modification and a summary of the consultation undertaken in relation to the Modification. |
| Section 2 | Provides a description of the Modification. |
| Section 3 | Provides an environmental assessment of the Modification and describes the existing environmental management systems and measures available to manage and monitor any potential impacts. |
| Section 4 | Describes the general statutory context of the proposed Modification. |
| Section 5 | References. |

2 MODIFICATION OVERVIEW

A description of the Modification is provided below, including a comparison of the modified NM with the existing/approved mine (Table 1).

2.1 ROM COAL STOCKPILE

Existing/Approved

The existing ROM coal stockpile is located in the pit top area (Figure 2). Its footprint is approximately 210 metres (m) by 225 m (approximately 4.7 hectares [ha]) and has a maximum height of approximately 20 m.

The capacity of the existing ROM coal stockpile is approximately 400,000 tonnes (t).

The ROM coal stockpile is serviced by a skyline conveyor and reclaim valves with associated conveyors.

Modification

The ROM coal stockpile footprint would be extended approximately 110 m to the north resulting in an approximate 210 m by 335 m (approximately 7 ha) ROM coal stockpile footprint (Figure 2).

The maximum height of the ROM coal stockpile (approximately 20 m) would remain unchanged.

The modified ROM coal stockpile footprint would be located in existing/approved pit top area (Figure 2).

The ROM coal stockpile capacity would increase from 400,000 t to 700,000 t.

No changes to the existing skyline conveyor and reclaim valves and associated conveyors are required.

2.2 PRODUCT COAL STOCKPILE

Existing/Approved

The existing product coal stockpile is located in the pit top area (Figure 2). Its footprint is approximately 130 m by 260 m (approximately 3.4 ha) and is approximately 25 m high.

The capacity of the existing product coal stockpile is approximately 350,000 t.

The product coal stockpile is serviced by skyline conveyors and three reclaim valves with associated conveyors.

Modification

The product coal stockpile footprint would be extended approximately 55 m to the south resulting in a 185 m by 260 m (approximately 4.8 ha) product coal stockpile footprint (Figure 2).

The height of the product coal stockpile (approximately 25 m) would remain unchanged.

The modified product coal stockpile footprint would be located in existing/approved pit top area (Figure 2).

The product coal stockpile capacity would increase from 350,000 t to 500,000 t.

Two additional reclaim valves would be constructed under the product coal stockpile to allow for the efficient reclaiming and loading of product coal and to minimise dozer movements.

No changes to the existing skyline conveyors and train load-out facilities are required.

2.3 WATER MANAGEMENT SYSTEM

Water management at the NM is conducted in accordance with the Water Management Plan (URS Australia, 2013).

It describes the existing/approved NM pit top area water management infrastructure as including:

- sediment basins (SB1, SB2 and containment bund) to store runoff from the Coal Handling and Preparation Plant (CHPP)/coal stockpile and the rail loop areas;
- water storage dams (SD1, SD2, SD3, SD4 and SD5) to store runoff from the periphery of the pit top area;
- water storages (A1, A2, A3, B1, B2, C and D) to store and dispose of mine water and runoff from the pit top area;
- box cut sump to store mine water and runoff draining to the box cut;
- collection drains to divert disturbed area runoff to sediment basins and water storage dams; and
- associated pumps and pipelines.

Table 1
Comparison of the Existing/Approved and Modified NM

Project Component	Existing/Approved	Modified
Project Life	Mining operations approved until July 2031.	Unchanged.
Tenement	Mining operations conducted within ML 1609.	Unchanged.
Mining	- Underground mining of up to 8 Mtpa of ROM coal from the Hoskissons Seam. - Total ROM coal production of approximately 170 million tonnes.	Unchanged.
Subsidence Commitments and Management	The subsidence impact performance measures listed in Conditions 2 and 3, Schedule 3 of Project Approval 08-0144.	Unchanged.
Coal Washing	CHPP and secondary crusher/screen capable of processing approximately 2,000 tonnes per hour.	Unchanged.
Coal Handling and Stockpiling	- ROM coal stockpile capacity of 400,000 t. - Product coal stockpile capacity of 350,000 t. - Skyline conveyors. - Reclaim valves with associated conveyors.	- An increase in the ROM coal stockpile capacity from 400,000 t to 700,000 t. - An increase in the product coal stockpile capacity from 350,000 t to 500,000 t. - Two additional product coal stockpile reclaim valves and associated conveyors. - Skyline conveyors unchanged.
CHPP Rejects Management	CHPP rejects emplaced in Rejects Emplacement Area.	Unchanged.
Product Coal Transport	Product coal transported to Newcastle by rail.	Unchanged.
Water Management	Conducted in accordance with the Water Management Plan.	Minor changes to the pit top area water management infrastructure.
Water Supply	Make-up water demand to be met from runoff recovered from operational areas, mine dewatering, licensed extraction from Namoi River and Namoi River Alluvium.	Unchanged.
Hours of Operation	24 hours per day, seven days per week.	Unchanged.
Employment	Operational workforce (employees and contractors) of approximately 330 employees.	Unchanged.
Rehabilitation Strategy	Conducted in accordance with the Rehabilitation Management Plan.	Unchanged.

The Modification would include the construction of a new sediment basin (SB4) to the north-east of the ROM coal stockpile (Figure 2) and associated collection drains to collect runoff from the modified ROM coal stockpile area.

SB4 would be designed and constructed to capture runoff from a 1 in 100 year, 72 hour rainfall event consistent with existing sediment basins at the NM.

Water captured in SB4 would be transferred to either SB1 or directly to the ponds within rail loop for re-use onsite.

Runoff from the modified product coal stockpile area would be captured in existing sediment basins (SB1 and SB2). SB1 would be augmented to maintain access around the product coal stockpile without changing its storage capacity.

No other changes to NM water management system would be required for the Modification.

2.4 CONSTRUCTION

Construction activities associated with the Modification would include (Figure 2):

- development of the extended ROM and product coal stockpile pads;
- construction of a new sediment basin (SB4) and associated collection drains;
- minor augmentation to SB1; and
- realignment of minor access roads.

Material excavated during the construction of the new sediment basin (SB4) would be used in the construction of the extended ROM and product coal stockpile pads.

Construction activities would generally be restricted to 7.00 am to 10.00 pm up to seven days a week for approximately six months.

Mobile equipment required for construction would generally be sourced from existing NM mobile equipment fleet. Some additional mobile equipment would however be required during construction (Appendix A).

2.5 REHABILITATION

Rehabilitation at the NM is managed in accordance with the Rehabilitation Management Plan (EcoLogical Australia Pty Ltd, 2012).

At the completion of NM operations, the existing pit top areas (including the ROM and product coal stockpiles areas) will be re-contoured to equivalent to the pre-mining topography (i.e. slopes between 1 to 4%) prior to spreading of soils and sowing a pasture seed mix (EcoLogical Australia Pty Ltd, 2012).

Drainage control structures (e.g. sediment basins and collection drains) will be filled in and rehabilitated as described above.

The Modification would not change the rehabilitation strategy for the pit top area.

2.6 OTHER MINE COMPONENTS

There would be **no change** to the following key components of the existing/approved NM due to the Modification:

- mine life and hours of operation;
- mining tenement;
- mining operations (i.e. underground longwall mining);
- mine fleet;
- maximum annual ROM coal production rate;
- ROM coal processing operations;
- coal reject management;
- product coal transport;
- water demand and supply;
- workforce;
- rehabilitation strategy; and
- biodiversity offset.

3 ENVIRONMENTAL REVIEW

3.1 IDENTIFICATION OF KEY ISSUES

The key potential impacts of the Modification are related to the extension of the existing ROM and product coal stockpiles and would include potential noise, air quality, surface water and visual amenity impacts. A discussion of these potential impacts is provided in this section of the EA.

As no additional surface development outside the existing/approved pit top area is proposed for the Modification, there would be no material alteration to the existing/approved impacts of the NM on land resources, agricultural resources, flora, fauna, Aboriginal cultural heritage, non-Aboriginal cultural heritage and the rehabilitation strategy.

The Modification would not change the annual ROM coal production rate, total ROM coal mined, mine fleet or mine life and therefore there would be no material alteration to the existing/approved groundwater impacts or greenhouse gas emissions from the NM.

As no change to the approved NM workforce or mine life is proposed for the Modification, there would be no material alteration to the approved community infrastructure and road transport impacts.

3.2 NOISE

3.2.1 Background

Previous Assessment

An assessment of potential noise impacts associated with Stage 2 of the NM was conducted by Spectrum Acoustics (2009), which indicated that, with the implementation of mitigation measures, four privately owned residences would experience noise levels above the project-specific noise limit (PSNL) of 35 A-weighted decibels equivalent continuous noise level (dBA $L_{Aeq}(15\text{minute})$), including:

- one residence in the noise affectation zone (greater than 5 dBA above the PSNL) (i.e. “Kurrajong”); and
- three residences in the noise management zone (i.e. 1 to 5 dBA above the PSNL) (i.e. “Greylands”, “Naroo” and “Bow Hills”).

The residence in the affectation zone (i.e. “Kurrajong”) and two of the three residences in the noise management zone (i.e. “Greylands” and “Naroo”) have since been purchased by NCOPL. NCOPL has entered into a private agreement with the remaining residence in the noise management zone (i.e. “Bow Hills”).

NM Noise Limits

Condition 1, Schedule 4 of Project Approval 08_0144 and Condition L3 of Environment Protection Licence (EPL) 12789 specify the noise limits for the NM. Noise at the NM must not exceed 35 dBA $L_{Aeq}(15\text{minute})$ at a privately owned residence.

Noise Management and Monitoring

Existing noise management and monitoring measures are described in the Noise Management Plan (Spectrum Acoustics, 2011). The Noise Management Plan includes (Spectrum Acoustics, 2011):

- Project Approval 08_0144 and EPL 12789 noise criteria;
- noise management measures;
- operator-attended and real-time noise monitoring program; and
- complaints handling procedures.

Operator-Attended Noise Monitoring

The NM noise monitoring program includes operator-attended noise monitoring at locations surrounding the mine (Figure 3).

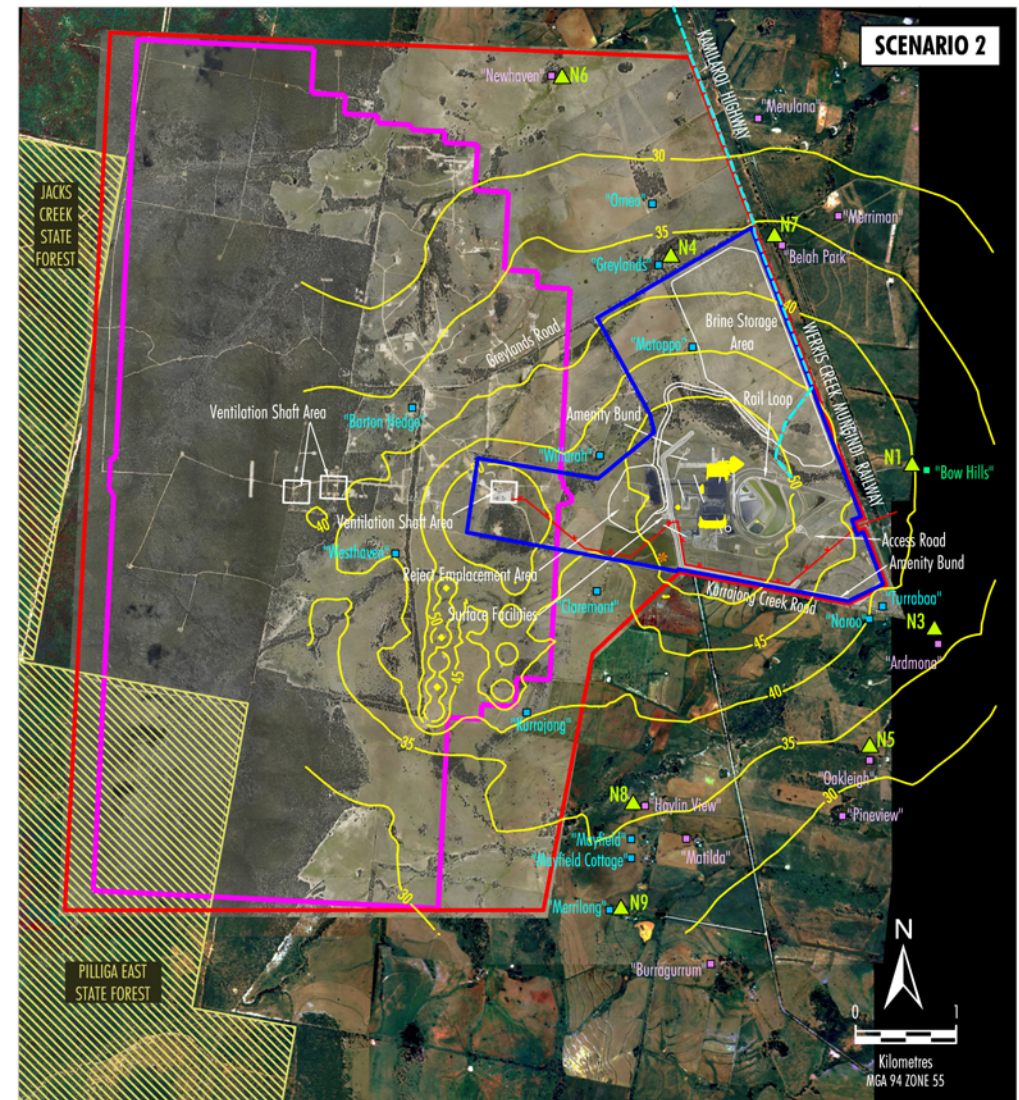
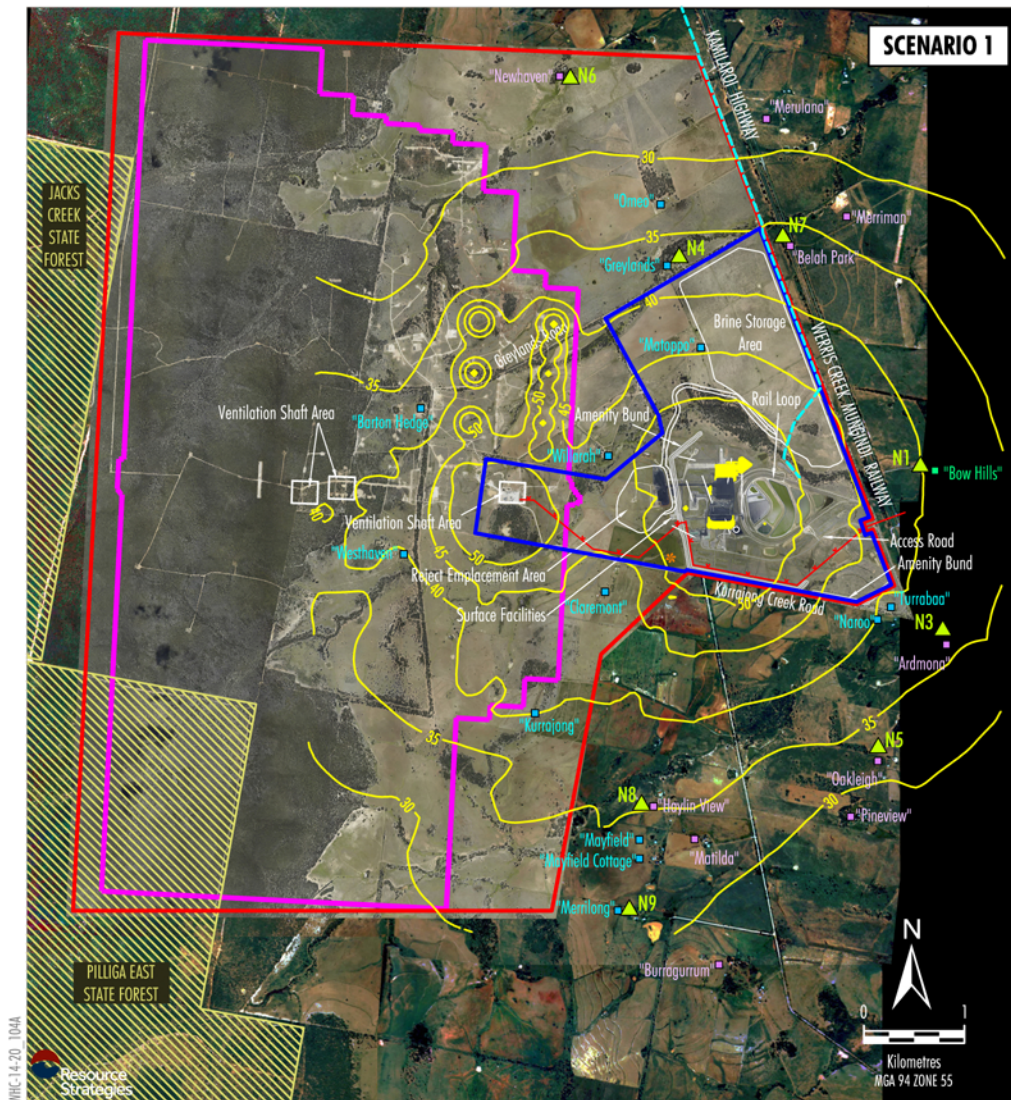
Based on the results of operator-attended monitoring, operational noise from the NM has complied with the noise limits specified in Project Approval 08_0144 and EPL 12789 at privately owned residences during 2012 to 2014 except on six occasions (Appendix A). Three of these exceedances occurred at “Bow Hills” which NCOPL has entered into a private agreement with.

Real-time Monitoring

Real time (unattended) noise monitoring is conducted at the NM to assist in the management of noise impacts (Appendix A).

3.2.2 Environmental Review

Spectrum Acoustics (2015) has conducted predictive noise modelling to determine potential noise impacts associated with the Modification.



Source: R.W. Corley & CO Pty Ltd (2009), NSW Trade & Investment (2015) and NCOPL (2015)

WHITEHAVEN COAL

NARRABRI MINE

**Noise and Meteorological Monitoring Locations
and Night-time ($4^{\circ}\text{C}/100\text{m}$ Inversion)
 L_{Aeq} (15 minute) Noise Contours**

Figure 3

Potential Impacts

Noise Modelling Methodology

The noise modelling methodology used by Spectrum Acoustics was based on previous predictive noise modelling conducted in accordance with the NSW Industrial Noise Policy (INP) for the NM (Spectrum Acoustics, 2009), with revisions as required to account for the Modification.

Assessable Meteorological Conditions

For the Modification, NM meteorological data were reviewed to determine assessable meteorological conditions in accordance with the INP.

The predictive modelling for the Modification considered calm (neutral) conditions and a 4 degrees Celsius (°C)/100 m temperature inversion (Appendix A).

No other assessable meteorological conditions were considered relevant (Appendix A).

Modelling Scenarios

The Modification would involve extensions of the existing ROM and product coal stockpile footprints (Figure 2) but no change to the existing/approved heights would be required (Sections 2.1 and 2.2).

The extensions to the ROM and product coal stockpile footprints would not materially change the potential noise impacts compared to the existing/approved NM, as the locations of the potential noise sources (i.e. dozers) would not significantly change.

The Modification would result in no other changes to the NM operations that would significantly alter potential noise impacts from the NM.

Since no significant changes to the existing/approved NM operations are proposed, the same operational scenarios assessed in Spectrum Acoustics (2009) were used. These scenarios are summarised below:

- Scenario 1: All surface plant and train loading activities occurring with goaf drainage pumps located above longwall 1 and pre-drainage construction above longwalls 2 and 3.
- Scenario 2: All surface plant and train loading activities occurring with goaf drainage pumps located above longwall 24 and pre-drainage construction above longwalls 25 and 26.

Predicted Noise Levels

Maximum predicted operational noise levels at privately owned residences are presented in Table 2.

Table 2
Maximum Predicted Noise Levels for the Modification (at Privately-owned Residences not Subject to a Private Agreement with NCOPL)

Residence	Predicted Noise Level dBA L _{Aeq} (15 minute)
"Ardmona"	35
"Oakleigh"	31
"Pineview"	<30
"Matilda"	32
"Haylin View"	35
"Newhaven"	<30
"Belah Park"	36
"Merriman"	33
"Merulana"	<30

Source: After Appendix A.

Noise contours for the Modification are shown on Figure 3.

In summary, it is predicted that (Table 2):

- no privately-owned residences¹ would be in the noise affectation zone; and
- one privately-owned residence¹ would be in the noise management zone ("Belah Park" – Figure 3).

NCOPL is currently negotiating the acquisition of "Belah Park".

Noise Management Measures Incorporated in Noise Model

NCOPL implements reasonable and feasible on-site noise controls at the NM and these have been included in the noise modelling conducted for the Modification (Appendix A).

Restricting dozers operating on the ROM and product coal stockpiles to first gear while in reverse was considered as an additional noise control for the Modification.

¹ Privately-owned residences not subject to an existing private agreement with NCOPL.

While restricting dozers to first gear while in reverse would reduce the sound power level of the dozers, it would also result in the requirement for an additional two dozers on the ROM and product coal stockpiles due to the restricted dozer speed. As a result, noise reduction due to operating in first gear, would be largely offset by the need for two extra dozers. Given the significant cost associated with purchasing two new dozers, and the minimal environmental gain this option (i.e. restricting dozers to first gear) would provide, it is not considered to be reasonable and feasible.

Management Measures and Monitoring

NCOPL would continue to implement the noise management and monitoring measures detailed in the Noise Management Plan (Spectrum Acoustics, 2011), which would be reviewed in consultation with the DP&E and EPA to reflect an updated operator-attended noise monitoring network to reflect current land ownership.

3.3 AIR QUALITY

3.3.1 Background

Previous Assessment

An assessment of potential air quality impacts associated with Stage 2 of the NM was undertaken by Heggies (2009).

The assessment predicted there would be no exceedances of annual average criteria for particulate matter with diameter less than 10 microns (PM₁₀), total suspended particulate (TSP) or dust deposition levels (Heggies, 2009).

No exceedances of the project-only 24-hour average PM₁₀ criterion were predicted (Heggies, 2009).

Cumulative exceedances of the 24-hour average PM₁₀ criterion were predicted at two residences (Heggies, 2009), one of which is now owned by NCOPL.

Air Quality Management and Monitoring

The existing Air Quality Monitoring Program (Whitehaven, 2012) describes the air quality management and monitoring regime at the NM.

The Air Quality Monitoring Program (Whitehaven, 2012) describes:

- Project Approval 08_0144 air quality criteria;
- air quality controls and management procedures;

- air quality monitoring locations and frequency, comprising (Figure 4):
 - two High Volume Air Samplers (HVAS) measuring PM₁₀ on a one day in six cycle; and
 - eight dust deposition gauges.
- response protocol to any exceedances of Project Approval 08_0144 air quality criteria; and
- complaints management protocol.

Pollution Reduction Programs

NCOPL implements dust control measures at the NM in accordance with the following conditions of EPL 12789 (Appendix B):

- Condition U1: *Development of TARPs* – requires NCOPL to develop a trigger action response plan (TARP) for each activity with the potential to generate dust. NCOPL has implemented a TARP for generation of dust from the pit top area.
- Condition U2: *Fully automated water spray system* – requires NCOPL to implement an automated water spray system for the ROM and product coal stockpiles. NCOPL commissioned the automated water spray system on 30 January 2015.
- Condition U3: *Tripper discharge chute redesign* – requires NCOPL to redesign the product coal tripper discharge chute. NCOPL has modified the product coal tripper in accordance with the Pollution Reduction Program (PRP).

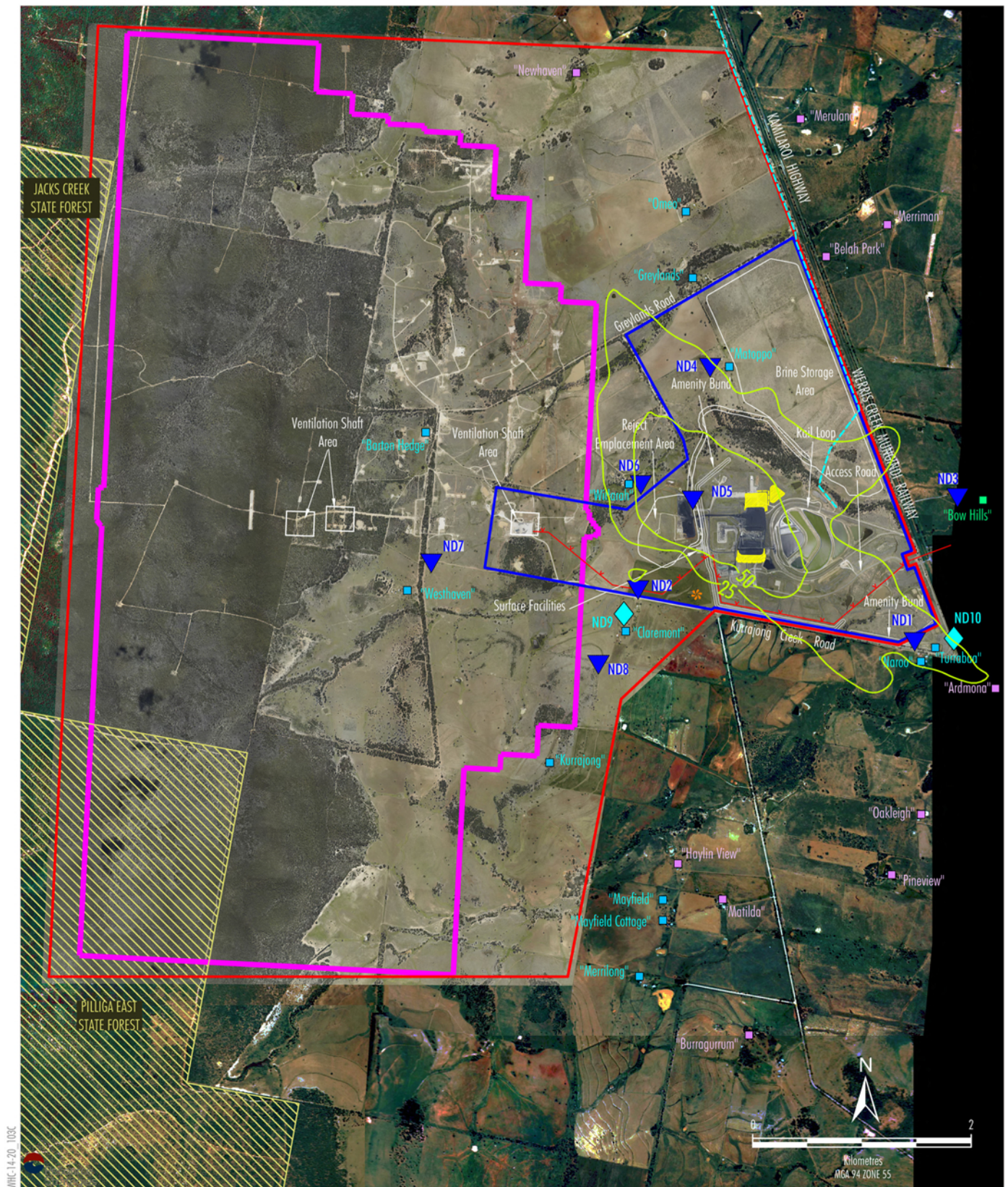
In addition, NCOPL has previously completed the following PRPs (Appendix B):

- *Narrabri Mine: Air Quality Control Protocol* (November 2013); and
- *Implementation of Practical Best Management Practices – Dust Mitigation* (December 2013 and February 2014).

The Implementation of Practical Best Management Practices – Dust Mitigation PRP identified the following practical dust mitigation measures:

- ROM and product coal stockpile water spray system; and
- product coal tripper discharge chute.

NCOPL has implemented these dust mitigation measures.



WMC 14-20 103C

- LEGEND**
- State Forest
 - Mining Lease Boundary (ML 1609)
 - Pit Top Area
 - Underground Mining Area
 - Approved Surface Development (Not Constructed)
 - Modified Surface Development
 - Water Pipeline
 - Electricity Transmission Line
 - Mine-owned Dwelling
 - Private Dwelling
 - Private Dwelling - NCOPL Agreement
 - Project Only - 24-hour PM₁₀ Air Quality Contour (μg/m³)

- Monitoring Sites**
- Deposited Dust Monitoring Location
 - PM₁₀ Monitoring Location
 - Meteorological Station



NARRABRI MINE
Air Quality and Meteorological Monitoring
Locations and 24-hour PM₁₀ Contours
(Project only)

Figure 4

Source: R.W. Corkery & Co Pty Ltd (2009), NSW Trade & Investment (2015) and NCOPL (2015)

Existing Air Quality

Air quality monitoring conducted since 2007 in accordance with the Air Quality Monitoring Program (Whitehaven, 2012) shows cumulative 24-hour PM₁₀ levels have been below the Project Approval 08_0144 criterion with the exception of a one-off exceedance in 2008 associated with localised short-term construction activities and exceedances in late 2009 associated with a regional dust storm event (Appendix B).

No exceedances of the Project Approval 08_0144 annual average PM₁₀ criterion have been recorded (Appendix B).

No exceedances of the Project Approval 08_0144 cumulative annual average dust deposition criterion have been recorded at the dust depositions gauge that is located on privately-owned property with the exception of 2008 and 2009 exceedances as discussed above (Appendix B).

3.3.2 Environmental Review

Potential Impacts

Modelling Methodology

Air quality dispersion modelling has been conducted by Environ Australia (2015) to assess potential impacts of the Modification.

The air quality modelling scenario selected was the existing NM with the extended ROM and product coal stockpiles operating at the approved maximum ROM coal production rate (i.e. 8 Mtpa).

Emissions of TSP (i.e. dust) were estimated by Environ Australia (2015) using contemporary emission estimation methodologies.

Predicted Impacts – Project Only

Concentrations of TSP, PM₁₀ and particulate matter with diameter less than 2.5 microns (PM_{2.5}) as well as dust deposition levels were predicted at privately owned residences.

There were no predicted exceedances of the Project Approval 08_0144 24-hour average PM₁₀ criterion, or annual average TSP, PM₁₀ or dust deposition criteria, at any privately-owned residence due to emissions from the project only (i.e. the NM incorporating the Modification) (Appendix B).

In addition, predicted 24-hour average and annual average PM_{2.5} concentrations are below reporting guidelines at all privately-owned residences (Appendix B).

The predicted compliance with air quality criteria is consistent with the assessment conducted by Heggies (2009).

Contours showing predicted project only 24-hour PM₁₀ concentrations are provided on Figure 4.

Predicted Impacts – Cumulative

Environ Australia (2015) has analysed monitoring data to estimate the contribution of other (i.e. non-NM) sources to dust concentrations and dust deposition levels. When considering project only dust emissions cumulatively with other sources, no exceedances of annual average PM₁₀, TSP or dust deposition criteria are predicted (Appendix B).

Statistical analysis, where all available 24-hour PM₁₀ monitoring data is added to 365 days of predicted project only 24-hour PM₁₀ concentrations was undertaken for the Modification. The analysis found that the risk of an additional exceedance of the 24-hour average PM₁₀ criterion at privately owned residences due to the Modification is minimal (less than 0.2%) (Appendix B).

Management Measures and Monitoring

NCOPL would continue to implement the existing air quality management and monitoring measures detailed in the Air Quality Monitoring Program (Whitehaven, 2012) and PRPs (Section 3.3.1) for the Modification.

The existing automated water spray system (Section 3.3.1) would be extended to the modified ROM and product coal stockpiles.

3.4 SURFACE WATER

3.4.1 Background

Surface Water Management and Monitoring

Water management at the NM is conducted in accordance with the Water Management Plan (URS\ Australia, 2013) which includes:

- a description of the site water management system;
- surface water management measures;
- erosion and sediment control measures;
- a site water balance;
- a surface water monitoring program; and
- a surface water response plan.

3.4.2 Environmental Review

Potential Impacts

Water Quality

The extension of the ROM coal stockpile footprint would result in a minor increase in the catchment size of the pit top area water management system (approximately 2.3 ha).

As described in Section 2.3, a new sediment basin (SB4) would be constructed to the north-east of the ROM coal stockpile (Figure 2) and associated collection drains to collect runoff from the modified ROM coal stockpile area.

SB4 would be designed and constructed to capture runoff from a 1 in 100 year, 72 hour rainfall event consistent with existing sediment basins at the NM.

Water captured in SB4 would be transferred to either SB1 or directly to the ponds within rail loop for re-use onsite.

The modified product coal stockpile footprint would not change the catchment size of the of the existing pit top area water management system.

Runoff from the modified product coal stockpile area would continue to be captured in existing sediment basins (SB1 and SB2). SB1 would be augmented to maintain access around the product coal stockpile without changing its storage capacity. No change to SB2 would be required.

Surface runoff from disturbed areas at the NM would continue to be captured on-site and, therefore, there would be no change to approved impacts associated with the potential release of this surface runoff from disturbed areas.

Changes in Contributing Catchment

The reduction in the catchment area of Kurrajong Creek and the Namoi River associated with the Modification (i.e. approximately 2.3 ha) represents approximately 0.04% of the total catchment of the Kurrajong Creek and less than 0.01% of the Namoi River catchment.

As a result, the surface water flow regimes in the tributary of Kurrajong Creek, Kurrajong Creek and the Namoi River would not be materially affected by the minor changes in catchment area as a result of runoff capture in the extended ROM coal stockpile footprint.

It should be noted that the catchments of Kurrajong Creek and the Namoi River would be reinstated post-mining.

Management Measures and Monitoring

NCOPL would continue to implement the existing surface water management and monitoring measures detailed in the Water Management Plan (URS Australia, 2013) for the Modification.

3.5 VISUAL AMENITY

3.5.1 Background

Existing Land Uses and Landscape

Existing land use in the vicinity of the NM is characterised by a combination of mining and agricultural (beef cattle and cereal production) land uses.

Topography in the vicinity of the NM is generally flat to undulating. Elevations range up to approximately 400 metres Australian Height Datum (m AHD) in Jacks Creek State Forest in the west decreasing to approximately 230 m AHD in the east towards the Namoi River.

Elevations on the NM site range from approximately 370 m AHD in the west to approximately 240 m AHD in the east.

Views of the NM are available from some private dwellings (e.g. Matilda) and sections of the Kamilaroi Highway and Kurrajong Creek Road.

In general, however, views of the NM from surrounding public and private viewpoints are effectively screened by existing topography, vegetation and the amenity bund.

Previous Assessment

An assessment of potential visual impacts associated with the NM was conducted by R.W. Corkery & Co (2009).

The assessment concluded that with the implementation of mitigation measures, the potential visual impacts associated with NM would be minor.

Existing Mitigation Measures

NCOPL has implemented a number of measures at the NM to minimise potential visual impacts (NCOPL, 2014):

- an approximate 3 m high earthen amenity bund (vegetated) has been established to the south and west of the pit top area (Figure 2);
- strategic tree planting has been undertaken across the NM site to enhance visual screening;
- the CHPP, rotary breaker enclosure, conveyor covers and rail load-out bin are coloured green;
- progressive rehabilitation is undertaken where possible;
- all outdoor lighting is directed so that it does not shine above the horizontal as required by Condition 29(a), Schedule 4 of Project Approval 08_0144; and
- all external lighting is operated in accordance with Australian Standard 4282 (INT):1995 - *Control of Obtrusive Effects of Outdoor Lighting* as required by Condition 29(b), Schedule 4 of Project Approval 08_0144.

Given the change in visual modification associated with the Modification would be low and the continued implementation of the existing management measures, it is expected that the visual amenity impacts of the NM would continue to be minor.

Management Measures

NCOPL would continue to implement the existing visual amenity management measures (Section 3.5.1) for the Modification.

3.5.2 Environmental Review

Potential Impacts

The Modification would result in an extension of the existing ROM and product coal stockpile footprints within the existing/approved pit top area (Figure 2). No change in the existing/approved maximum elevation of the stockpiles would be required for the Modification (Sections 2.1 and 2.2).

In the context of the existing surface infrastructure in the vicinity of the extended ROM and product coal stockpiles (e.g. CHPP, rotary breaker, conveyors/reclaimers, rail load-out bin, reject emplacement area), the incremental visual modification associated with the ROM and product coal stockpile footprint extensions would be low.

4 STATUTORY CONTEXT

This section outlines the statutory requirements relevant to the assessment of the Modification. It also provides a consideration of the Modification against the objects of the EP&A Act.

4.1 APPLICABILITY OF SECTION 75W OF ENVIRONMENTAL PLANNING AND ASSESSMENT ACT, 1979

NM was approved under Part 3A of the EP&A Act in 2010 (Project Approval 08_0144).

NM is a 'transitional Part 3A project' under Clause 2 of Schedule 6A of the EP&A Act and therefore section 75W of the EP&A Act continues to apply to modifications to Project Approval 08_0144, notwithstanding its repeal.²

As outlined in Section 1.3, NCOPL consulted with the DP&E in February 2015 with regards to seeking the necessary approvals for the Modification and based on this consultation, this EA has been prepared under section 75W of the EP&A Act.

Section 75W of the EP&A Act relevantly provides:

75W Modification of Minister's approval

(1) *In this section:*

Minister's approval means an approval to carry out a project under this Part, and includes an approval of a concept plan.

Modification of approval means changing the terms of a Minister's approval, including:

- (a) revoking or varying a condition of the approval or imposing an additional condition of the approval, and
- (b) changing the terms of any determination made by the Minister under Division 3 in connection with the approval.

(2) *The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.*

- (3) *The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.*
- (4) *The Minister may modify the approval (with or without conditions) or disapprove of the modification...*

4.2 GENERAL STATUTORY REQUIREMENTS

4.2.1 Environmental Planning Instruments

State environmental planning policies and the local environmental plan that may be relevant to the Modification are discussed below.

State Environmental Planning Policies

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* (Mining SEPP) regularises the various environmental planning instruments that previously controlled mining activities.

Clause 5(3) of the Mining SEPP gives it primacy where there is an inconsistency between the provisions of the Mining SEPP and the provisions of any other environmental planning instrument (except the *State Environmental Planning Policy (Major Development) 2005*, *State Environmental Planning Policy No. 14 [Coastal Wetlands]* and *State Environmental Planning Policy No. 26 [Littoral Rainforest]*).

Clause 2

Clause 2 sets out the aims of the Mining SEPP as follows:

- (a) *to provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State, and*
- (b) *to facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and*

² Part 3A of the EP&A Act (as in force immediately before its repeal) continues to apply for the NM. The description and quotations of relevant references to clauses of Part 3A in this document are as if Part 3A of the EP&A Act is still in force.

- (c) *to establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources.*

Clause 7

Clause 7(1) of the Mining SEPP states that development for any of the following purposes may be carried out only with development consent:

- (a) *underground mining carried out on any land,*

The NM (incorporating the Modification) comprises underground mining activities.

Clause 12

Clause 12 of the Mining SEPP requires that, before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:

- (a) *consider:*
 - (i) *the existing uses and approved uses of land in the vicinity of the development, and*
 - (ii) *whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and*
 - (iii) *any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and*
- (b) *evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and*
- (c) *evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).*

Existing/approved land use in the vicinity of NM is characterised by a combination of mining and agricultural (beef cattle and cereal production) land uses.

The Modification would not result in additional land resource impacts as it would be located in the existing/approved pit top area (Section 3.1).

The potential impacts of the Modification on noise, air quality, surface water and visual amenity are described in Sections 3.2 to 3.5.

The Modification would allow for the efficient extraction of coal at the NM.

NCOPL would implement a range of measures to avoid or minimise incompatibility of the Modification with existing and future land uses in the area. This would be achieved through the implementation of the existing NM Environmental Management Strategy.

Clause 12AA

Clause 12AA of the Mining SEPP requires that:

- (1) *In determining an application for consent for development for the purposes of mining, the consent authority must consider the significance of the resource that is the subject of the application, having regard to:*
 - (a) *the economic benefits, both to the State and the region in which the development is proposed to be carried out, of developing the resource, and*
 - (b) *any advice by the Director-General of the Department of Trade and Investment, Regional Infrastructure and Services as to the relative significance of the resource in comparison with other mineral resources across the State.*
- (2) *The following matters are (without limitation) taken to be relevant for the purposes of subclause (1) (a):*
 - (a) *employment generation,*
 - (b) *expenditure, including capital investment,*
 - (c) *the payment of royalties to the State.*
- (3) *The Director-General of the Department of Trade and Investment, Regional Infrastructure and Services is, in providing advice under subclause (1) (b), to have regard to such matters as that Director-General considers relevant, including (without limitation):*
 - (a) *the size, quality and availability of the resource that is the subject of the application, and*
 - (b) *the proximity and access of the land to which the application relates to existing or proposed infrastructure, and*
 - (c) *the relationship of the resource to any existing mine, and*
 - (d) *whether other industries or projects are dependent on the development of the resource.*

- (4) *In determining whether to grant consent to the proposed development, the significance of the resource is to be the consent authority's principal consideration under this Part.*
- (5) *Accordingly, the weight to be given by the consent authority to any other matter for consideration under this Part is to be proportionate to the importance of that other matter in comparison with the significance of the resource.*
- (6) *To avoid doubt, the obligations of a consent authority under this clause extend to any application to modify a development consent.*

The Modification would not change the resource or employment at the NM. The Modification would however allow for the efficient extraction of coal at the approved maximum production rate (i.e. 8 Mtpa).

Clause 14

Clause 14(1) of the Mining SEPP requires that, before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the approval should be issued subject to conditions aimed at ensuring that the development is undertaken in an environmentally responsible manner, including conditions to ensure the following:

- (a) *that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable,*
- (b) *that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable,*
- (c) *that greenhouse gas emissions are minimised to the greatest extent practicable.*

In addition, clause 14(2) requires that, without limiting clause 14(1), in determining a development application for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable state or national policies, programmes or guidelines concerning greenhouse gas emissions.

The potential impacts of the Modification on groundwater and surface water resources, greenhouse gas emissions, flora and fauna are discussed in Sections 3.1 and 3.4.

Clause 15

Clause 15 of the Mining SEPP requires that:

- (1) *Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider the efficiency or otherwise of the development in terms of resource recovery.*
- (2) *Before granting consent for the development, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at optimising the efficiency of resource recovery and the reuse or recycling of material.*
- (3) *The consent authority may refuse to grant consent to development if it is not satisfied that the development will be carried out in such a way as to optimise the efficiency of recovery of minerals, petroleum or extractive materials and to minimise the creation of waste in association with the extraction, recovery or processing of minerals, petroleum or extractive materials.*

The Modification would allow for the efficient extraction of coal at the approved maximum production rate (i.e. 8 Mtpa).

It is in NCOPL's financial interest to maximise the efficiency of coal recovery and minimise the generation of coal rejects which require disposal.

Clause 16

Clause 16(1) of the Mining SEPP requires that, before granting consent for development for the purposes of mining or extractive industry that involves the transport of materials, the consent authority must consider whether or not the consent should be issued subject to conditions that do any one or more of the following:

- (a) *require that some or all of the transport of materials in connection with the development is not to be by public road,*
- (b) *limit or preclude truck movements, in connection with the development, that occur on roads in residential areas or on roads near to schools,*
- (c) *require the preparation and implementation, in relation to the development, of a code of conduct relating to the transport of materials on public roads.*

Product coal is transported from the NM via rail to Newcastle (i.e. no road transport) (Table 1). The Modification would not change NM product coal transport (Section 2.6).

The potential impacts of the Modification on the road transport network are considered in Section 3.1.

Clause 17

Clause 17 of the Mining SEPP requires that before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the approval should be issued subject to conditions aimed at ensuring the rehabilitation of land that will be affected by the development. In particular, the consent authority must consider whether conditions of the consent should:

- (a) *require the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated, or*
- (b) *require waste generated by the development or the rehabilitation to be dealt with appropriately, or*
- (c) *require any soil contaminated as a result of the development to be remediated in accordance with relevant guidelines (including guidelines under section 145C of the Act and the Contaminated Land Management Act 1997), or*
- (d) *require steps to be taken to ensure that the state of the land, while being rehabilitated and at the completion of the rehabilitation, does not jeopardize public safety.*

The rehabilitation of the NM would be conducted in accordance with the Rehabilitation Management Plan (Section 2.5).

The Modification would not change the existing/approved rehabilitation strategy.

State Environmental Planning Policy No. 33 (Hazardous and Offensive Development)

Clause 13 of the *State Environmental Planning Policy No. 33 (Hazardous and Offensive Development)* (SEPP 33) requires the consent authority, in considering a Development Application for a potentially hazardous or a potentially offensive industry, to take into account:

- (c) *in the case of development for the purpose of a potentially hazardous industry—a preliminary hazard analysis prepared by or on behalf of the applicant, and*

- (d) *any feasible alternatives to the carrying out of the development and the reasons for choosing the development the subject of the application (including any feasible alternatives for the location of the development and the reasons for choosing the location the subject of the application),*
...

The Modification is not expected to result in changes to the existing/approved risks and hazards.

Notwithstanding, relevant environmental management plans would be reviewed and, if necessary, revised by NCOPL to include the Modification and manage any associated environmental risk (subject to any modified Project Approval 08_0144 conditions).

State Environmental Planning Policy No. 44 (Koala Habitat Protection)

State Environmental Planning Policy No. 44 (Koala Habitat Protection) requires the consent authority for any Development Application in certain LGAs (including Narrabri) to consider whether land subject to a Development Application is "potential Koala habitat" or "core Koala habitat".

The Modification would not result in additional fauna impacts as it would be located in the existing/approved pit top area (Section 3.1).

State Environmental Planning Policy No. 55 (Remediation of Land)

State Environmental Planning Policy No. 55 (Remediation of Land) (SEPP 55) aims to provide a State-wide planning approach to the remediation of contaminated land. Under SEPP 55, planning authorities are required to consider the potential for contamination to adversely affect the suitability of the site for its proposed use.

A consent authority must consider the following under Clause 7(1):

- (a) *it has considered whether the land is contaminated, and*
- (b) *if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and*
- (c) *if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.*

Further, under Clause 7(2), before determining an application for consent to carry out development that would involve a change of use of land, the consent authority must consider a report specifying the findings of a preliminary investigation of the land concerned, carried out in accordance with the contaminated land planning guidelines.

As the Modification requires no increase to the existing/approved pit top area, no change of use is proposed and no preliminary land contamination investigation is required.

Narrabri Local Environmental Plan 2011

The NM is located wholly within the Narrabri LGA (Figure 1). The following identifies the provisions in the *Narrabri Local Environmental Plan, 2012* (Narrabri LEP) which may have relevance to the Modification.

Under the Narrabri LEP “open cut mining” is permissible on lands in the RU1 Zone with development consent. Underground mining is not listed as a permissible use under the Narrabri LEP.

The Narrabri LEP states:

***Note.** A type of development referred to in the Land Use Table is a reference to that type of development only to the extent it is not regulated by an applicable State environmental planning policy. The following State environmental planning policies in particular may be relevant to development on land to which this Plan applies:*

...

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

...

Clause 4 of the Mining SEPP relevantly provides:

4 Land to which Policy applies

This Policy applies to the State.

As described above, Clause 5(3) gives the Mining SEPP primacy where there is any inconsistency between the provisions in the SEPP and the provisions in any other environmental planning instrument (subject to limited exceptions).

Clause 5(3) relevantly provides:

5 Relationship with other environmental planning policies

(3) ... if this Policy is inconsistent with any other environmental planning instrument, whether made before or after this Policy, this Policy prevails to the extent of the inconsistency.

The practical effect of clause 5(3) for the NM is that if there is any inconsistency between the provisions of the Mining SEPP and those contained in the Narrabri LEP, the provisions of the Mining SEPP will prevail.

As described above, Clause 7 of the Mining SEPP provides what types of mining development are permissible only with development consent. In this regard, clause 7(1) states:

7 Development permissible with consent

(1) Mining

Development for any of the following purposes may be carried out only with development consent:

- (a) underground mining carried out on any land,*

...

The term ‘underground mining’ in the Mining SEPP is given an extended definition in clause 3(2) as follows:

underground mining means:

- (a) mining carried out beneath the earth's surface, including bord and pillar mining, longwall mining, top-level caving, sub-level caving and auger mining, and*
- (b) shafts, drill holes, gas and water drainage works, surface rehabilitation works and access pits associated with that mining (whether carried out on or beneath the earth's surface),*

but does not include open cut mining.

The effect of clause 7(1), in conjunction with the operation of clause 5(3) of the Mining SEPP, is that notwithstanding any prohibition contained in the land use table of the Narrabri LEP, the NM may be carried out with development consent.

Part 2.3, clause 2 of the Narrabri LEP provides:

The consent authority must have regard to the objectives for development in a zone when determining a development application in respect of land within the zone.

The NM is located within Zone RU1 (Primary Production) within the Narrabri LGA. The objectives of this zone include:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.*
- *To encourage diversity in primary industry enterprises and systems appropriate for the area.*
- *To minimise the fragmentation and alienation of resource lands.*

- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*
- *To allow for non-agricultural land uses that will not restrict the use of other land for agricultural purposes.*

The Modification is consistent with the general objectives of the RU1 zone as mining is a primary industry and the Modification would enhance the productivity of the NM.

The Modification would not result in additional land resource impacts as it would be located in the existing/approved pit top area (Section 3.1).

The Modification would not significantly alter the compatibility of the NM with adjoining land uses.

The rehabilitated NM will include agricultural final land uses.

4.2.2 NSW Government Policy

Strategic Regional Land Use Plan

As part of the Strategic Regional Land Use Policy, the NSW Government introduced a 'Gateway Process' for the upfront assessment of the impacts of State Significant mining and coal seam gas proposal on Strategic Agricultural Land (NSW Government, 2012a).

The Modification area is wholly contained within existing NM mining lease, therefore the 'Gateway Process' does not apply to assessment of the Modification (NSW Government, 2012a).

An assessment of potential impacts on land resources is presented in Section 3.1.

Aquifer Interference Policy

The Aquifer Interference Policy (AIP) (NSW Government, 2012b) has been developed by the NSW Government as a component of the NSW Government's Strategic Regional Land Use Policy. The AIP applies State-wide and details water licence and impact assessment requirements.

The AIP has been developed to ensure equitable water sharing between various water users and proper licensing of water taken by aquifer interference activities such that the take is accounted for in the water budget and water sharing arrangements. The AIP also aims to enhance existing regulation, contributing to a comprehensive framework to protect the rights of all water users and the environment in NSW.

The NSW *Water Management Act, 2000* defines an aquifer interference activity as that which involves any of the following:

- *the penetration of an aquifer;*
- *the interference with water in an aquifer;*
- *the obstruction of the flow of water in an aquifer;*
- *the taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations; and*
- *the disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.*

The Modification would not include an aquifer interference activity as defined in the NSW *Water Management Act, 2000* and therefore the AIP has not been considered any further for the Modification.

4.2.3 Plans that Require Revision

Management/Monitoring Plans

Some management plans (e.g. the Water Management Plan [URS Australia, 2013]) may require revision to reflect updated environmental management measures or changes to Project Approval 08_0144 conditions resulting from the Modification.

Mining Operations Plan

The current Mining Operations Plan would require revision to reflect the Modification.

5 REFERENCES

Eco Logical (2012) *Rehabilitation Management Plan – Narrabri Mine*.

Environ Australia (2015) *Narrabri Mine Stockpile Extension Modification Air Quality Assessment*.

Heggies (2009) *Narrabri Coal Mine Stage 2 Longwall Project Air Quality Assessment*.

Narrabri Coal Operations Pty Ltd (2014) *Annual Environmental Management Report (ML 1609) and Annual Review (PA 08_0144 MOD 2)*.

New South Wales Government (2012a) *Strategic Regional Land Use Policy*.
Released September 2012.

NSW Government (2012b) *NSW Aquifer Interference Policy NSW Government policy for the licensing and assessment of aquifer interference activities*.
Released September 2012.

R.W. Corkery & Co (2009) *Environmental Assessment for the Narrabri Coal Mine Stage 2 Longwall Project*.

Spectrum Acoustics (2009) *Narrabri Coal Mine Stage 2 Longwall Project Noise and Vibration Impact Assessment*.

Spectrum Acoustics (2011) *Narrabri Mine Noise Management Plan*.

Spectrum Acoustics (2015) *Narrabri Mine Stockpile Extension Modification Noise Assessment*.

URS Australia (2013) *Narrabri Mine Water Management Plan*.

Whitehaven Coal Limited (2012) *Narrabri Mine Air Quality Monitoring Program*.



Narrabri Mine

**Environmental
Assessment**

APPENDIX A

Noise Assessment

The Noise Assessment was prepared on the basis that Narrabri Coal Operations Pty Ltd was in the process of obtaining a private agreement with the landholder of “Bow Hills”. Since the finalisation of the Noise Assessment, Narrabri Coal Operations Pty Ltd has entered into a private agreement with the landholder of “Bow Hills”.



Project No: 14933

Noise Assessment Narrabri Mine Stockpile Extension Modification Narrabri, NSW

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1 INTRODUCTION

This report presents the results of a noise assessment conducted for the Narrabri Mine (NM) Stockpile Extension Modification (the Modification). NM is an underground coal mining operation and is located approximately 28 kilometres (km) south-east of Narrabri and approximately 65 km north-west of Gunnedah in the Gunnedah Basin, New South Wales (NSW).

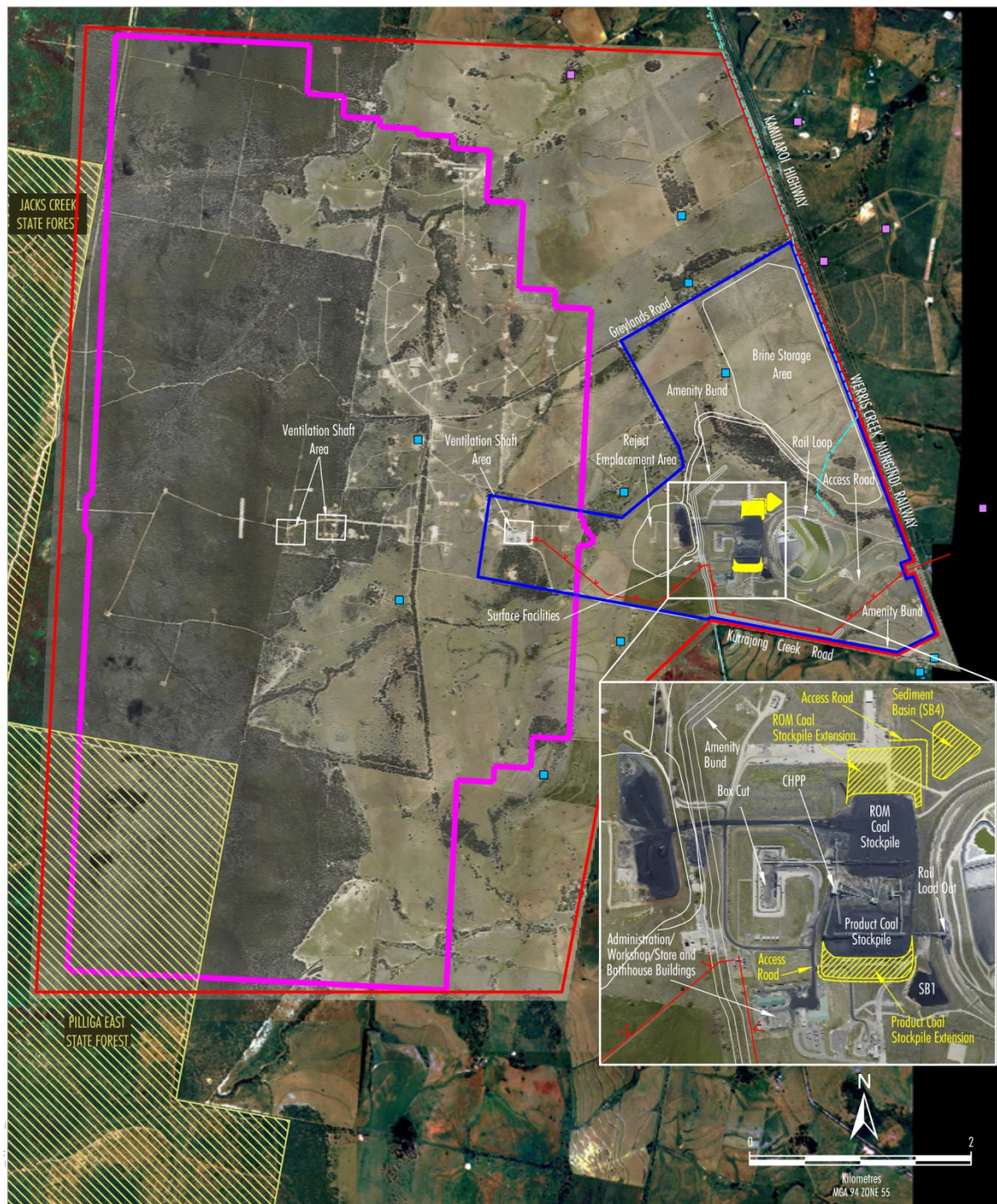
The NM is operated by Narrabri Coal Operations Pty Ltd (NCOPL) on behalf of the Narrabri Joint Venture, which consists of Whitehaven Coal Limited (70 percent [%]), Upper Horn Investments (Australia) Pty Ltd (7.5%), Electric Power Development Co. Ltd (7.5%), EDF Trading (7.5%), and Daewoo International Corporation and Korea Resources Corporation (7.5%).

Stage 1 of the NM was originally approved under Part 3A of the NSW *Environmental Planning and Assessment Act, 1997* (EP&A Act) in 2007 and involved initial site establishment activities and continuous miner mining operations.

Project Approval (08_0144) for Stage 2 of the NM was issued in 2010 and allowed the mine to convert to a longwall mining operation.

Project Approval (08_0144) allows for the production and processing of up to 8 million tonnes per annum of run-of-mine (ROM) coal for a period of 21 years. ROM coal is processed at the NM to produce thermal and PCI product coal. Product coal is transported from the NM by rail to Newcastle.

NCOPL is seeking to modify Project Approval (08_0144) under section 75W of the EP&A Act to increase the capacity of the existing ROM and product coal stockpiles as shown in **Figure 1** to allow for the efficient storage, handling and loading of coal at the NM (the Modification).



- LEGEND**
- State Forest
 - Mining Lease Boundary (ML 1609)
 - Pit Top Area
 - Underground Mining Area
 - Approved Surface Development (Not Constructed)
 - Modified Surface Development
 - Water Pipeline
 - Electricity Transmission Line
 - Mine-owned Dwelling
 - Private Dwelling

Source: R.W. Carbery & CO Pty Ltd (2009), NSW Trade & Investment (2015) and NCOPL (2015)

Figure 1. Existing/approved and modified NM general arrangement

2 EXISTING NM NOISE MANAGEMENT AND MONITORING

Project Approval (08_0144) for the NM outlines conditions specific to noise management including impact assessment criteria, acquisition and additional mitigation upon request criteria, noise mitigation measure requirements and monitoring requirements.

2.1 IMPACT ASSESSMENT CRITERIA

Condition 1, Schedule 4 of Project Approval (08_0144) and Condition L3 of Environment Protection Licence (EPL) 12789 outline the noise impact assessment criteria for the NM. Noise at the NM must not exceed 35 A-weighted decibels (dB[A]), $L_{eq}(15 \text{ mins})$ at a privately owned residence or at 25% of a private landholders land during the day, evening or night.

Condition 1, Schedule 4 of Project Approval (08_0144) and Condition L3 of EPL 12789 also includes a sleep disturbance noise criteria of 45 dB(A), $L_{1(1 \text{ min})}$ during the night.

The impact assessment criteria do not apply during the following meteorological conditions:

- wind speeds greater than 3 metres/second (m/s) at 10 metres (m) above ground level;
- temperature inversions of 1.5 to 4 degrees Celsius ($^{\circ}\text{C}$)/100 m^1 and source to receiver wind speed greater than 2 m/s at 10 m above ground level; or
- temperature inversions of greater than $4^{\circ}\text{C}/100 \text{ m}^2$.

2.2 ACQUISITION AND ADDITIONAL MITIGATION MEASURES CRITERIA

Condition 2, Schedule 4 of Project Approval (08_0144) requires NCOPL to acquire land upon the written request of the relevant landholder, if the noise generated by the NM at the landholders residence or at 25% of the landholders land exceeds 40 dB(A), $L_{eq}(15 \text{ mins})$ during the day, evening or night.

Condition 3, Schedule 4 of Project Approval (08_0144) requires NCOPL to undertake reasonable and feasible noise mitigation measures at a residence upon the written request of the relevant landholder, if the noise generated by the NM at the landholders residence is equal to or exceeds 38 dB(A), $L_{eq}(15 \text{ mins})$ during the day, evening or night.

2.3 NOISE MANAGEMENT AND MITIGATION MEASURES

Noise management at the NM is conducted in accordance with the Noise Management Plan (NMP) (Spectrum Acoustics, 2011) prepared in accordance with Condition 4, Schedule 4 of Project Approval (08_0144).

¹ Condition L3.4 of EPL 12789 excludes "Stability category F temperature inversion conditions" rather than "temperature inversions of 1.5 to $4^{\circ}\text{C}/100 \text{ m}$ ".

² Condition L3.4 of EPL 12789 excludes "Stability category G temperature inversions" rather than "temperature inversions of greater than $4^{\circ}\text{C}/100 \text{ m}$ ".

NCOPL is required to manage noise levels from the NM in accordance with the noise impact assessment criteria specified in Project Approval (08_0144) using reasonable and feasible mitigation measures. The following reasonable and feasible mitigation measures are implemented at the NM:

- Operations are conducted within the approved hours of operation (e.g. construction activities are restricted to 7:00 am to 10:00 pm).
- The rotary breaker is fully enclosed.
- The CHPP is enclosed and 50% of the internal surface is lined with acoustic insulation.
- Ventilation fans are banded when located in the vicinity of a receiver.
- Surface drills operating over LW1 to LW3 and LW24 to LW26 will be attenuated to achieve a sound power level of 109 dB.
- Dozers are not used on the reject emplacement area during evening and night periods during temperature inversion conditions.
- Truck movements to the reject emplacement area are restricted to one load per 15 minutes during temperature inversion conditions.
- All reversing alarms on equipment are broadband frequency types (i.e. high frequency reversing alarms are not permitted).
- Equipment used on-site is regularly serviced so that sound power levels remain the same.
- When selecting new/replacement equipment, equipment with a lower sound power level is selected where feasible.

2.4 NOISE MONITORING AND COMPLIANCE

The NMP includes a noise monitoring program in accordance with Condition 4, Schedule 4 of Project Approval (08_0144). The NMP also addresses EPL 12789 noise monitoring requirements. The noise monitoring program includes attended noise monitoring and real time (unattended) noise monitoring.

Attended Monitoring

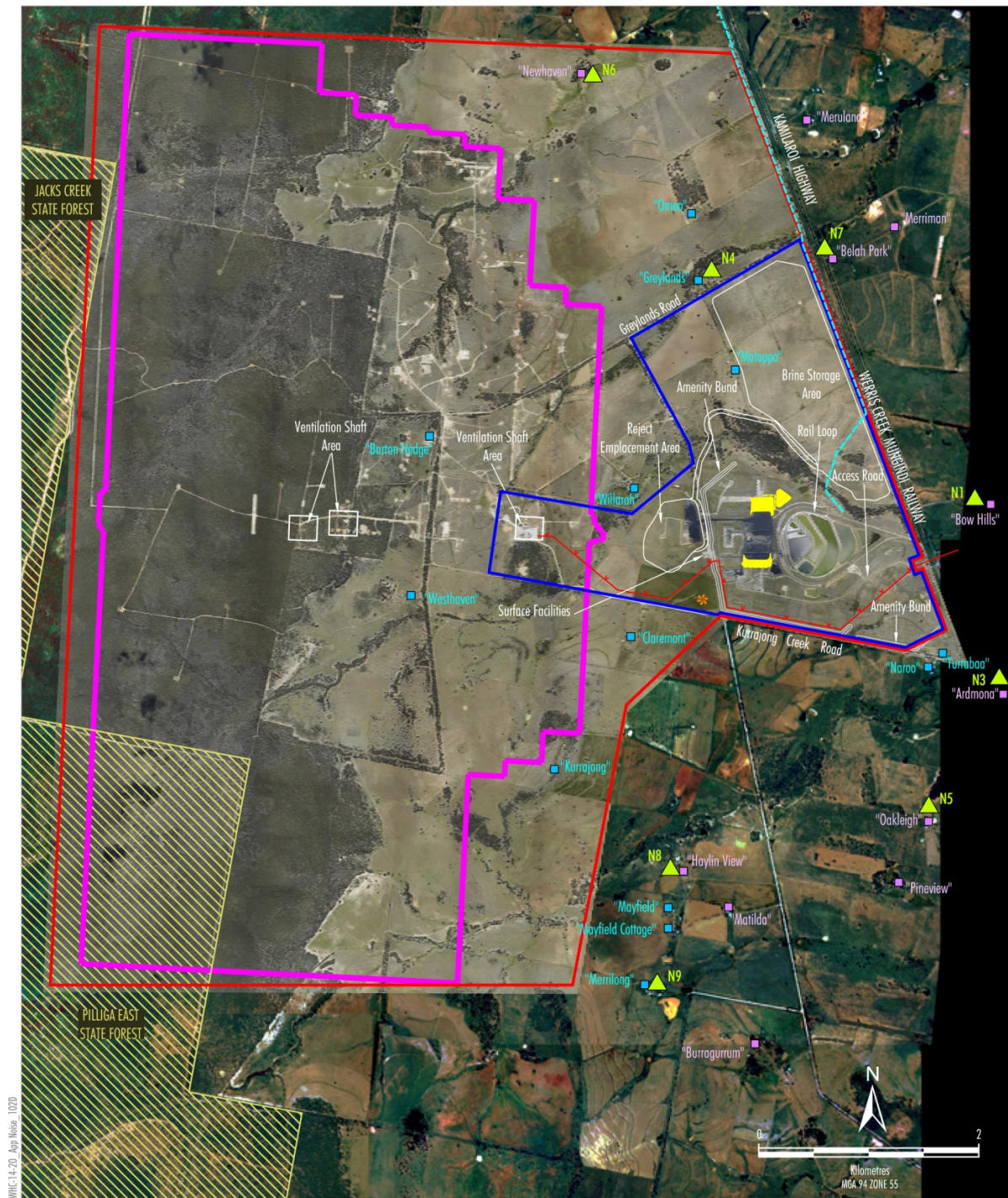
The attended noise monitoring is conducted monthly during the cooler months (i.e. May to September) and quarterly during the warmer months (i.e. December and March) at the locations listed in **Table 1** and shown on **Figure 2**.

TABLE 1 Noise monitoring locations	
• N1 "Bow Hills"	• N6 "Newhaven" ¹
• N3 "Naroo"	• N7 "Belah Park" ²
• N4 "Greylands"	• N8 "Haylin View" ³
• N5 "Oakleigh"	• N9 "Merrilong" ³

¹ Attended noise monitoring has been conducted at the boundary of the "Newhaven" property (**Figure 2**) as NCOPL has not been able to obtain access to the "Newhaven" property. A correction factor is applied to the property boundary monitored noise level to estimate the noise level at the "Newhaven" dwelling. The correction factor (18 dB[A]) is based on the difference in modelled results at these two locations.

² Attended noise monitoring has been conducted at "Merriman" rather than "Belah Park" (**Figure 2**) in accordance with a request from the owner of these properties.

³ In accordance with the NMP, attended noise monitoring at "Haylin View" and "Merrilong" will commence when surface activities approach the eastern side of the southern longwall panels.



Source: R.W. Carbery & CO Pty Ltd (2009), NSW Trade & Investment (2015) and NCOPL (2015)

Figure 2. Noise and meteorological monitoring locations

A summary of the noise monitoring results during the three year period 2012 to 2014 is provided in **Table 2**.

TABLE 2	
Summary of operational noise monitoring results 2012 to 2014	
Monitoring Period	Result
2012	
<i>March</i>	No exceedances recorded.
<i>June</i>	Noise levels above the impact assessment criteria were recorded at “Bow Hills” during non-compliant meteorological conditions¹.
<i>July</i>	No exceedances recorded.
<i>August</i>	Noise levels above the impact assessment criteria were recorded at “Bow Hills” during non-compliant meteorological conditions¹.
<i>September</i>	No exceedances recorded.
<i>December</i>	No exceedances recorded.
2013	
<i>March</i>	No exceedances recorded.
<i>May</i>	Exceedance recorded at “Naroo”.
<i>June</i>	Noise levels above the impact assessment criteria were recorded at “Bow Hills” during non-compliant meteorological conditions¹.
<i>July</i>	No exceedances recorded.
<i>August</i>	No exceedances recorded.
<i>September</i>	Exceedance recorded at “Bow Hills” and “Naroo”.
<i>December</i>	Noise levels above the impact assessment criteria were recorded at “Naroo” and “Bow Hills” during non-compliant meteorological conditions¹.
2014	
<i>March</i>	Noise levels above the impact assessment criteria were recorded at “Bow Hills” and “Newhaven” during non-compliant meteorological conditions¹.
<i>May</i>	Exceedance recorded at “Merriman”². - Noise levels above the impact assessment criteria were recorded at “Bow Hills and “Greylands” during non-compliant meteorological conditions¹. - Sleep disturbance criterion exceeded at “Bow Hills” under non-compliant meteorological conditions¹.
<i>June</i>	No exceedances recorded.
<i>July</i>	Noise levels above the impact assessment criteria were recorded at “Bow Hills”, “Naroo” and “Greylands” during non-compliant meteorological conditions¹.
<i>August</i>	No exceedances recorded.
<i>September</i>	Exceedances (2) recorded at “Bow Hills”. - Noise levels above the impact assessment criteria were recorded at “Bow Hills”, “Merriman” and “Greylands” during non-compliant meteorological conditions¹.
<i>December</i>	No exceedances recorded.

¹ Non-complaint meteorological conditions as outlined in Condition 1, Schedule 4 of Project Approval (08_0144) (**Section 2.1**).

² It is noted that Section 11.1.3 of the INP indicates that noise levels 2 dB(A) or less above noise criterion does not constitute an exceedance.

The results in **Table 2** show one exceedance at “Merriman”, two exceedances at “Naroo” and three exceedances at “Bow Hills” during the past three years. “Naroo” is mine-owned.

Real Time Monitoring

Real time (unattended) noise monitoring is conducted using a mobile SentineX real time continuous noise monitor to assist in the management of NM noise impacts (i.e. is not used for compliance monitoring). The real time noise monitor is positioned at a receiver that is most likely to be impacted by NM operations or at a receiver where a noise-related complaint has been received.

During 2014, the real time noise monitor was located at “Merriman” (**Figure 2**) and noise levels were recorded above the noise impact assessment criteria.

The real time noise monitor does not however provide comparable results to the attended noise monitoring. Raw (or unprocessed) noise levels from the real time noise monitor were approximately 10 dB(A) higher than noise levels from attended noise monitoring conducted simultaneously at “Merriman”. Advitech Environmental (2014) was able to post-process the raw real time noise monitor data to reduce this difference to 1 to 3 dB(A).

As described above, the real time noise monitor is not used for compliance monitoring. Compliance monitoring is conducted using attended monitoring methodology in accordance with Project Approval (08_0144) and EPL 12789.

2.5 ACQUISITION AND ADDITIONAL MITIGATION MEASURES

In response to noise monitoring results (**Section 2.4**) and consultation with surrounding landholders, NCOPL is undertaking the following acquisition or additional mitigation measures:

- “Bow Hills” – the landholders indicated that they did not want to be acquired so is entering into an agreement with NCOPL which will include the implementation of additional mitigation measures at the “Bow Hills” residence. The additional mitigation measures will include enclosing the verandah of the house.
- “Merriman” and “Belah Park” – NCOPL is currently considering a written request from the landholder to acquire “Merriman” and “Belah Park”.

3 PREVIOUS NM NOISE ASSESSMENTS

The following noise assessments have previously been conducted for the NM:

- *Narrabri Coal Project Noise Impact Assessment* (Spectrum Acoustics, 2006).
- *Narrabri Coal Mine Stage 2 Longwall Project Noise and Vibration Impact Assessment* (Spectrum Acoustics, 2009).

In addition, the NM Stage 2 Environmental Noise Model (ENM) was updated in 2013 to incorporate the existing NM operations in response to noise impact assessment criteria exceedances identified by noise monitoring (**Section 2.4**).

A summary of these previous noise assessments is provided below.

3.1 NM STAGE 1

Spectrum Acoustics (2006) developed an ENM to assess the potential noise impacts associated with the originally approved NM. The noise model was developed in accordance with the *NSW Industrial Noise Policy* (INP) (Environment Protection Authority, 2000).

3.2 NM STAGE 2

Spectrum Acoustics (2009) assessed the potential noise impacts associated with NM Stage 2. The NM Stage 2 noise modelling was based on the existing ENM developed in 2006 and considered the following operational modelling scenarios:

- Scenario 2a: All surface plant and train loading activities occurring. Goaf drainage pumps above longwall (LW) 1 and pre-drainage construction above LW 2 and LW 3.
- Scenario 3a: All surface plant and train loading activities occurring. Goaf drainage pumps above LW 24 and pre-drainage construction above LW 25 and LW 26.

An assessment of site specific meteorological conditions based on the NM meteorological station data was conducted for NM Stage 2. The following noise enhancing meteorological conditions were assessed (Spectrum Acoustics, 2009):

- south-easterly wind (3 m/s); and
- temperature inversions (2°C/100 m, 4°C/100 m and 6°C/100 m).

A detailed description of the meteorological environment at the NM site is provided in Spectrum Acoustics (2009).

Table 3 shows the predicted NM operational $L_{eq(15 \text{ mins})}$ intrusive levels for Scenarios 2a and 3a under a 4 °C/100 m inversion at relevant privately owned receivers.

TABLE 3 NM Stage 2 – Predicted noise levels dB(A)_{Leq(15minute)}, 4°C/100 m inversion conditions				
Receiver		Criterion ¹ dB(A)	Predicted dB(A)	
			Scenario 2a	Scenario 3a
R1	"Bow Hills"	35	37	38
R2	"Ardmona"	35	33	34
R4	"Oakleigh"	35	32	35
R5	"Pineview"	35	29	33
R6	"Matilda"	35	30	37
R7	"Haylin View"	35	32	40
R13	"Newhaven"	35	35	28
R16	"Belah Park"	35	35	35
R18	"Merulana"	35	30	29

¹ Project Approval (08_0144) and EPL 12789 (refer to **Section 2.1**).

3.3 2013 MODELLING

Spectrum Acoustics (2013) updated the NM Stage 2 ENM in 2013 to reflect the existing NM operations in response to noise impact assessment criteria exceedances identified by noise monitoring (**Section 2.4**). The following changes to the NM Stage 2 Scenario 2a operational noise sources (**Table 3**) were incorporated into the updated model:

- The total number of dozers increased from 3 to 4 and the number of dozers operating on each of the ROM coal and product coal stockpiles increased from one to two.
- Dozers operating in 2nd gear reverse.
- The bypass crusher was included in the model.
- The sound power levels of the CHPP and dozers were updated based on onsite sound power level measurements.

A 6°C/100 m inversion was conservatively used in the 2013 noise modelling. **Table 4** shows the predicted 2013 modelling noise for Scenario 2a at relevant privately owned receivers.

TABLE 4 2013 Modelling – Predicted noise levels dB(A)_{Leq(15minute)}, 6°C/100 m inversion conditions			
Receiver		Criterion ¹ dB(A)	Predicted ² dB(A)
R1	"Bow Hills"	35	41
R2	"Ardmona"	35	38
R4	"Oakleigh"	35	34
R5	"Pineview"	35	32
R6	"Matilda"	35	35
R7	"Haylin View"	35	37
--	"Merriman"	35	33
R13	"Newhaven"	35	<30
R18	"Merulana"	35	<30

¹ Project Approval (08_0144) and EPL 12789 (refer to **Section 2.1**).

² Scenario 2a was modelled.

4 MODIFICATION OVERVIEW

An overview of the Modification is provided in this section. A detailed description of the Modification is provided in the Environmental Assessment.

The Modification would include an increase in the capacity of the existing ROM and product coal stockpiles to allow for the efficient storage, handling and loading of coal at the NM.

The ROM coal stockpile capacity would increase from 400,000 tonnes (t) to 700,000 t. The ROM coal stockpile footprint would need to be extended approximately 110 m to the north resulting in an approximate 210 m by 335 m ROM coal stockpile footprint to accommodate the increased capacity (**Figure 1**).

The product coal stockpile capacity would increase from 350,000 t to 500,000 t. The product coal stockpile footprint would need to be extended approximately 55 m to the south resulting in a 185 m by 260 m product coal stockpile footprint to accommodate the increased capacity (**Figure 1**).

There would be no change to the existing mine fleet, coal handling infrastructure or CHPP.

Modification construction activities would include:

- development of the extended ROM and product coal stockpile pads;
- construction of a new sediment basin (SB4) and associated collection drains;
- minor augmentation to existing sediment basin (SB1); and
- realignment of minor access roads.

Mobile equipment required for construction would generally be sourced from existing NM mobile equipment fleet. An additional dozer (CAT D9) and a compactor (825) would be required.

Modification construction activities would generally be restricted to 7.00 am to 10.00 pm up to seven days a week for approximately three months.

5 NOISE MODELLING METHODOLOGY

5.1 NOISE MODEL

The existing NM ENM noise model (Spectrum Acoustics, 2013) that was developed in accordance with the INP has been updated for the Modification.

A comparison of the predicted noise levels from the 2013 modelling (**Table 4**) against attended noise monitoring conducted during 2013 and 2014 is provided in **Table 5**. The scenario modelled in the 2013 modelling reflects the current operations at the NM and therefore the predicted noise levels should be generally consistent with the noise levels monitored during 2013 and 2014.

NCOPL commissioned 131 attended night period noise measurements at relevant receivers during 2013 and 2014 (**Table 5**). Of these attended measurements, only eleven were higher than the predicted 2013 modelling noise levels including:

- five attended measurements during inversion conditions less than 6°C/100 m and wind speeds less than 3 m/s at 10 m;
- three attended measurements during unknown temperature inversion conditions as temperature inversion monitoring was not conducted during these monitoring events as they were conducted outside of the usual NMP monitoring program;
- two attended measurements during inversion conditions greater than 6°C/100 m and therefore these noise measurements are expected to be higher than the predicted Modification noise levels; and
- one attended noise measurement during wind speeds greater than 3 m/s at 10 m (i.e. a non-compliant meteorological condition as outlined in Condition 1, Schedule 4 of Project Approval [08_0144] [**Section 2.1**]);

Approximately 96% of the attended noise measurements conducted during inversion conditions less than 6°C/100 m and wind speeds less than 3 m/s at 10 m were equal to or less than the predicted Modification noise levels.

Based on the above, it is considered that the predicted 2013 modelling noise levels are generally consistent with existing attended noise measurements and provide a reliable indication of potential noise impacts associated with the existing NM.

The existing NM ENM noise model is therefore considered suitable to predict potential noise impacts associated with the Modification.

TABLE 5
Comparison of 2013 Modelling – Predicted noise levels with attended monitoring noise levels

TABLE 5 Comparison of 2013 Modelling – Predicted noise levels with attended monitoring noise levels																
Receiver	2013 Modelling – predicted noise levels dB(A) _{Leq(15minute)} , 6°C/100 m inversion conditions	Attended Monitoring Noise Levels dB(A) _{Leq(15minute)} , Night (all meteorological conditions)														
		2013							2014							
		March	May	June	July	August	September	December	March	May	June	July	August	September	October	December
Privately Owned																
“Bow Hills” (N1)	39	25, IA, 22	24	<30, 39, 22	33	IA	38, <u>30</u> , IA	<u>28</u> , <u>35</u> , <u>36</u>	38, 30, IA	42	31, 31, 27	44	<u>IA</u>	<u>39</u> , IA, 28	-	<u>30</u> , 26, 33
“Oakleigh” (N5)	31	<20, 25, IA	29	IA, <25, IA	20	IA	33, <u>30</u> , 25	<u>IA</u> , <u>IA</u> , <u>IA</u>	IA, IA, IA	35	32, IA, 24	38	<u>IA</u>	<u><20</u> , IA, IA	-	<u>30</u> , <u>25</u> , <u>IA</u>
“Newhaven” (N6)	<30	<20, <20, <20	IA	<20, <25, <20	<20	<20	<20	<u><20</u> , <20, <u><20</u>	<25, <u><20</u> , <u><20</u>	29	21, 19	<20	<u><20</u>	<20, 19, 21	-	<20, <20, 23
“Merriman”	33	-	25	<30, 34, IA	31	31	34, IA, 34	<u>32</u> , 28, <u>35</u>	32, <u>30</u> , IA	36	24, 33, 28	26	<u>IA</u>	33, 36, 30	37, <u>28</u> , 25, 26	IA, IA, <u>IA</u>
“Ardmona”	35	-	-	-	-	-	-	-	IA	32	IA	28	<u>IA</u>	IA	-	<u>28</u>
“Matilda”	32	-	-	-	-	-	-	-	-	IA	IA	32	<u>IA</u>	IA	-	<u>IA</u>

Bold noise measurements were conducted during inversions greater than 6°C/100 m.

Underlined noise measurements were conducted during wind speeds greater than 3 m/s at 10 m (i.e. a non-compliant meteorological condition as outlined in Condition 1, Schedule 4 of Project Approval [08_0144] [Section 2.1]).

Italicised noise measurements were conducted during unknown temperature inversion conditions as temperature inversion monitoring was not conducted during these monitoring events.

IA = inaudible.

5.2 METEOROLOGICAL CONDITIONS

NCOPL maintains a meteorological station at the NM (**Figure 2**). A summary of relevant meteorological considerations for the noise model is provided below.

Calm (Neutral)

Calm (neutral) conditions (i.e. no wind or temperature inversions) have been considered in this assessment in accordance with the INP.

Winds

In relation to wind effects, Section 5.3 of the INP states:

“Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source to receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30 percent of the time or more in any assessment period in any season.”

An assessment of site specific wind conditions based on the NM meteorological station was conducted by Spectrum Acoustics (2009). The assessment considered south-easterly winds at 3 m/s to be relevant meteorological assessment conditions in accordance with the INP. Northerly winds do occur in most seasons, however, only a small percentage are below 3 m/s and therefore are not required to be assessed in accordance with the INP (Spectrum Acoustics, 2009).

A review of recent (2012 to 2014) wind conditions at the NM has been conducted by Environ Australia Pty Ltd (2015) for the Air Quality Assessment of the Modification. South-easterly winds remain the relevant meteorological assessment conditions at the NM in accordance with the INP.

As there are no privately-owned receivers to the north-west of the NM (i.e. downwind of prevailing south-easterly winds), no privately-owned receivers would be subject to this enhanced noise impact. This meteorological assessment condition has therefore not been considered in this assessment.

Temperature Inversions and Drainage Flow

Section 5.2 of the INP states:

“Assessment of impacts is confined to the night noise assessment period (10.00 pm to 7.00 am), as this is the time likely to have the greatest impact – that is, when temperature inversions usually occur and disturbance to sleep is possible.”

“Where inversion conditions are predicted for at least 30% (or approximately two nights per week) of total night-time in winter, then inversion effects are considered to be significant and should be taken into account in the noise assessment”.

An analysis of the atmospheric stability classes recorded at the NM meteorological station during the 2012, 2013 and 2014 winters has been conducted and the frequency of their occurrences and the estimated Environmental Lapse Rates (ELR) are presented in **Table 6**.

TABLE 6
Atmospheric stability frequency of occurrence – winter evening and night periods

Stability Class	Frequency of Occurrence			Estimated ELR (°C/100 m) ¹	Qualitative Description ¹
	2012	2013	2014		
A	6.03	7.62	0.05	<-1.9	Lapse
B	3.77	4.26	0.05	-1.9 to -1.7	Lapse
C	10.06	9.34	0.07	-1.7 to -1.5	Lapse
D	43.00	40.70	34.23	-1.5 to -0.5	Neutral
E	28.18	28.34	53.71	-0.5 to 1.5	Weak inversion
F	8.36	9.08	8.63	1.5 to 4	Moderate inversion
G	0.61	0.66	3.26	>4	Strong inversion

¹ In accordance with the INP.

In accordance with the INP, the frequency of occurrence of neutral (i.e. -1.5 to -0.5°C/100 m) winter temperature inversions is greater than 30% during the combined evening and night-time period and therefore should be assessed. The prevalence of stronger inversions at the NM is expected to be higher than indicated by the data from the NM meteorological station based on experience in the Gunnedah Basin³. Given the above, it has been conservatively assumed that moderate-strong inversions occur greater than 30% of the combined evening and night-time period during winter and therefore a 4°C/100 m inversion has been assessed in accordance with the INP. This inversion strength is consistent with that adopted for the noise impact assessment criteria in Project Approval (08_0144).

Section 5.2 of the INP also states:

“The drainage-flow wind default value should generally be applied where a development is at a higher altitude than a residential receiver, with no intervening higher ground (for example, hills). In these cases, both the specified wind and temperature inversion default values should be used in the noise assessment for receivers at the lower altitude.”

As described above, there are no privately-owned receivers to the north-west of the NM (i.e. downwind of prevailing south-easterly winds). In addition, areas to the north-west of the NM are upslope of the key NM noise sources. Accordingly, no drainage flow has been applied for this assessment.

5.3 NOISE MANAGEMENT AND MITIGATION MEASURES

NCOPL is required to manage noise levels from the NM in accordance with the noise impact assessment criteria specified in Project Approval (08_0144) using reasonable and feasible mitigation measures.

³ NCOPL is conducting a review of the performance of the NM meteorological station to confirm the accuracy of the sigma-theta measurements.

The existing noise management and mitigation measures at the NM (**Section 2.3**) will continue to be implemented for the Modification. In addition, consideration of additional reasonable and feasible noise mitigation measures relevant to the Modification was conducted in consultation with NCOPL.

Restricting the dozers on the ROM and product coal stockpiles to 1st gear reverse (which would reduce the sound power level of each dozer by approximately 7 dB) was considered as an additional noise management measure. A reduction of 7 dB in sound power (near-field) would translate to a noise level reduction of approximately 4 dB at distant receivers. NCOPL considered the operational implications of restricting the dozers to 1st gear reverse and concluded that two additional dozers would be required to maintain the ROM and product coal stockpiles (i.e. the number of dozers on the ROM and product coal stockpiles would increase from four to six).

Given the above, restricting the dozers to 1st gear reverse and adding two dozers would result in a noise reduction at the closest privately owned receiver of no more than 2 dB. Given the significant extra cost associated with two additional dozers and the minor potential reduction in noise levels at privately owned receivers, restricting dozers to 1st gear reverse is not considered reasonable and feasible.

Whilst other, noise management and mitigation measures may be technically possible (e.g. restricting dozers to daytime), they are not considered by NCOPL to be feasible and reasonable.

It is considered that the noise management and mitigation measures proposed for the Modification are reasonable and feasible.

5.4 NOISE SOURCE SOUND POWER LEVELS

Operational noise sources used for the Modification noise modelling are shown in **Table 7**.

TABLE 7		
Modification – Operational noise sources and sound power levels (dB)		
Noise sources	Number	Sound Power Level (dB)
Conveyors	-	80dB/m
Dozer at stockpile	2	117
	2	118
Crusher (attenuated)	1	103
CHPP (attenuated)	1	111
Bypass crusher (attenuated)	1	107
Rail load-out	1	102
Workshop	1	95
Vent fans (attenuated)	1	117
Personnel carrier	1	110
Locos idling on rail loop	1	102
Truck at rejects	1	107
Dozer at rejects	1	107
Water cart	1	105
Gas drainage pumps	>10	102
Drill	2	109
TOTAL sound power	-	125

The sound power levels of the CHPP, bypass crusher, dozers and vent fan were updated based on onsite sound power level measurements.

5.5 NOISE MODELLING SCENARIOS

For the Modification, similar operational scenarios assessed for NM Stage 2 (Spectrum Acoustics, 2009) were considered:

- Scenario 1: All surface plant and train loading activities occurring. Goaf drainage pumps above LW 1 and pre-drainage construction above LW 2 and LW 3.
- Scenario 2: All surface plant and train loading activities occurring. Goaf drainage pumps above LW 24 and pre-drainage construction above LW 25 and LW 26.

The locations of noise sources are the same as previous modelling with the exception of the dozers operating on the ROM and product coal stockpiles. The location of the modified locations of the dozers is shown on **Figure 3**.



Figure 3. ROM and product coal stockpiles expansion.

These scenarios were modelled under a 4°C/100 m inversion conditions during the night-time period (**Section 5.2**).

A modelling scenario including the simultaneous brine storage pond construction with Scenario 1 and 2 operations during the day and evening periods⁴ has not been modelled as the predicted noise levels associated with this scenario would be less than those predicted for Scenarios 1 and 2 during the night period with adverse meteorological conditions (i.e. 4°C/100 m inversion).

In addition, no privately owned receivers would be subject to enhanced noise impacts associated with the prevailing south-easterly winds during the day and evening periods as there are no privately owned receivers to the north-west of the NM (i.e. downwind of the prevailing south-easterly winds) (**Section 5.2**).

⁴ Construction activities at the NM are restricted to 7:00 am to 10:00 pm (**Section 2.3**).

6 IMPACT ASSESSMENT

6.1 CONSTRUCTION

As described in **Section 4**, construction activities required for the Modification would generally be restricted to 7.00 am to 10.00 pm up to seven days for approximately six months.

Additional mobile equipment required for construction would include a dozer (CAT D9) and a compactor (825).

It is expected that potential short-term construction noise impacts during the day and evening periods would be negligible in comparison with the potential noise levels under the relevant ‘worst case’ meteorological conditions during the night period. Consequently, a full quantitative assessment of these short-term construction activities is not considered necessary.

6.2 OPERATIONS

Intrusive Noise

The predicted Modification operational $L_{Aeq(15minute)}$ intrusive levels for Scenarios 1 and 2 under relevant meteorological conditions at relevant receivers and the approved impact assessment criteria are presented in **Table 8**.

Noise contours for the Modification are shown on **Figure 4**. With regard to noise contours the calculation involves numerical interpolation of a noise level grid; subject to topography within the grid this can lead to a graphical accuracy of up to approximately 1 to 2 dB

The predicted noise levels for the two scenarios are the same as the noise at all receivers is now dominated by dozer noise and the noise generated from the goaf drainage pumps and drills does not significantly change noise levels at all receivers.

The predicted Modification operational $L_{eq(15minute)}$ intrusive levels under calm (neutral) conditions at all privately-owned receivers comply with the Project Approval (08_0144) and EPL 12789 impact assessment criteria (**Table 8**).

The predicted Modification operational $L_{eq(15minute)}$ intrusive levels under inversion conditions (i.e. 4°C/100 m inversion conditions) show:

- “Belah Park” negligibly exceeds (1 dB[A]) the Project Approval (08_0144) and EPL 12789 impact assessment criteria.
- “Bow Hills” moderately exceeds (4 dB[A]) the Project Approval (08_0144) and EPL 12789 impact assessment criteria.

TABLE 8 Modification – Predicted noise levels dB(A), _{L_{eq}(15minute)}						
Receiver		Criterion ¹ dB(A)	Scenario 1		Scenario 2	
			Calm (neutral)	4°C/100 m inversion conditions	Calm (neutral)	4°C/100 m inversion conditions
Privately Owned						
R1	“Bow Hills” ²	35	31	39	31	39
R2	“Ardmona”	35	27	35	27	35
R4	“Oakleigh”	35	24	31	24	31
R5	“Pineview”	35	22	29	22	29
R6	“Matilda”	35	23	32	23	32
R7	“Haylin View”	35	27	35	29	35
R13	“Newhaven”	35	20	<30	20	<30
R16	“Belah Park” ³	35	27	36	27	36
R16B	“Merriman” ³	35	25	33	25	33
R18	“Merulana”	35	22	<30	22	<30
Mine Owned						
--	“Turrabaa”	--	32	39	32	39
R3	“Naroo”	35	31	39	31	39
R8	“Mayfield”	35	25	34	26	34
R9	“Mayfield Cottage”	35	25	33	26	33
R10	“Merrilong”	35	24	31	25	31
R11	“Kurrajong”	35	32	40	36	40
R15	“Greylands”	35	31	37	29	37

¹ Project Approval (08_0144) and EPL 12789 (refer to **Section 2.1**).

² NCOPL is entering into an agreement with the landholder which will include the implementation of additional mitigation measures at the "Bow Hills" residence (**Section 2.5**).

³ NCOPL is currently considering a written request from the landholder to acquire "Merriman" and "Belah Park" (**Section 2.5**).

In relation to the marginal (1 dB[A]) exceedances at "Belah Park", the *Voluntary Land Acquisition and Mitigation Policy* (the Policy) (NSW Government, 2014) states:

"The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatment or controls."

In accordance with the Policy, it is recommended that the modified Project Approval (08_0144) should include noise limits equal to the predicted noise levels for the receiver (i.e. 36 dB(A),_{Leq[15 mins]}). As described in **Section 2.5**, NCOPL is in the process of acquiring "Belah Park".

For the exceedance at "Bow Hills" (i.e. 4 dB[A]), the Policy indicates that the impacts would be "moderate" and voluntary mitigation rights should be granted unless a negotiated agreement is in place. This is consistent with the existing Project Approval (08_0144) (**Section 2.2**). As described in **Section 2.5**, NCOPL is entering into an agreement with the landholder which will include the implementation of additional mitigation measures at the "Bow Hills" residence.

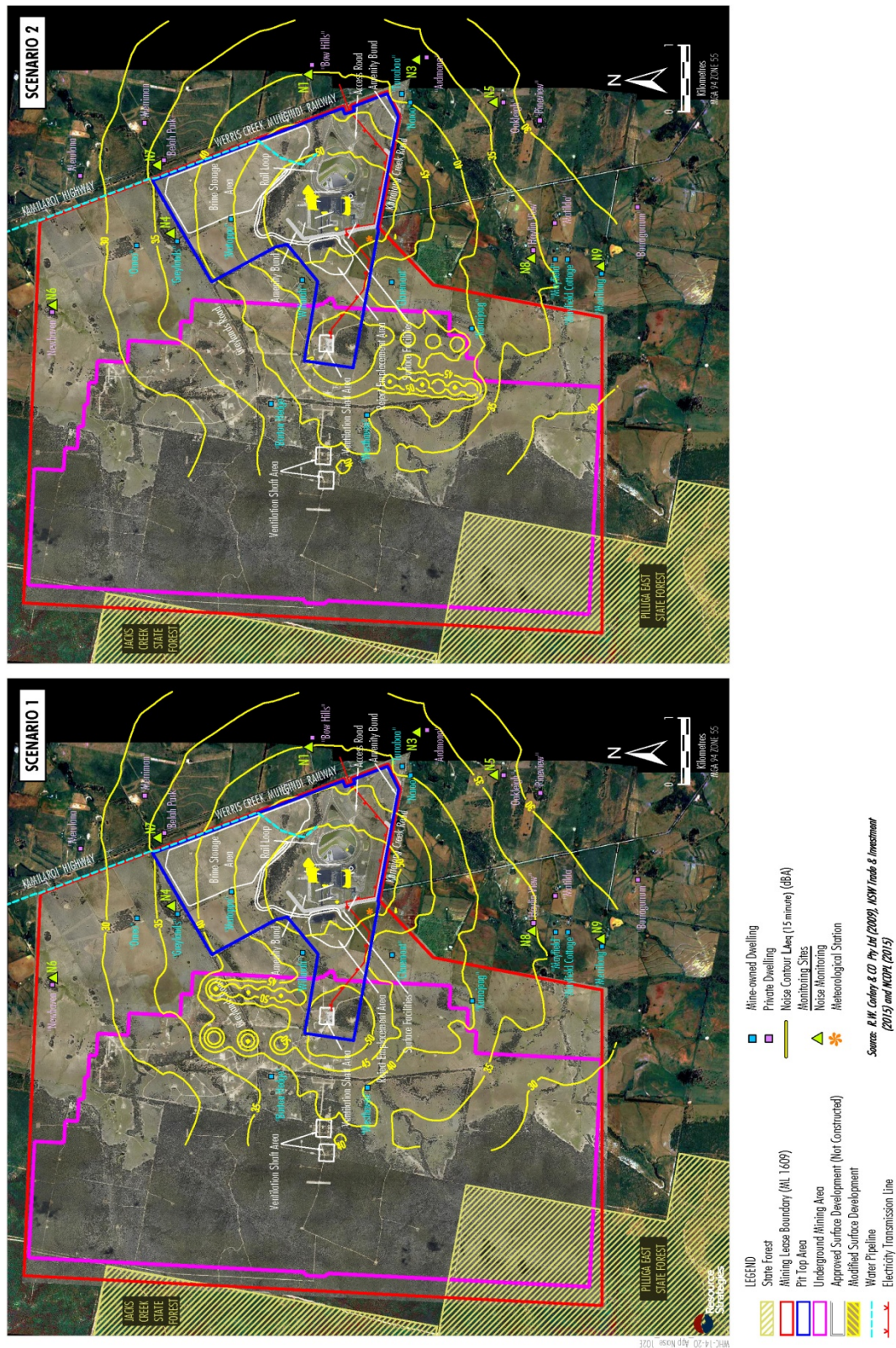


Figure 4. Night-time (4°C/100m) $L_{eq(15 \text{ minute})}$ noise contours

Sleep Disturbance

The NM sleep disturbance noise criterion (i.e. 45 dB[A]_{L1[1 min]} – **Section 2.1**) is less stringent compared to the NM intrusive noise criteria (i.e. 35 dB[A]_{Leq[15 mins]} – **Section 2.1**). Provided that the predicted Modification intrusive noise levels generally comply with the intrusive noise criteria, then sleep disturbance impacts are expected to be within the NM sleep disturbance noise criterion.

6.3 TRANSPORT

The Modification would not result in any change to rail or road transport movements associated with the NM. Potential transport noise impacts have therefore not been considered in this report.

6.4 CUMULATIVE IMPACTS

As there are no existing or approved projects with the potential to generate significant noise in the vicinity of the NM, no assessment of potential cumulative (or amenity) noise impacts is considered necessary.

Notwithstanding the above, the relevant INP amenity noise criteria are less stringent compared to the NM intrusive noise criteria (i.e. 35 dB[A]_{Leq[15 mins]} – **Section 2.1**). Provided that the predicted Modification intrusive noise levels generally comply with the intrusive noise criteria, then cumulative (or amenity) impacts are expected to be within the relevant INP amenity criteria.

7 RECOMMENDED NOISE MONITORING PROGRAM

The following changes to the current attended noise monitoring program in the NMP (**Section 2.4**) are recommended as a result of this assessment:

- ‘Naroo’ and “Greylands” be removed as they are now mine-owned;
- “Ardmona” be included due to predicted noise level under inversion conditions (4°C/100 m inversion conditions) equal to the Project Approval (08_0144) and EPL 12789 impact assessment criteria; and
- monitoring at “Haylin View” to commence upon approval of the Modification due to predicted noise level under inversion conditions (4°C/100 m inversion conditions) equal to the Project Approval (08_0144) and EPL 12789 impact assessment criteria.

8 REFERENCES

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Narrabri Mine

**Environmental
Assessment**

APPENDIX B

Air Quality Assessment

The Air Quality Assessment was prepared on the basis that Narrabri Coal Operations Pty Ltd was in the process of obtaining a private agreement with the landholder of “Bow Hills”. Since the finalisation of the Air Quality Assessment, Narrabri Coal Operations Pty Ltd has entered into a private agreement with the landholder of “Bow Hills”.



Narrabri Mine Stockpile Extension Modification - Air Quality Assessment

Prepared for:
Narrabri Coal Operations Pty Ltd

Prepared by:
ENVIRON Australia Pty Ltd

Date:
30 January 2015

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This document is issued in confidence to Narrabri Coal Operations Pty Ltd for the purposes of assessment of air quality impacts associated with the proposed stockpile expansion at Narrabri Mine. It should not be used for any other purpose.

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1 Introduction

The Narrabri Mine (NM) is an underground coal mining operation and is located approximately 28 kilometres (km) south-east of Narrabri and approximately 65 km north-west of Gunnedah in the Gunnedah Basin, New South Wales (NSW) (**Figure 1**).

The NM was approved (Project Approval [08_0144]) under Part 3A of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) in 2010 and full commercial production commenced in October 2012.

The NM is operated by Narrabri Coal Operations Pty Ltd (NCOPL) on behalf of the Narrabri Joint Venture, which consists of Whitehaven Coal Limited (70%), Upper Horn Investments (Australia) Pty Ltd (7.5%), Electric Power Development Co. Ltd (7.5%), EDF Trading (7.5%), and Daewoo International Corporation and Korea Resources Corporation (7.5%).

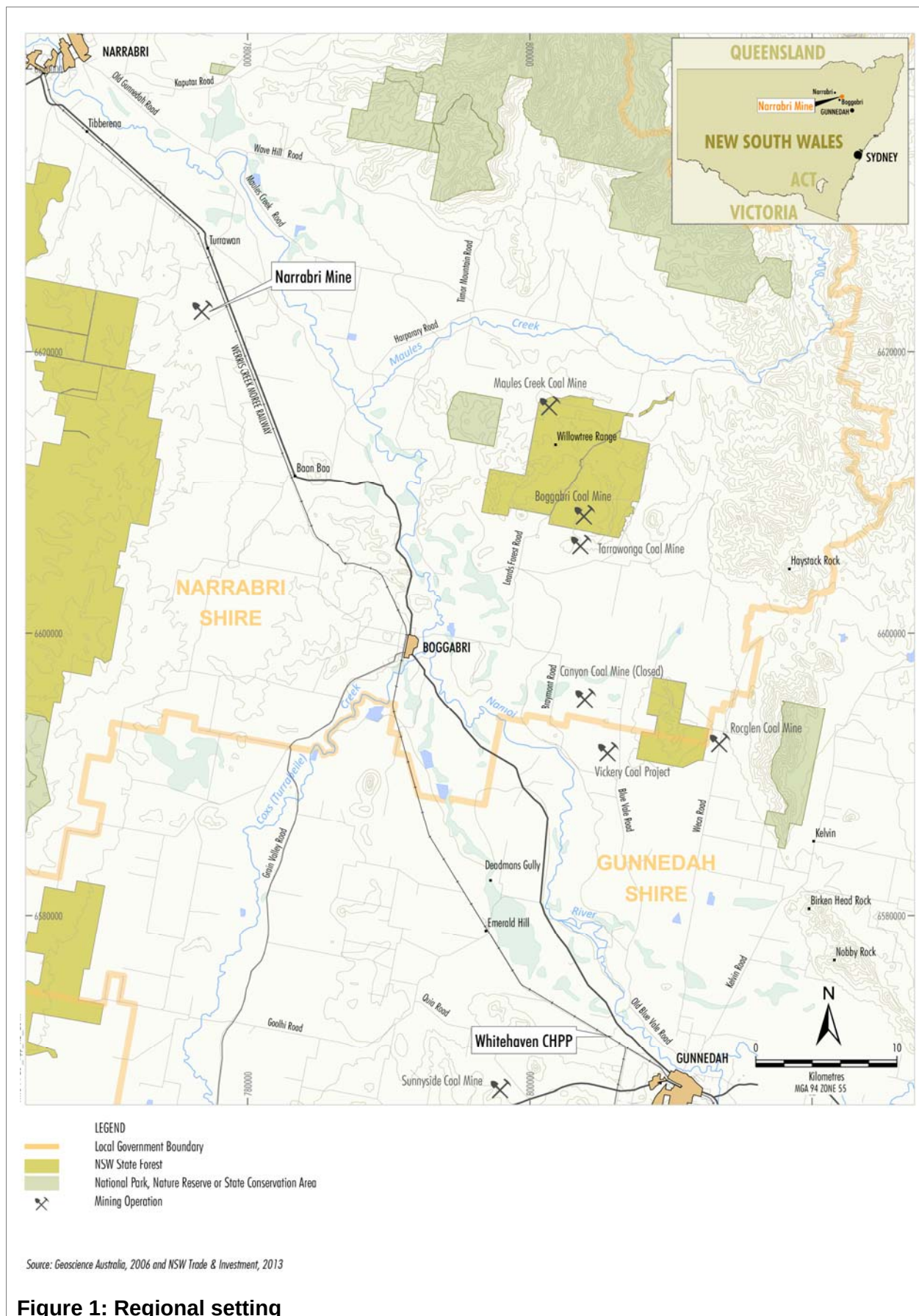
NCOPL is seeking to modify Project Approval (08_0144) under section 75W of the EP&A Act to increase the capacity of the existing run-of-mine (ROM) and product coal stockpiles to allow for the efficient storage, handling and loading of coal at the NM (the Stockpile Extension Modification [the Modification]).

NCOPL has commissioned ENVIRON Australia Pty Limited (ENVIRON) to complete an Air Quality Assessment of the Modification.

1.1 Study objectives and requirements

The Air Quality Assessment has been prepared in accordance with the procedures outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* ("the Approved Methods") (NSW Environment Protection Authority [EPA], 2005a).

The reports presents a quantitative assessment of air quality including construction and operational impacts, with a particular focus on dust emissions (including particulate matter less than 10 microns in aerodynamic diameter [PM₁₀] and particulate matter less than 2.5 microns in aerodynamic diameter [PM_{2.5}]) from mining operations.



2 Overview of operations

Project Approval (08_0144) allows for the production and processing of up to 8 million tonnes per annum (Mtpa) of ROM coal for a period of 21 years. ROM coal is processed at the NM to produce thermal and PCI product coal. Product coal is transported from the NM by rail to the Port of Newcastle.

ROM coal from the underground workings is conveyed to a drift conveyor and stacked by means of a reversible tripper onto the ROM coal stockpile. ROM coal is then either fed through reclaim valves to a rotary breaker (~67%) or fed by dozer push to a hopper which feeds a secondary bypass crusher (~33%).

Approximately 95% to 97% of coal from the rotary breaker is conveyed to the coal handling and preparation plant (CHPP) where thermal and PCI products are separated. The waste from the rotary breaker (3% to 5%) is conveyed to the rejects pile. Approximately 27% of the CHPP product coal is loaded to the PCI stockpile and approximately 73% loaded to the thermal product stockpile. CHPP waste is minimal and are blended back into the thermal product with total product yield approaching approximately 98%.

All of the ROM coal from the secondary bypass crusher is loaded directly to the thermal product stockpile.

The existing/approved NM general arrangement is shown on **Figure 2**.

2.1 Overview of stockpile extension modification

The ROM coal stockpile capacity would increase from 400,000 tonnes (t) to 700,000 t. The ROM coal stockpile footprint would need to be extended approximately 110 metres (m) to the north resulting in an approximate 210 m by 335 m ROM coal stockpile footprint to accommodate the increased capacity (**Figure 2**).

The product coal stockpile capacity would increase from 350,000 t to 500,000 t. The product coal stockpile footprint would need to be extended approximately 55 m to the south resulting in a 185 m by 260 m product coal stockpile footprint to accommodate the increased capacity (**Figure 2**).

The increased ROM and product coal stockpile size would require an approximate 50% increase in dozer hours operating on these stockpiles.

There would be no change to the existing coal handling infrastructure or CHPP.



Figure 2: Existing/approved and modified NM general arrangement

2.2 Project approval

Project Approval (08_0144) outlines conditions specific to air quality management which include impact assessment criteria, monitoring requirements and statement of commitments.

2.2.1 Impact assessment criteria

Condition 6, Schedule 4 of Project Approval (08_0144) requires that NCOPL ensure no additional exceedances of the impact assessment criteria, at any residence on privately owned land or on more than 25% of any privately owned land. The impact assessment criteria are given in **Table 1**, **Table 2** and **Table 3**.

Table 1: Long term impact assessment criteria for particulate matter		
Pollutant	Averaging Period	Criterion
Total Suspended Particulates (TSP)	Annual	90 µg/m ³
PM ₁₀	Annual	30 µg/m ³

Table 2: Short term impact assessment criteria for particulate matter		
Pollutant	Averaging Period	Criterion
PM ₁₀	24 hours	50 µg/m ³

Table 3: Long term impact assessment criteria for deposited dust			
Pollutant	Averaging Period	Maximum increase	Maximum total
Deposited Dust	Annual	2 g/m ² /month	4 g/m ² /month

2.2.2 Monitoring requirements

Conditions 7 and 8, Schedule 4 of Project Approval (08_0144) outline the requirement for NCOPL to implement dust deposition, PM₁₀ and meteorological monitoring, in accordance with the *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (NSW EPA, 2005b). Further requirements are outlined in the statement of commitments (**Section 2.2.3**).

2.2.3 Statement of commitments

The statement of commitments included in Appendix 3 of Project Approval (08_0144) and their relevance to this study are outlined below in **Table 4**.

Table 4: Statement of commitment for air quality		
Commitment	Timing	Relevance to this study
Minimise the extent of clearing across the mine site including the campaigns to construct the area for reject emplacement and brine storage ponds.	Ongoing	N/A
Retain cleared trees and branches on the margins of cleared areas for use in stabilising disturbed areas once they are no longer required.		N/A
Undertake soil stripping at time when most appropriate (such as when there is sufficient soil moisture to prevent significant lift off of dust and at times other than periods of high winds).		Controls applied in emissions inventory calculation.
Operate water sprays on all continuous miners, the longwall unit and the breaker feeder to minimise dust creation underground.		N/A
Apply water to the coal at the feed hopper, crusher and at all conveyor transfer and discharge points.		Controls applied in emissions inventory calculation.
Fit all surface conveyors with collection devices to minimise the amount of material falling from the return conveyor belts.	Prior to commencement of coal processing	Included as best practice dust control measure but not included in emission inventory calculation due to lack of published control factors, resulting in a conservative overestimate of emissions.
Enclose the rotary breaker.		Controls applied in emissions inventory calculation.
Partially enclose all surface conveyors to minimise dust lift off.		
Cease construction of the brine storage ponds when the prevailing winds are from the northwest quadrant.	Ongoing	N/A
Apply water onto stockpiles and hardstand areas.	Ongoing	Stockpile controls applied in emissions inventory calculation with consideration also to the findings in SMEC (2014).
Progressively rehabilitate areas of disturbance including gas drainage areas.	Ongoing	Included in emissions inventory calculation based on assumed areas of exposed or active rehabilitation.
Progressively rehabilitate areas no longer required for operational purposes.		
Minimise the length of time coal is held in stockpiles.	Ongoing	Included in emissions inventory calculation based on assumed coal moisture contents.
Monitor coal for signs of spontaneous combustion.		Ongoing air quality controls but not considered relevant to this study.
Immediately report incidents to the appropriate authorities.		
Extinguish fire by removal from stockpile, spreading and saturation with water.	In the event of ignition	

Table 4: Statement of commitment for air quality		
Commitment	Timing	Relevance to this study
Install underground ventilation system to provide fresh air to employees.	Ongoing	
Optimise and schedule vehicle operations to minimise vehicle movements.		
Maintain engines according to manufacturers' guidelines and keep tyres at optimal pressure.		
Minimise vehicle idling time.		
Prepare an updated energy savings plan.	Within 12 months of approval	
Monitor dust deposition levels at 8 sites (ND1 – ND8).	Monthly	Data reviewed to describe existing environment (Section 6).
Monitor PM ₁₀ levels at 2 sites (ND9 and ND10).	1 in 6 days	
Review and submit dust monitoring results to relevant government agency.	Annually	

2.3 Annual Environmental Management Report (AEMR)

In accordance with Project Approval (08_0144), each year NCOPL prepare annual environmental management reports (AEMR) and annual reviews (NCOPL, 2014; NCOPL, 2013; NCOPL, 2012; NCOPL, 2011, NCOPL, 2010, NCOPL, 2009). The AEMR provides a review of environmental performance and includes a summary of the air quality monitoring data collected for the period.

In the latest AEMR (NCOPL, 2014), a number of complaints are reported relating to the generation of visible dust from the pit top area. In response, NCOPL developed and implemented a Trigger Action Response Plan (TARP) for dust generation from the coal processing area and is implementing a number of measures to reduce emissions, including:

- Installation of a fully automated water spray system for ROM and product coal stockpiles (refer **Section 2.4**).
- Better maintenance to remove fine dust from toe of stockpiles and dozer travel routes.
- Converting D10 dozers to D11 dozers to reduce dust emissions.
- Installation of fixed chutes on the product coal skyline gantry to reduce emissions during product loading during unfavourable weather conditions.
- Dust awareness training.

2.4 Pollution Reduction Programs (PRPs)

As a scheduled premises, NCOPL operate under an Environmental Protection Licence (EPL 12789) which outlines air quality monitoring and reporting requirements.

In accordance with EPL 12789, NCOPL has previously completed two Pollution Reduction Programs (PRPs) to the satisfaction of the EPA:

- Narrabri Mine: Air Quality Control Protocol (November 2013); and
- Implementation of Practical Best Management Practices - Dust Mitigation (December 2013 and February 2014).

EPL 12789 includes three additional PRPs related to controlling dust emissions, as follows:

- Condition U1 requires NCOPL to develop a TARP for each activity with the potential to generate dust. As described above, NCOPL has implemented a TARP for generation of dust from the pit top area.
- Condition U2 requires NCOPL to implement a fully automated water spray system for ROM and product coal stockpiles.
- Condition U3 requires NCOPL to redesign the product tipper discharge chute which has been completed, as reported in the AEMR (NCOPL, 2014).

In accordance with condition U2 of EPL 12789, NCOPL commissioned a dust suppression feasibility study (SMEC, 2014) to:

- *“Determine the optimal, economically viable, solution to mitigate the risk of, and actual release of fugitive dust emissions from site to ensure compliance with statutory requirements and community expectations; and*
- *Recommend a go-forward option supported by a suitably robust capital estimate to be considered for implementation by Whitehaven's management”.*

The study concluded that the dust suppression system installed during the construction of the CHPP is ineffective and an alternative water cannon spray system was recommended (SMEC, 2014). The system was commissioned on 30 January 2015.

The PRPs are relevant to the existing and future operations of the NM and are considered in this study where appropriate.

2.5 Previous air quality assessment

An Air Quality Impact Assessment was prepared for the NM in 2009 (Heggies, 2009). Emissions were estimated for key dust generating sources for operations at the NM and the air quality impacts were assessed at 14 private sensitive receptors surrounding the NM site. An annual emission inventory was not presented, however based on the emission rates provided in the report, it is estimated that approximately 227,314 kilograms per annum (kg/annum) of PM₁₀ emissions were modelled.

A summary of the modelling predictions for PM₁₀ concentrations are presented in **Table 5**, and allow comparison with the predicted impacts for the Modification. No exceedances of the project-only PM₁₀ 24-hour or annual average impact assessment criteria were predicted.

Table 5: Predicted Incremental PM₁₀ concentration (µg/m³) – Heggies (2009)		
Receptor Name	Maximum 24-hour	Annual Average
Criteria	50 µg/m³	30 µg/m³
Bow Hills	8	1.3
Ardmona	33	1.5
Naroo	31	2.6
Oakleigh	7	0.6
Pineview	4	0.4
Matilda	3	0.3
Haylin View	3	0.4
Merrilong	2	0.2
Kurrajong	4	0.5
Newhaven	6	1.1
Greylands	16	2.3
Belah Park	19	2.7
Bungaree	6	0.9
Merulana	5	0.7

3 Local setting

The NM is located immediately to the west of the Kamilaroi Highway and North Western Branch Railway Line, approximately 28 km south-east of Narrabri and approximately 65 km north-west of Gunnedah (refer **Figure 1**). The NM site covers an area of approximately 5,298 hectares (ha).

The location of the NM in the context of regional topography and land use is shown in **Figure 3**. Land use surrounding the site is largely agricultural, primarily cleared grazing land, with areas of native vegetation immediately to the west. The terrain elevation within a radius of 10 km from the site is relatively uniform, varying between approximately 250 m Australian Height Datum (AHD) to 300 m AHD. To the north-east, the terrain raises towards Mt Kaputar, rising elevations of over 1000 m AHD.

Also shown on **Figure 3** are the two regional and onsite automatic weather stations (AWS) which are used in the modelling, discussed further in **Section 5**.

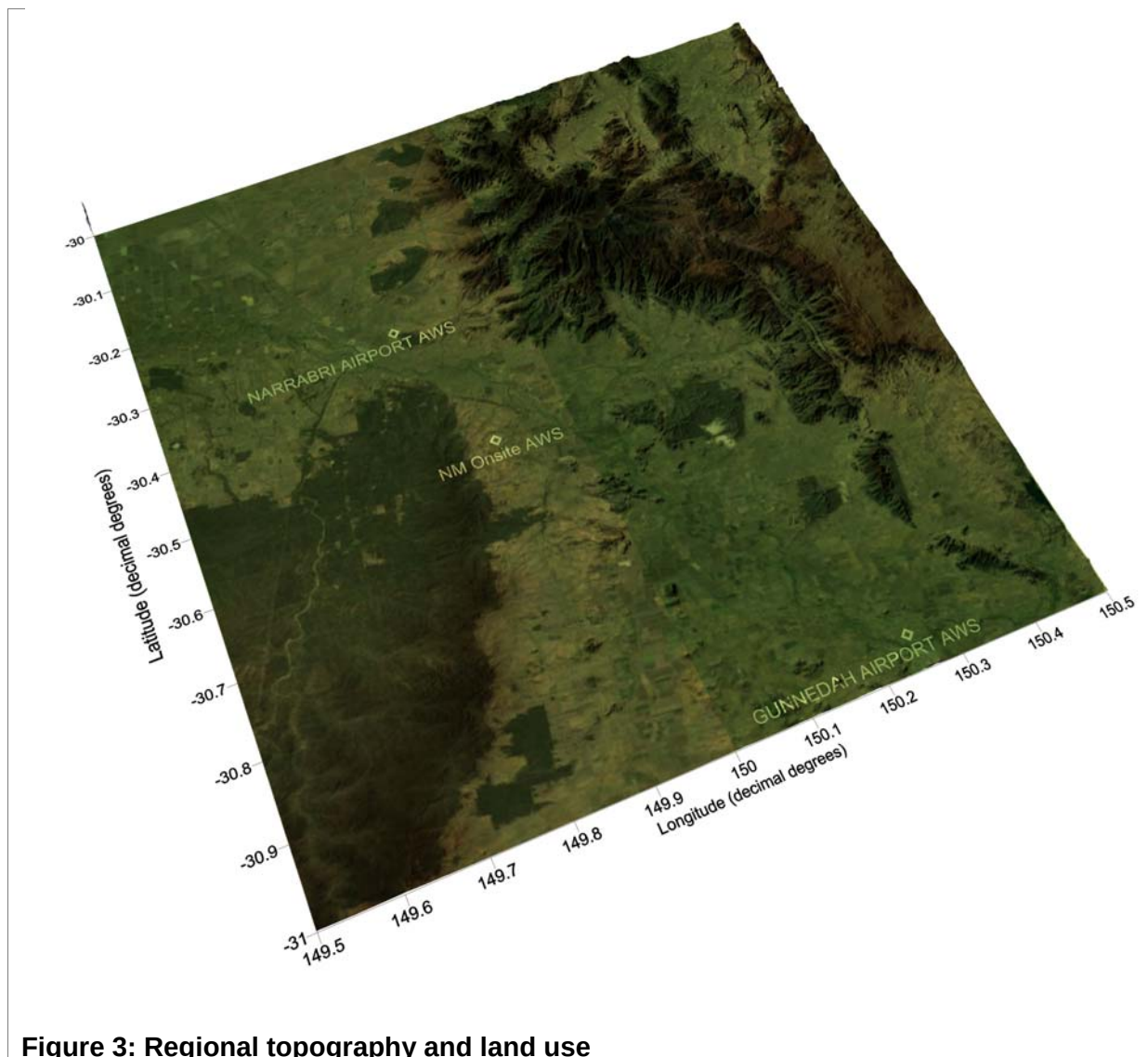


Figure 3: Regional topography and land use

3.1 Nearest sensitive receptor locations

The region surrounding the NM site contains a number of rural-residential properties situated at varying distances from the NM site.

The locations of the 11 private and 13 mine owned sensitive receptor locations surrounding the NM site are illustrated in **Figure 4** and listed in **Table 6**.

Table 6: Locations of private sensitive receptors surrounding the site				
Property Name	Location (m MGA, Zone 55)		Distance (km) / Direction from CHPP	Elevation (m AHD)
	Easting	Northing		
Private				
Ardmona	780316	6618940	4.6/SE	263
Belah Park	778761	6622882	3.8/NNE	258
Bow Hills	780193	6620654	3.0/ENE	255
Burrigurum	778050	6615757	2.7/S	260
Haylin View	777409	6617326	2.8/S	271
Matilda	777816	6617001	2.5/S	269
Merriman	779320	6623173	1.8/NE	269
Merulana	778531	6624145	3.1/NNE	301
Newhaven	776470	6624574	1.2/NNW	271
Oakleigh	779632	6617776	2.2/SE	245
Pineview	779361	6617224	3.1/SSE	294
Mine Owned				
Barton Hedge	775091	6621282	1.5/WNW	295
Claremont	776928	6619452	2.0/SW	246
Greylands	777535	6622698	2.0/NNE	250
Kurrajong	776231	6618257	2.7/SW	247
Matoppo	777880	6621887	2.7/N	322
Mayfield	777268	6616996	3/SSW	264
Mayfield Cottage	777268	6616808	3.1/SSW	272
Merrilong	777053	6616298	3.5/SSW	281
Naroo	779628	6619182	3.6/SE	281
Omeo	777474	6623296	3.3/N	278
Turrabaa	779760	6619305	3.4/SE	268
Westhaven	774930	6619835	4.2/WSW	283
Willarah	776960	6620807	4.5/WNW	278

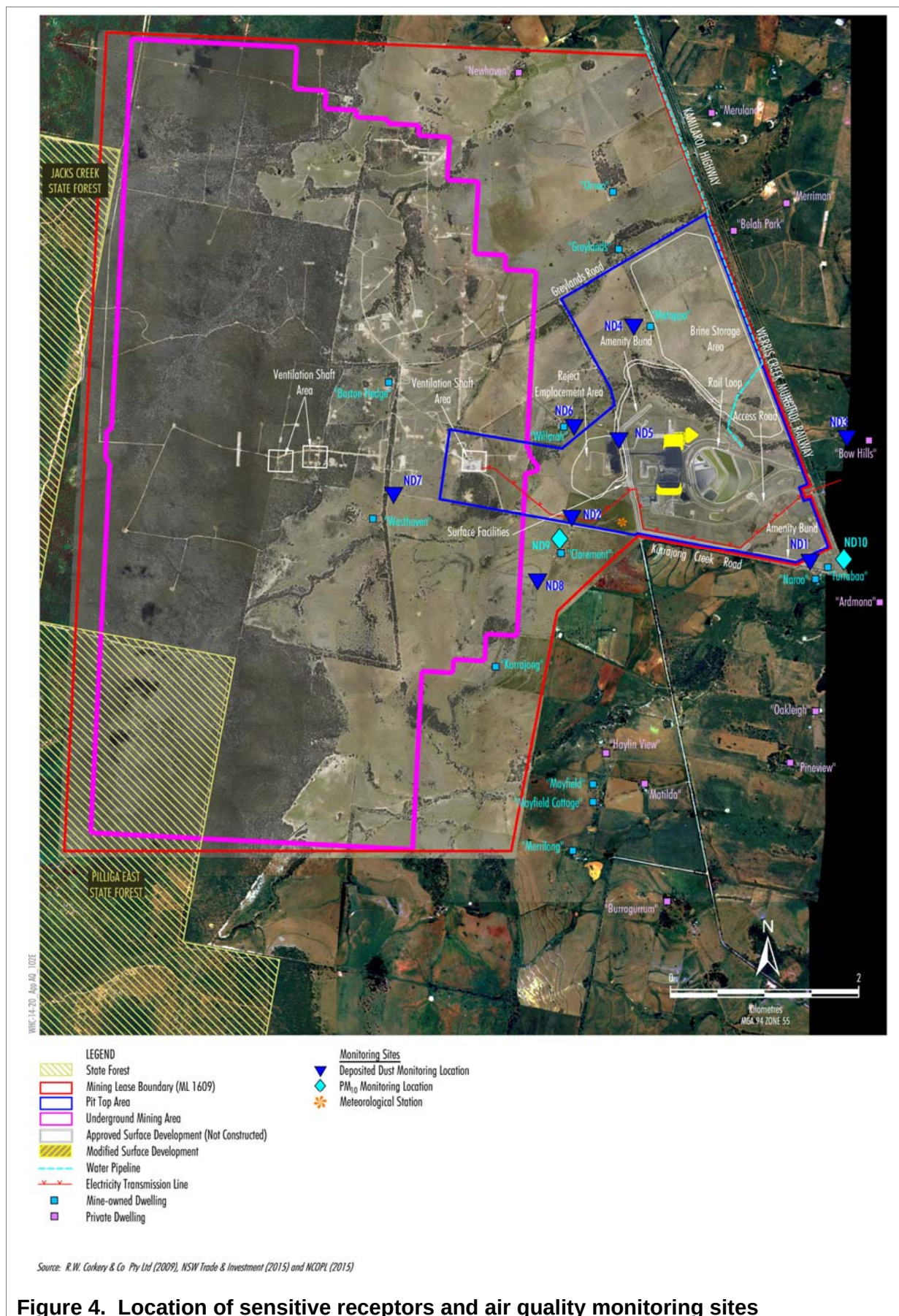


Figure 4. Location of sensitive receptors and air quality monitoring sites

4 Impact assessment criteria

NCOPL is required to demonstrate compliance with the impact assessment criteria outlined in Project Approval (08_0144) and EPL 12789, which are consistent with the criteria outlined in the Approved Methods (NSW EPA, 2005a). The impact assessment criteria are designed to maintain ambient air quality that allows for the adequate protection of human health and well-being.

The key emissions to air from the NM occur from coal handling and include total suspended particulate matter (TSP), PM₁₀, PM_{2.5} and dust.

The Approved Methods specifies that the impact assessment criteria for 'criteria pollutants'¹ are applied at the nearest existing or likely future off-site sensitive receptor and compared against the 100th percentile (i.e. the highest) dispersion modelling prediction. Both the incremental and cumulative impacts need to be considered (consideration of existing ambient background concentration is required).

4.1 Particulate matter (PM)

Air quality limits for PM are typically given for particle size metrics including TSP, PM₁₀ and PM_{2.5}. The impact assessment criteria for TSP and PM₁₀ are prescribed in the Approved Methods (and in Project Approval [08_0144] and EPL 12789), however PM_{2.5} is not included.

Reference is therefore made to the PM_{2.5} advisory reporting standards issued by the National Environmental Protection Council (NEPC) (NEPC, 2003). The *National Environment Protection (Ambient Air Quality) Measure* (NEPC, 2003) (AAQ NEPM) PM_{2.5} advisory reporting standards were published in 2003 for the purpose of supporting the monitoring and evaluation of ambient PM_{2.5} concentrations ahead of the setting ambient air quality standards for this pollutant.

A review of the AAQ NEPM, completed in 2011, recommended updating the air quality standards (NEPC, 2011). In 2012 the Council of Australian Governments (COAG) identified air quality as an issue of national priority (COAG, 2012), and agreed that its Standing Council on Environment and Water would implement a strategic approach to air quality management in the form of a National Plan for Clean Air. On 29 April 2014, Ministers signalled their intention to vary the AAQ NEPM for particles, to reflect the latest scientific understanding on health risks. An impact statement was published in July 2014 which outlines the options considered in the variation (NEPC, 2014).

In summary the variation seeks to formalise the advisory reporting standards for PM_{2.5} and adopt more stringent standards for PM₁₀. The NSW EPA's 24-hour PM₁₀ assessment criterion of 50 µg/m³ is numerically identical to the current AAQ NEPM except that the NEPM standard allows up to five exceedances per year to provide for infrequent bushfire or dust storm incidents. No provision is made by the NSW EPA for allowable exceedances of the 24-hour PM₁₀ criterion.

The air quality criteria applied for PM in this assessment are presented in **Table 7**.

¹ 'Criteria pollutants' is used to describe air pollutants that are commonly regulated and typically used as indicators for air quality. In the Approved Methods the criteria pollutants are TSP, PM₁₀, nitrogen oxide (NO₂), sulphur dioxide (SO₂), carbon monoxide (CO), ozone (O₃), deposition dust, hydrogen fluoride and lead.

Table 7: Impact assessment criteria for PM

PM metric	Averaging period	Concentration ($\mu\text{g}/\text{m}^3$)	Reference
TSP	Annual	90	EPA ⁽¹⁾
PM ₁₀	24 hour	50	EPA ⁽¹⁾
	24 hour	50 ⁽³⁾	NEPM ⁽²⁾
	Annual	30	EPA ⁽¹⁾
PM _{2.5}	24 hour	25	NEPM ⁽²⁾
	Annual	8	NEPM ⁽²⁾
Note: 1) NSW EPA, 2005a <i>Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales</i> . 2) NEPC, 2003, National Environment Protection (Ambient Air Quality) Measure, as amended. 3) Provision made for up to five exceedances of the limit per year.			

4.2 Dust deposition criteria

The NSW EPA impact assessment criteria for dust deposition are summarised in **Table 8**, illustrating the maximum increase and total dust deposition rates which would be acceptable so that dust nuisance can be avoided. Cumulative annual average dust deposition rates within residential areas, which are in excess of 4 grams per square metre per month ($\text{g}/\text{m}^2/\text{month}$), are generally considered to indicate that nuisance dust impacts may occur.

Table 8: Dust deposition criteria

Pollutant	Maximum Increase in Dust Deposition	Maximum Total Dust Deposition Level
Deposited dust (assessed as insoluble solids)	2 $\text{g}/\text{m}^2/\text{month}$	4 $\text{g}/\text{m}^2/\text{month}$
Source: <i>Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales</i> (NSW EPA 2005a)		

4.3 Products of combustion

The combustion of diesel in mining equipment results in combustion-related emissions including fine particulate matter, NO₂, SO₂, CO and volatile organic compounds, however with the exception of particulate matter, combustion emissions have not been quantitatively assessed. Underground mining operations consume significantly less diesel than open cut mines and combustion related emissions for the NM would not result in significant ground level concentrations. It is noted that emissions of PM from the combustion of diesel fuel in mining equipment are included in the emission factors used to estimate total PM emissions for dozers and trucks.

5 Dispersion meteorology

NCOPL operate an on-site meteorological monitoring station at the NM which records 15 minute averages of wind speed and direction, temperature (at 2 and 10 m), rainfall, barometric pressure and solar radiation.

A review of data presented in the AEMRs indicates that during 2010 and 2011 there were periods of gaps in the data. From February 2012 the data capture improves (due to the upgrade of the meteorological monitoring station in January 2012) and the period February 2012 to August 2014 has been analysed further to determine a suitable period for modelling. A summary of the data capture for this period is presented in **Table 9**, including the period corresponding to the latest AEMR reporting period (April 2013 to March 2014).

Table 9: Summary of data capture				
Parameter	2012	2013	2014¹	Apr 2013 – Mar 2014
Temperature 2 m (°C)	86%	96%	66%	95%
Temperature 10 m (°C)	86%	96%	66%	95%
Humidity (%)	86%	95%	66%	95%
Wind Speed (m/s)	86%	96%	66%	95%
Wind Direction	86%	95%	63%	95%
Rain (mm)	86%	96%	66%	95%
Pressure (hPa)	78%	96%	66%	95%
Solar Radiation (W/m ²)	78%	96%	66%	95%
Note:				
1) Data to August 2014 were analysed.				

5.1 Prevailing winds

Annual wind roses for 2012, 2013 and April 2013 to March 2014 are presented in **Figure 5** and demonstrate that winds are consistently aligned along the north-west south-east axis. Annual average wind speeds are consistent (3.1 metres per second [m/s] to 3.2 m/s) and the percentage occurrence of calm conditions (less than or equate to 0.5 m/s) varies from 2.5% to 3.4%.

Regional wind patterns, as measured by Bureau of Meteorology (BoM) AWS located at Narrabri and Gunnedah, were compared to the NM winds (**Figure 6**). The wind roses show slightly higher average wind speeds at the BoM sites (4 m/s at Narrabri and 3.6 m/s at Gunnedah) with the frequency of calm conditions also increased (6.3% at Narrabri and 8.9% at Gunnedah).

The overall wind patterns are similar, although the Narrabri BoM site displays a strong northerly component that is absent from the NM and Gunnedah BoM site. Variations in regional wind flows are influenced by topographical features, and in particular, the elevated terrain of Mt Kaputar.

The wind roses presented in **Figure 6** are representative of longer term wind patterns, shown by an analysis of 5 years of data presented in **Appendix A**.

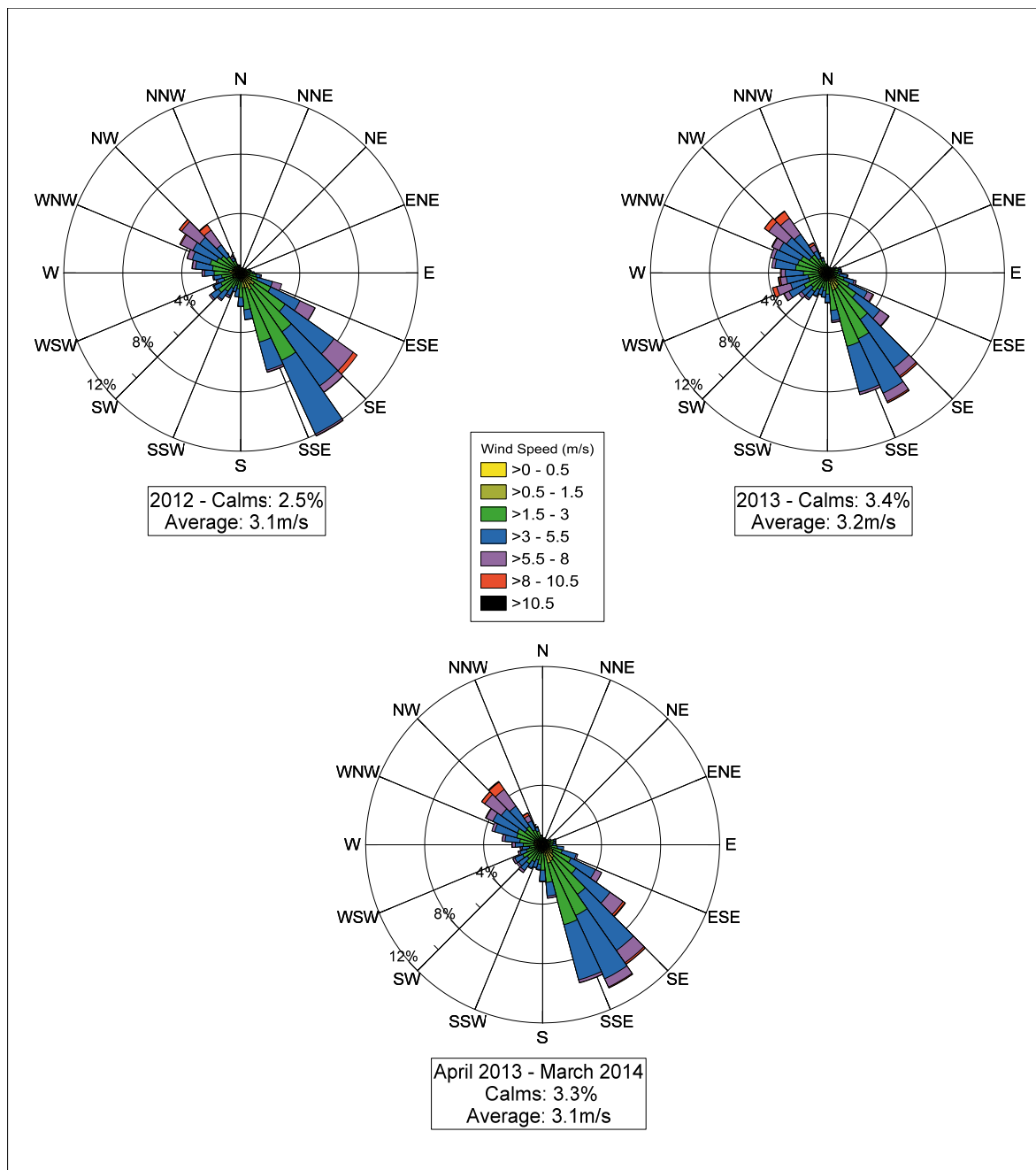
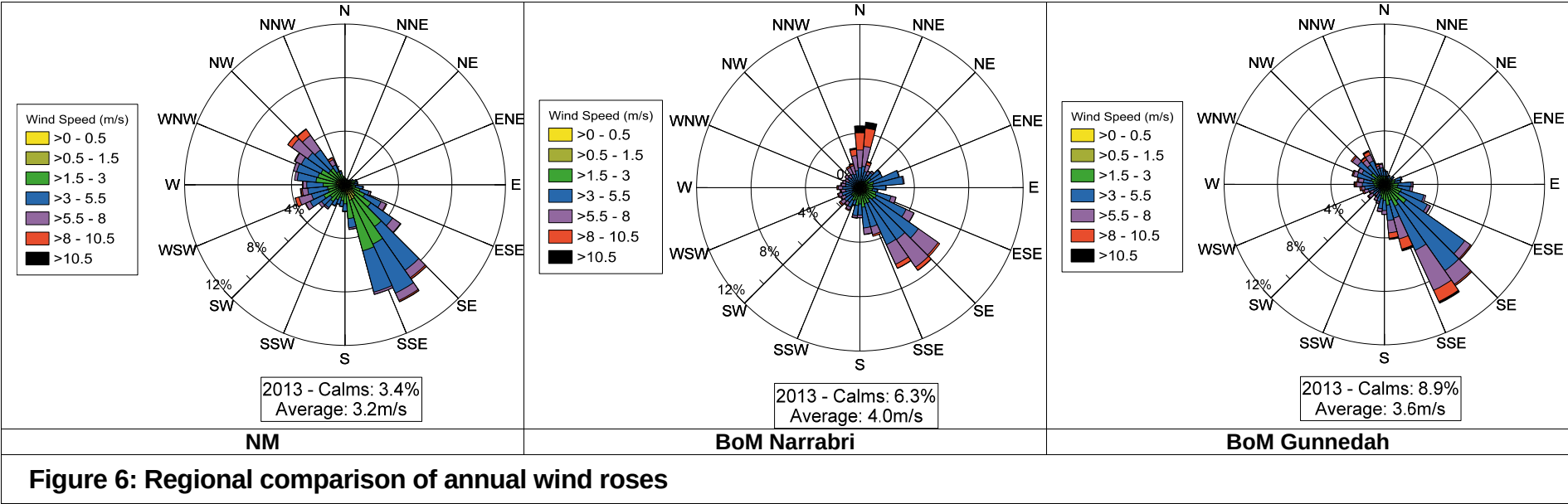


Figure 5: Annual wind rose for NM data



5.2 Period selected for modelling

Based on the availability and consistency of wind data, the AEMR period April 2013 to March 2014 is considered suitable for modelling. It is representative of longer term conditions recorded at the NM and region, there is a high data recovery for the period and it corresponds to the latest AEMR reporting period for which existing production data are available.

Gaps in the NM data were supplemented with data from the Gunnedah BoM site, which was determined to be more suitable than Narrabri BoM based on the analysis of wind direction and annual average wind speeds.

Further analysis of the NM data used for dispersion modelling is provided in the following sections.

5.3 Seasonal wind variation

Seasonal wind roses for the modelling dataset are presented in **Figure 7**. Seasonal variation is most evident in autumn when the dominant winds are predominantly from the south-east with little winds from the north-west. In other seasons, the wind patterns are similar to annual and generally aligned along the north-west to south-east axis.

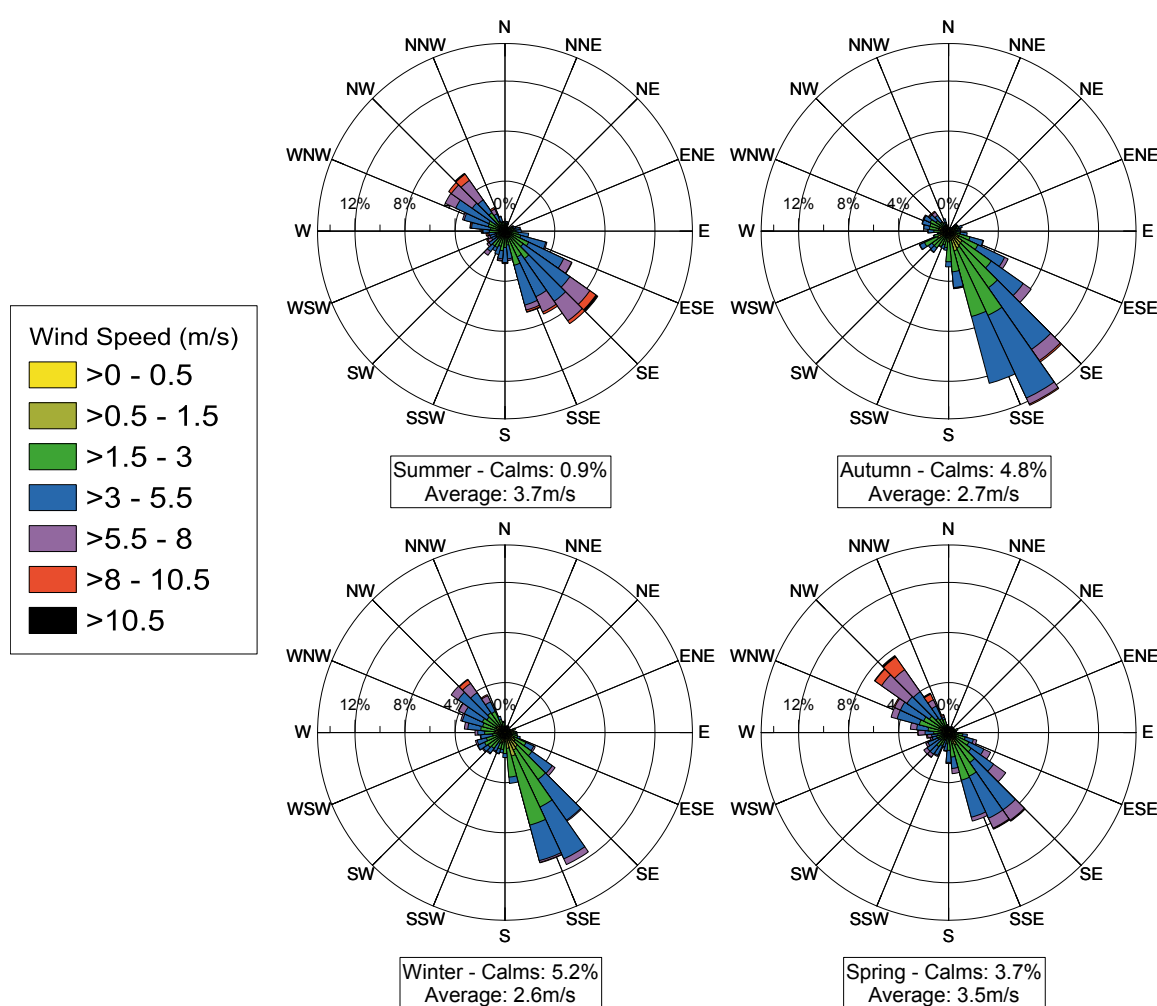


Figure 7: Seasonal wind roses for NM data

5.4 Ambient Temperature

The monthly minimum, maximum and average temperatures for the modelling dataset are presented in **Figure 8** compared with long term mean monthly minimum and maximum temperatures rainfall recorded at Narrabri Airport AWS. The April 2013 to March 2014 maximum temperatures are higher than the long term mean monthly maximum and the April 2013 to March 2014 minimum temperatures are generally lower than the long term mean monthly minimum. The average temperature falls between the long term maximum and minimum.

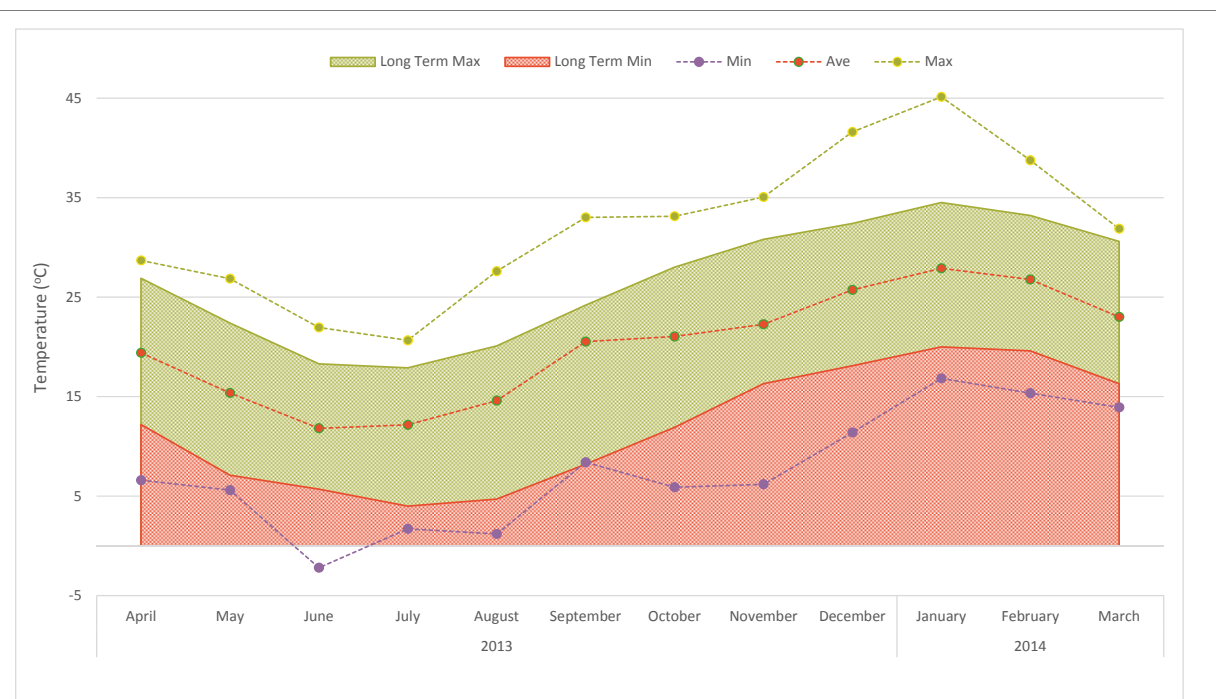


Figure 8: NM and Narrabri Airport AWS (long term) temperature

5.5 Rainfall

Precipitation is important to air pollution studies since it impacts on dust generation potential and represents a removal mechanism for atmospheric pollutants. A comparison between long term average monthly rainfall recorded at Narrabri Airport AWS² and the NM data for the modelling period is presented in **Figure 9**. June 2013 recorded rainfall in excess of the long term average and May and October 2013 recorded levels comparable to the long term average. For all other months in the modelling period the recorded rainfall was lower than the average rainfall.

To provide a conservative (upper bound) estimate of the airborne particulate matter concentrations occurring due to the NM, wet deposition (removal of particles from the air by rainfall) was conservatively excluded from the dispersion modelling simulations undertaken in this report.

² Data available from Narrabri Airport AWS since 2001

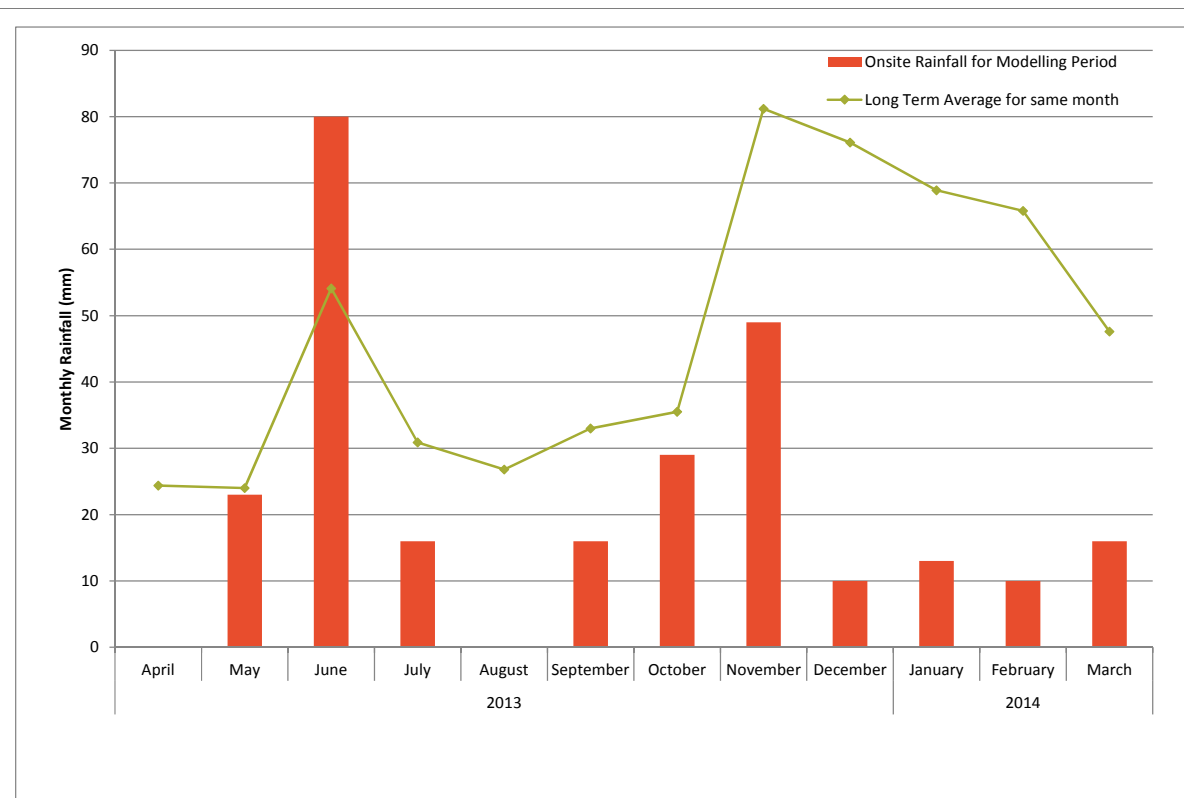


Figure 9: Rainfall comparison

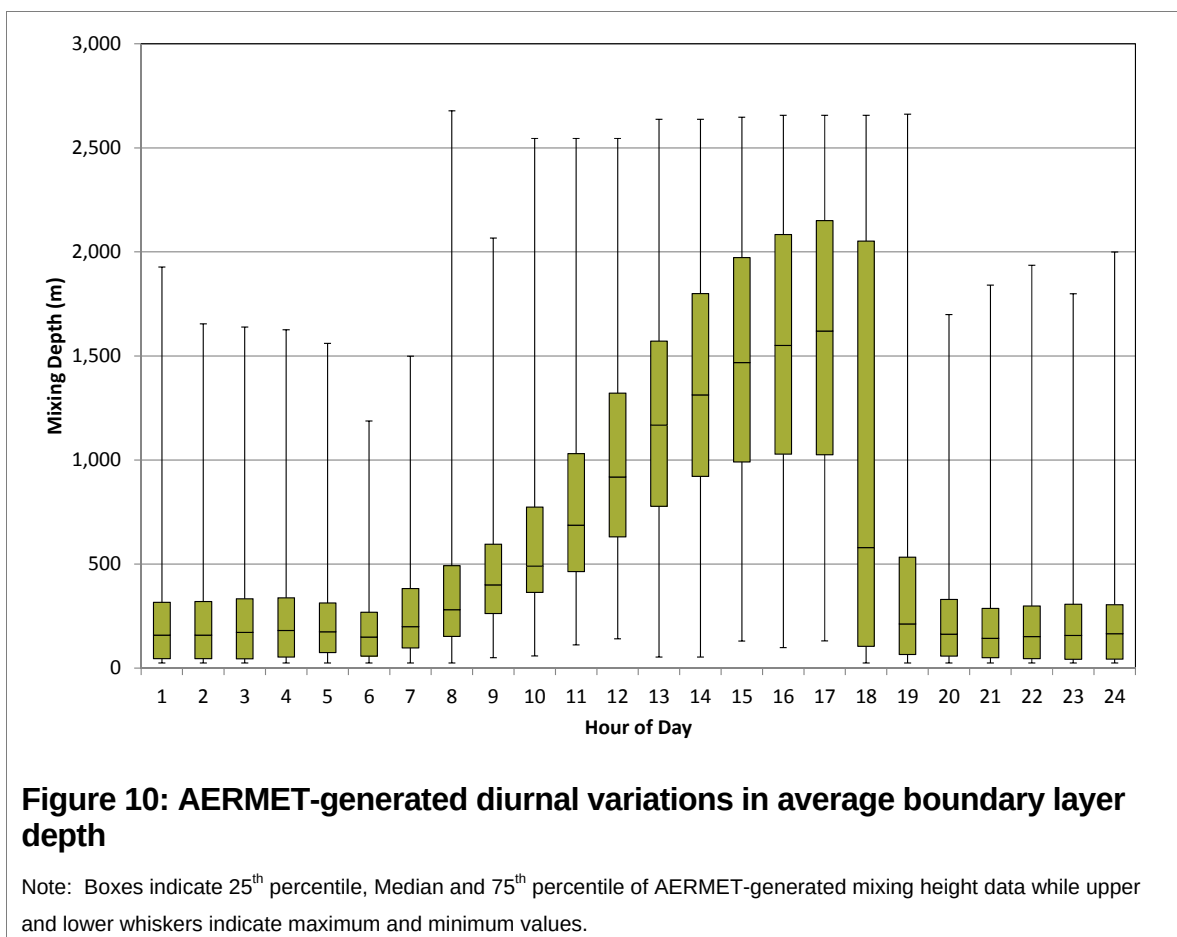
5.6 Atmospheric stability and boundary layer depth

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. This layer is directly affected by the earth's surface, either through the retardation of air flow due to the frictional drag of the earth's surface (mechanical mechanisms), or as result of the heat and moisture exchanges that take place at the surface (convective mixing) (Stull, 1997; Oke, 2003).

During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface and the extension of the mixing layer to the lowest elevated subsidence inversion. Elevated inversions may occur for a variety of reasons including anticyclonic subsidence and the passage of frontal systems. Due to radiative flux divergence, nights are typically characterised by weak to no vertical mixing and the predominance of stable conditions. These conditions are normally associated with low wind speeds and hence lower dilution potentials.

Hourly-varying atmospheric boundary layer depths were generated for modelling by AERMET, the meteorological processor for the AERMOD dispersion model, using a combination of surface observations from the on-site weather station, sunrise and sunset times and adjusted TAPM-predicted upper air temperature profile. The TAPM-predicted upper air temperature profile is adjusted to the observed 2 m and 10 m temperature recorded at the NM station.

The variation in average boundary layer depth by hour of the day is illustrated in **Figure 10**. It can be seen that greater boundary layer depths are experienced during the day time hours, peaking in the mid to late afternoon. Higher day-time wind velocities and the onset of incoming solar radiation increases the amount of mechanical and convective turbulence in the atmosphere. As turbulence increases so too does the depth of the boundary layer, generally contributing to higher mixing depths and greater potential for atmospheric dispersion of pollutants.

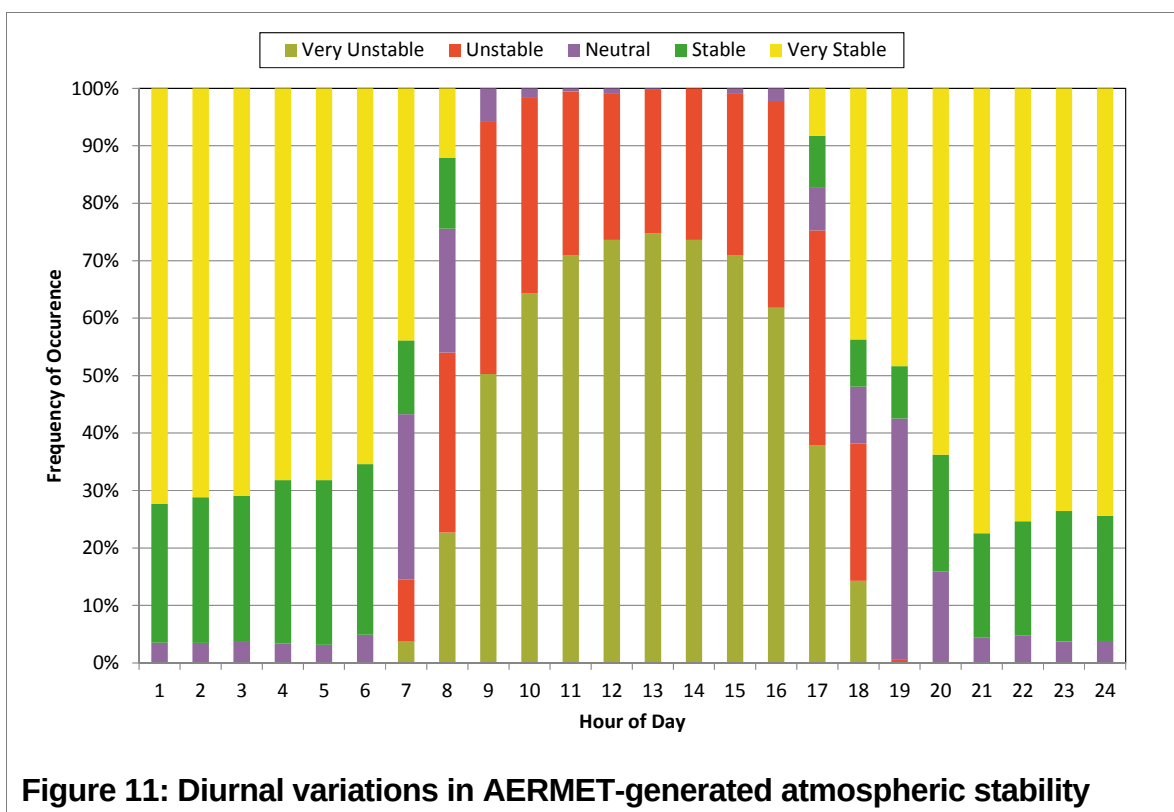


The Monin-Obukhov length provides a measure of the stability of the surface layer (i.e. the layer above the ground in which vertical variation of heat and momentum flux is negligible; typically about 10% of the mixing height). Wharton and Lundquist (2010) provide typical value ranges for the Monin-Obukhov length for widely referenced atmospheric stability classes, as listed within **Table 10**.

Table 10: Monin-Obukhov length with respect to atmospheric stability	
Monin-Obukhov length (L) range	Stability class
$-50 < L < 0$	Very Unstable
$-600 < L < -50$	Unstable
$ L > 600$	Neutral
$100 < L < 600$	Stable
$0 < L < 100$	Very Stable

Source: Table 2, Wharton and Lundquist (2010).

Figure 11 illustrates the diurnal variation of atmospheric stability derived from the Monin-Obukhov length calculated by AERMET for the NM site. The diurnal profile presented illustrates that atmospheric instability increases during daylight hours as convective energy increases, whereas stable atmospheric conditions prevail during the night-time. This profile indicates that the potential for atmospheric dispersion of emissions would be greatest during day time hours and lowest during evening through to early morning hours.



6 Existing ambient air quality

NCOPL operate an air quality monitoring network for monitoring compliance, including eight sites for dust deposition (ND1 to ND8) and two sites measuring PM₁₀ concentrations (ND9 - Claremont and ND10 - Turrabaa). The air quality monitoring locations are shown in **Figure 4**.

6.1 PM₁₀ concentration

PM₁₀ monitoring commenced in late 2007/early 2008 using high volume air samplers, run every sixth day, to obtain a 24-hour average composite PM₁₀ concentration. The 24-hour average PM₁₀ concentrations measured at ND9 (Claremont) and ND10 (Turrabaa) are presented in **Figure 12**. ND9 (Claremont) is located approximately 1 km south-west of the ROM and product coal stockpiles and ND10 (Turrabaa) is located approximately 1 km to the south-east of the ROM and product coal stockpiles.

With the exception of a period between September and December 2009 (when extensive dust storms occurred across NSW) the 24-hour PM₁₀ concentrations remain below the impact assessment criteria. The single exceedance in May 2008 at Turrabaa was attributed to vehicles travelling to the temporary site office at Turrabaa, along an unsealed access track (NCOPL, 2009).

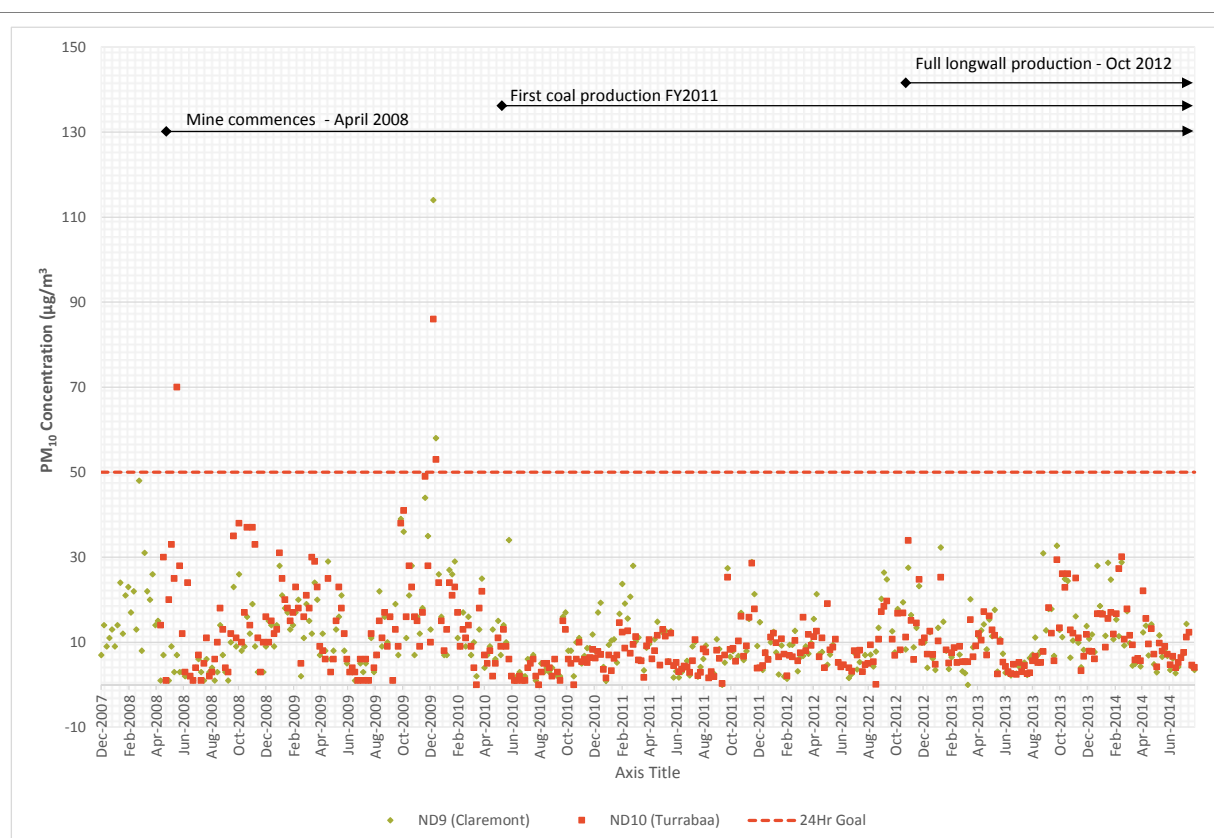


Figure 12: 24-hr average PM₁₀ concentration - December 2007 to July 2014

Annual average PM₁₀ concentrations are presented for each complete year and for the most recent AEMR monitoring period (**Figure 13**). In the previous four years, the annual average PM₁₀ concentrations at both locations have been less than 50% of the impact assessment criterion of 30 µg/m³. Annual averages in 2009 were higher, however this was a particularly dry year in NSW, resulting in elevated dust concentrations recorded across much of the state (<http://www.bom.gov.au/climate/mwr/>).



Figure 13: Annual Average PM₁₀ concentration - 2008 to 2014

Based on the dominant wind directions, ND10 (Turrabaa) is expected to be influenced more by dust emissions from the NM than ND9 (Claremont), however there is little evidence of this in the data and concentrations are similar across the two sites. For example, the maximum 24-hour average PM₁₀ concentration during the previous AEMR period was 32.7 µg/m³ at ND9 (Claremont) and 30.1 µg/m³ at ND10 (Turrabaa). Similarly the annual average was 11.9 µg/m³ at (ND9) Claremont and 11.2 µg/m³ at ND10 (Turrabaa).

Monitoring data suggests that emissions from NM are not significantly contributing to ambient PM₁₀ concentrations at the monitoring locations. This is explored further by modelling existing operations to evaluate model performance and derive a suitable background concentrations for cumulative assessment (**Section 9.1**). Based on the existing scenario modelling the background PM₁₀ concentration from sources other than NM is likely to be in the range of 9 – 11 µg/m³ and a conservative background PM₁₀ concentration of 11 µg/m³ is adopted for the assessment.

6.2 Dust deposition

Annual average dust deposition levels are presented in **Figure 14**. In calculating the annual average, outliers in the monthly measurements are removed. With the exception of ND5, compliance with the long term impact assessment criteria of 4 g/m²/month is generally achieved. ND5 is the closest monitoring location to NM, located at the boundary of the pit top area on NCOPL-owned land and in a direct prevailing downwind direction. ND1 was elevated in 2008 and 2009, but complies in more recent years. ND1 would also have been impacted by vehicles travelling to the temporary site office along an unsealed access track (NCOPL, 2009).

As described previously, 2009 was a particularly dry year in NSW, resulting in elevated dust concentrations recorded across much of the state, and reflected in the higher dust deposition readings.

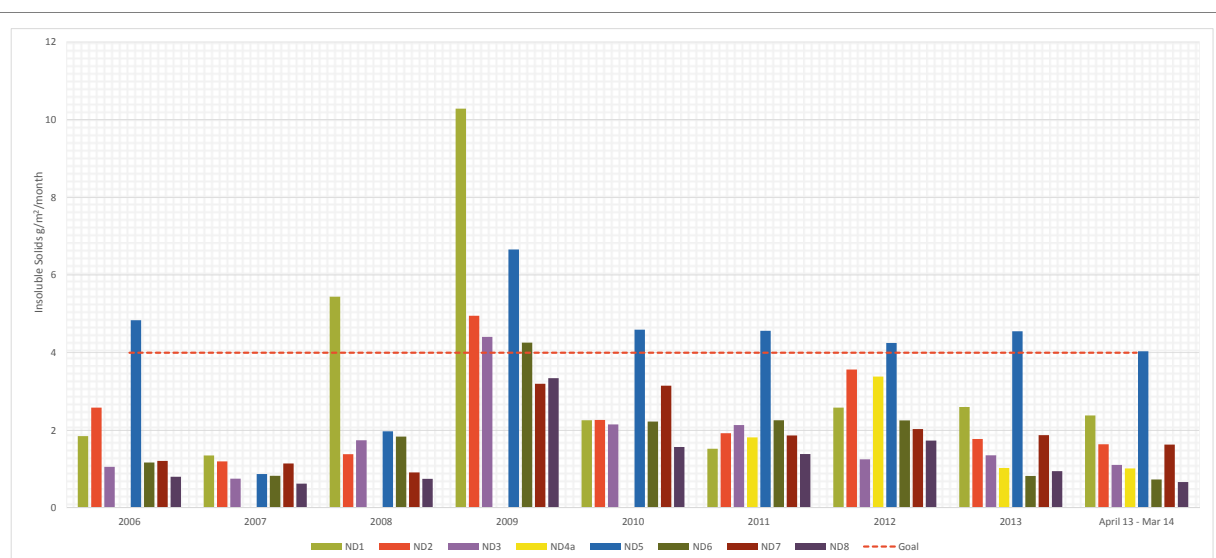


Figure 14: Annual Average dust deposition - 2008 to 2013

To derive a suitable background dust deposition level, three sites that are out of the prevailing wind direction of the NM operations were averaged. These sites are the least influenced by existing NM and the average across all sites and years is 1.9 g/m²/month. This is a reasonable indicative background for rural locations in NSW.

6.3 TSP concentration

TSP concentrations are not measured in the vicinity of the NM, however annual average TSP concentrations can be derived based on typical ratios of PM₁₀/TSP. To derive TSP concentrations, NCOPL assume that the PM₁₀ particle size mass fraction is typically of the order of 50% of the recorded TSP mass. The Department of Planning and Environment (DP&E) has accepted this relationship in its letter dated 5 August 2011.

Based on the existing scenario modelling presented in **Section 9.1**, a conservative background PM₁₀ concentration of 11 µg/m³ is adopted for the assessment. Applying this ratio to the NM PM₁₀ concentration data, an annual average TSP concentration of 22 µg/m³ is derived for background.

6.4 PM_{2.5} concentration

Limited PM_{2.5} monitoring data are available for rural NSW. The NSW Office of Environment and Heritage currently operate 17 stations where simultaneous concentrations of PM₁₀ and PM_{2.5} are recorded. The ratio of PM_{2.5} to PM₁₀ at these sites varies from 0.29 to 0.45 (with an average of 0.36). The ratio is often determined by the dominant source of PM emissions for that locality. For example, in areas with a lot of wood heaters in winter, PM_{2.5} is expected to make up a larger component of PM₁₀ (results in a higher ratio). In contrast, an area where crustal dust is expected to dominate (such as Camberwell in the middle of the Hunter Valley), PM_{2.5} is expected to form a smaller proportion of total PM and the ratio is lower.

The area surrounding the NM is expected to be influenced by PM derived from crustal sources, rather than combustion derived PM, and the PM_{2.5}/PM₁₀ ratio would be expected to be in the lower range described above. However, to provide a more conservative estimate of background PM_{2.5}, an average PM_{2.5}/PM₁₀ ratio of 0.4 is applied to the PM₁₀ concentration data, resulting in an annual average concentration of 4.4 µg/m³.

7 Emission inventory

Emissions inventories have been developed for the dust generating activities at the NM. Two scenarios are presented to compare existing operations with the Modification, as follows:

- Existing NM operations – representative of mining operations for the period April 2013 to March 2014 with a ROM coal production rate of 4.7 Mtpa.
- Modification – existing operations at the currently approved maximum ROM coal production rate of 8 Mtpa plus the extension of the ROM and product coal stockpiles.

7.1 Operations

Emission factors developed by the US EPA³, have been applied to estimate the amount of dust produced by each activity.

A summary of the estimated PM₁₀ emissions is provided in **Table 11**. The complete emission inventories for all size fractions are provided in **Appendix B**. The most significant dust sources are dozers (working on ROM and product coal stockpile reclaim) and stockpile wind erosion (which also includes dozer maintenance of stockpiles).

Emission reduction factors were applied to account for controls that are currently in place at NM or outlined in the statement of commitments (**Section 2.2.3**). The levels of emission controls are consistent with best practice emissions control for coal mining (Katestone Environmental, 2011) and as outlined in *Narrabri Mine Particulate Matter Control Best Practice Pollution Reduction Program* (PAEHolmes, 2012):

- Stockpile areas – 50% control applied for all stockpile activity based on the implementation of a fixed water spray suppression system.
- Unpaved roads/surfaces wheel dust – 85% reduction for water application.
- Rotary breaker and secondary crusher – 90% control for enclosure.
- Conveyor transfer – 40% control for wind shielding plus 50% control for water sprays.
- Soil stockpiles – 100% control as assumed to be undisturbed.

³ United States Environmental Protection Agency (US EPA) AP-42 Compilation of Air Pollutant Emission Factors (US EPA, 1998, US EPA, 2004, US EPA, 2006)

Table 11: Calculated annual PM₁₀ emissions – existing and proposed operations

Emissions source	Calculated annual emissions (kg/annum)	
	Existing NM operation (at 4.7 Mtpa ROM coal)	Modification (at 8 Mtpa ROM coal)
TOPSOIL		
Topsoil stripping	1,026	1,026
Topsoil spreading	244	244
ROM COAL		
Loading ROM coal stockpile	637	2,144
Dozer on reclaim	24,512	36,768
Rotary breaker	382	643
Screening secondary bypass – screening	675	1,135
Secondary bypass – crushing	188	317
Conveyor transfer	1,019	1,715
PRODUCT COAL		
Loading PCI product coal	104	351
Loading thermal (CHPP) product coal	186	626
Loading secondary bypass coal	210	707
Conveyor transfer	817	1,374
Dozer on reclaim	20,182	30,273
Loading trains	1,021	1,718
CRUSHER WASTE/REJECTS		
Conveyor transfer	59	100
Loading rejects pile	30	50
Hauling rejects	148	248
WIND EROSION		
ROM coal 'Live' stockpile	49	49
ROM coal stockpile – maintenance	12,539	37,618
Product coal 'Live' stockpile	77	77
Product coal stockpile – maintenance	4,758	23,149
Soil stockpiles	0	0
Active rehabilitation	876	876
MISCELLANEOUS		
Ventilation shaft	20,435	20,435
Grader	265	265
TOTAL	90,440	161,909

7.2 Construction activities

Modification construction activities would include:

- development of the extended ROM and product coal stockpile pads;
- construction of a new sediment basin (SB4) and associated collection drains;
- minor augmentation to sediment basin (SB1); and
- realignment of minor access roads.

Construction activities would generally be restricted to 7.00 am to 10.00 pm up to seven days a week for approximately six months.

Mobile equipment required for construction would generally be sourced from existing NM mobile equipment fleet, supplemented with an additional dozer and compactor.

The most significant dust generating activity during construction activities would be associated with the dozer constructing the extended ROM and product coal stockpile pads. The emissions intensity associated with dozer activity during construction is expected to be comparable to mine operations on a daily basis (described in **Section 7.1**), which accounts for additional dozer hours on the expanded stockpiles. On an annual basis, the emissions intensity during construction is significantly less due to reduced timeframes. Therefore no additional quantitative construction scenario was considered necessary.

8 Overview of dispersion modelling

AERMOD is the US EPA's recommended steady-state plume dispersion model for regulatory purposes. AERMOD is designed to handle a variety of pollutant source types, including surface and buoyant elevated sources, in a wide variety of settings such as rural and urban as well as flat and complex terrain⁴. AERMOD is able to predict pollutant concentrations from point, area and volume sources in addition to 'open pit' sources.

AERMOD replaced the Industrial Source Complex (ISC) model for regulatory purposes in the US in December 2006 as it provides more realistic results with concentrations that are generally lower and more representative of actual concentrations compared to the conservative ISC model. Ausplume, a steady state Gaussian plume dispersion model developed by the Victorian EPA and frequently used in Australia for simple near-field applications, is largely based on the ISC model.

Compared to ISC and Ausplume, AERMOD represents an advanced new-generation model, which requires additional meteorological and land use inputs to provide more refined predictions. The most important feature of AERMOD, compared to ISC and Ausplume, is its modification of the basic dispersion model to account more effectively for a variety of meteorological factors and surface characteristics. In particular, it uses the Monin-Obukhov length scale rather than Pasquill-Gifford stability categories to account for the effects of atmospheric stratification. Whereas Ausplume and ISC parameterise dispersion based on semi-empirical fits to field observations and meteorological extrapolations, AERMOD uses surface-layer and boundary layer theory for improved characterisation of the planetary boundary layer turbulence structure.

Verification studies have been undertaken for AERMOD both locally and abroad (Hanna et al 2001; Perry et al 2005; Hurley 2006). Hanna et al (2001) concluded that AERMOD performed better than ISC with predictions generally within a factor of two of actual values. It was noted that AERMOD did tend to under-predict actual concentrations by 20% to 40%, with predictions more accurate for short-term averaging periods. Perry et al (2005) summarises the performance of AERMOD across 17 field study databases placing emphasis on statistics that demonstrate the model's abilities to reproduce the upper end of the concentration distribution which are of importance in terms of regulatory modelling. The field studies include flat and complex terrain cases, urban and rural conditions and elevated and surface releases with and without building wake effects. Perry et al (2005) concluded that, with few exceptions, AERMOD's performance was superior to that of the other applied models tested.

Hurley (2006) compared the performance of Ausplume, AERMOD and TAPM across several case studies including flat terrain, flat terrain with building downwash, in complex terrain and coastal terrain. AERMOD was determined to perform acceptably for all of the datasets but was found unable to simulate shoreline fumigation in the case of the Kwinana case study. This potential limitation of AERMOD is not of relevance to the NM due to its inland setting.

⁴ Under complex wind conditions and for regional applications, CALPUFF is the US EPA's recommended model for regulatory purposes.

Input data types required for the AERMOD model include: meteorological data (from AERMET), source data (from the compiled emissions inventory), source and receptor elevations and information on the nature of the receptor grid.

The AERMOD system is composed of two pre-processors that generate the input files required by the AERMOD dispersion model: AERMET (for the preparation of meteorological data) and AERMAP (for the preparation of terrain data). Terrain data for the modelling domain was sourced from NASA's Shuttle Radar Topography Mission (SRTM) data. This data set provided a high-resolution topography at 3 arc-second (~90 m) grid spacing.

In applying the AERMET meteorological processor to prepare the meteorological data for the AERMOD model, appropriate values for three surface characteristics need to be determined: surface roughness length, albedo, and Bowen ratio. Surface roughness length is related to the height of obstacles in the path of wind flow and is, in principle, the height at which the mean horizontal wind speed is zero based on a logarithmic profile. The surface roughness length influences the surface shear stress and is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. The albedo is the fraction of total incident solar radiation reflected by the surface back to space without absorption. The daytime Bowen ratio, an indicator of surface moisture, is the ratio of sensible heat flux to latent heat flux and is used for determining planetary boundary layer parameters for convective conditions driven by the surface sensible heat flux.

Appropriate values for surface roughness length, albedo, and Bowen ratio were selected based on the dominant land use in the vicinity of NM.

9 Dispersion modelling results

9.1 Existing NM operations scenario

Modelling for existing NM operations is presented to evaluate model performance and derive a suitable background for cumulative assessment. As monitoring data are available for PM₁₀ but no other PM size metrics, results are presented for PM₁₀ only for the existing NM operations scenario.

The modelled incremental PM₁₀ concentrations for existing operations (April 2013 to March 2014) are presented in **Table 12**. As expected, the highest prediction at a private residences occurs at Ardmona, located directly downwind from the NM.

Table 12: Incremental PM₁₀ concentration (µg/m³) – existing NM operations		
Receptor ID	Maximum 24-hour	Annual Average
Criteria	50 µg/m³	30 µg/m³
Private		
Ardmona	17.6	1.3
Belah Park	5.9	0.9
Bow Hills	7.8	1.0
Burrigurum	1.7	0.1
Haylin View	2.6	0.3
Matilda	2.7	0.3
Merriman	3.9	0.7
Merulana	5.3	0.5
Newhaven	5.5	1.1
Oakleigh	6.9	0.7
Pineview	3.4	0.4
Mine Owned		
Barton Hedge	2.7	0.3
Claremont	2.9	0.3
Greylands	10.5	2.1
Kurrajong	1.0	0.0
Matoppo	12.2	3.0
Mayfield	2.5	0.3
Mayfield Cottage	2.4	0.3
Merrilong	2.0	0.2
Naroo	18.4	1.9
Omeo	8.1	1.4
Turrabaa	22.9	1.9
Westhaven	2.4	0.2
Willarah	25.5	5.9

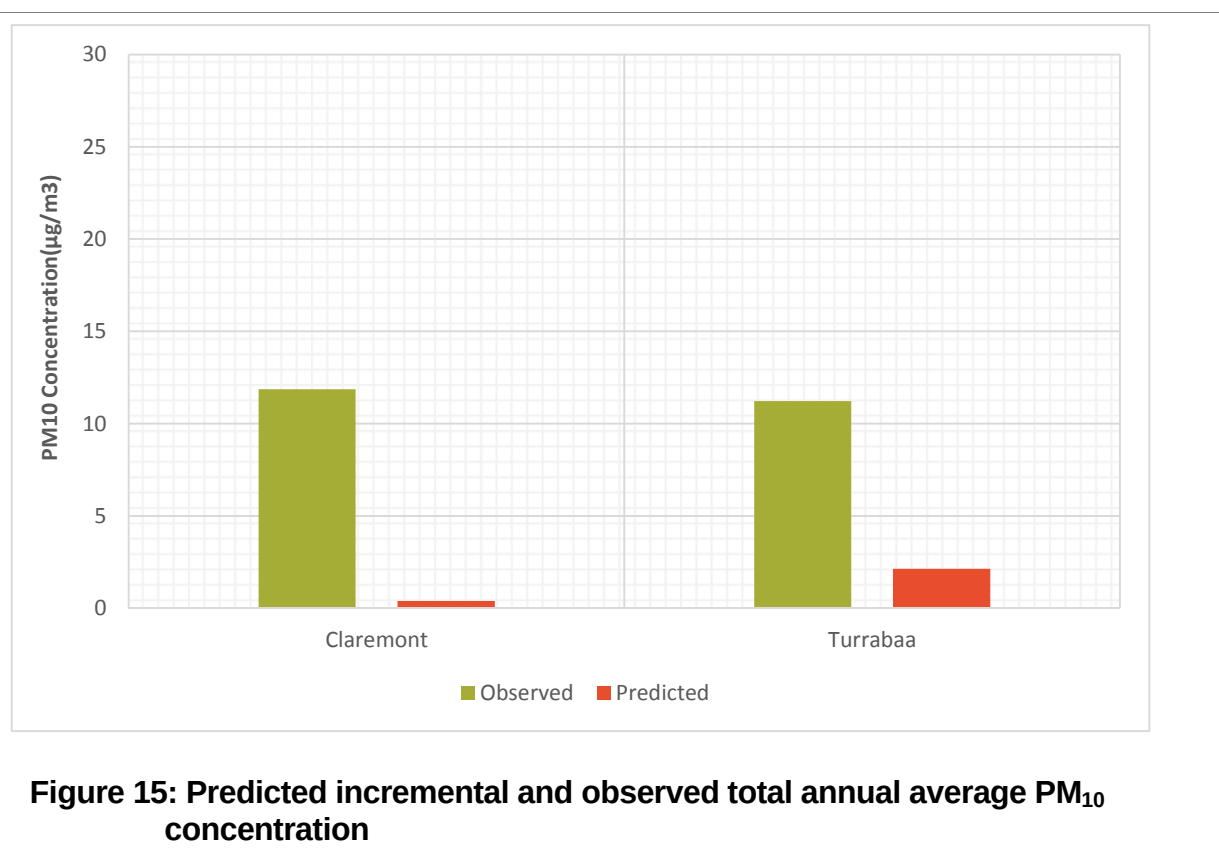
The incremental modelling predictions are also presented for the locations of the two HVAS (i.e. ND9 [Claremont] and ND10 [Turrabaa]) and compared with the measured total PM₁₀ concentrations for all sources in the area. This provides an indication of how much the NM contributes to the total measured PM₁₀, which as shown in in **Figure 15** is a small amount.

Also, by comparing the predicted increment from the NM against the total measured concentration at these HVAS monitoring sites we are able to estimate the background PM₁₀ concentrations from other sources in the area/region for use in cumulative assessment.

The modelled NM contribution and total measured PM₁₀ concentration at the HVAS monitoring locations is presented in **Figure 15**. The monitoring data indicates that although the annual average PM₁₀ concentrations do not differ significantly at the two HVAS monitoring sites, model predictions at ND10 (Turrabaa) are higher than at ND9 (Claremont).

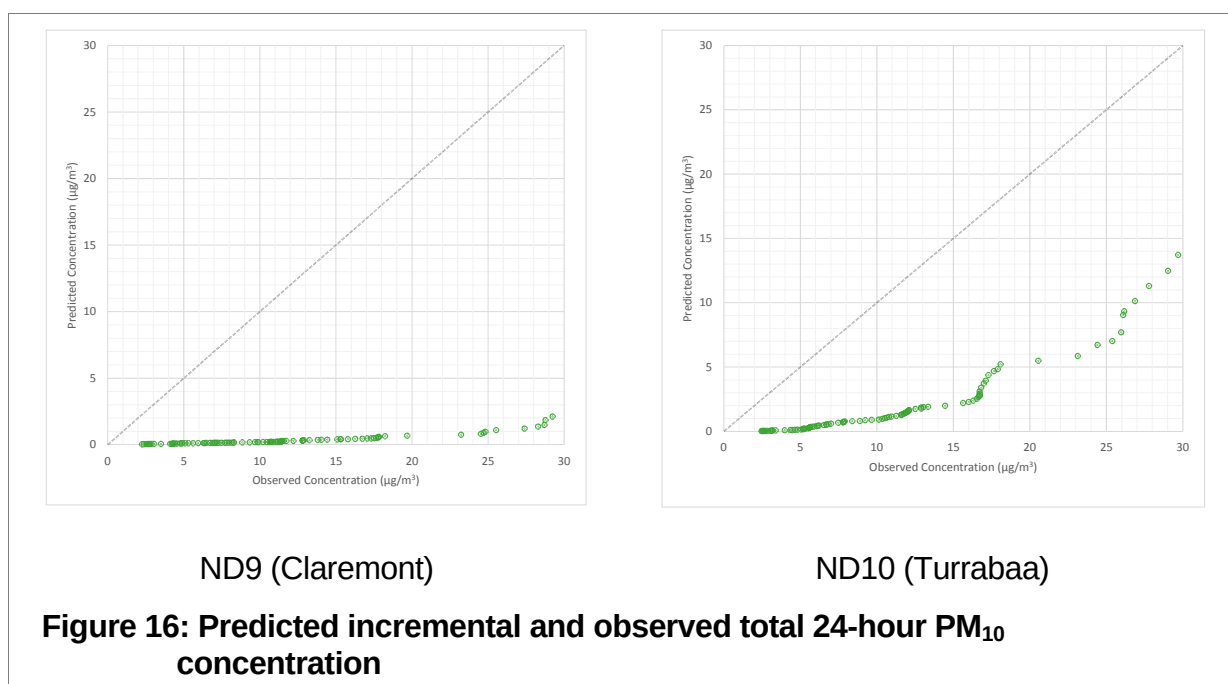
This is expected, given the prevailing wind conditions which drives the model, however, it suggests that the model may over-predicts at ND10 (Turrabaa) (although a slight under prediction at ND9 (Claremont) cannot be ruled out). It can also be assumed that the model may over-predict at other locations close to and in a prevailing downwind direction of the NM operations. Modelling predictions for the expansion are therefore likely to be conservatively high.

Based on this analysis, the background PM₁₀ concentration from sources other than the NM is therefore likely to be in the range of 9 to 11 µg/m³.



The predicted incremental 24-hour concentrations from NM are also compared with the observed total, presented as a Q-Q percentile plot in **Figure 16**. It is noted that the plots are not presented to indicate model performance (because only the increment from NM is presented for modelling results). The plots are presented to show how much the NM may contribute to total 24-hour PM₁₀. The 1:1 dotted line indicates perfect correlation, therefore the gap between the plotted values and the 1:1 dotted line could be taken as the difference between NM influence and background from all other sources.

The plots show that the predicted influence from the NM on 24-hour PM₁₀ concentrations is stronger at ND10 (Turrabaa) than at ND9 (Claremont), where little contribution from the NM is predicted to occur. The measured concentrations at ND9 (Claremont) therefore provide a reasonable indication of daily varying background from other sources (in other words, there is little contribution from the NM and therefore minimal double counting).



9.2 Modification scenario

9.2.1 PM₁₀ concentrations

The modelled incremental and cumulative PM₁₀ concentrations for the Modification are presented in **Table 13**. There are no predicted exceedances of the impact assessment criteria for the Modification. Contour plots are presented in **Appendix C**.

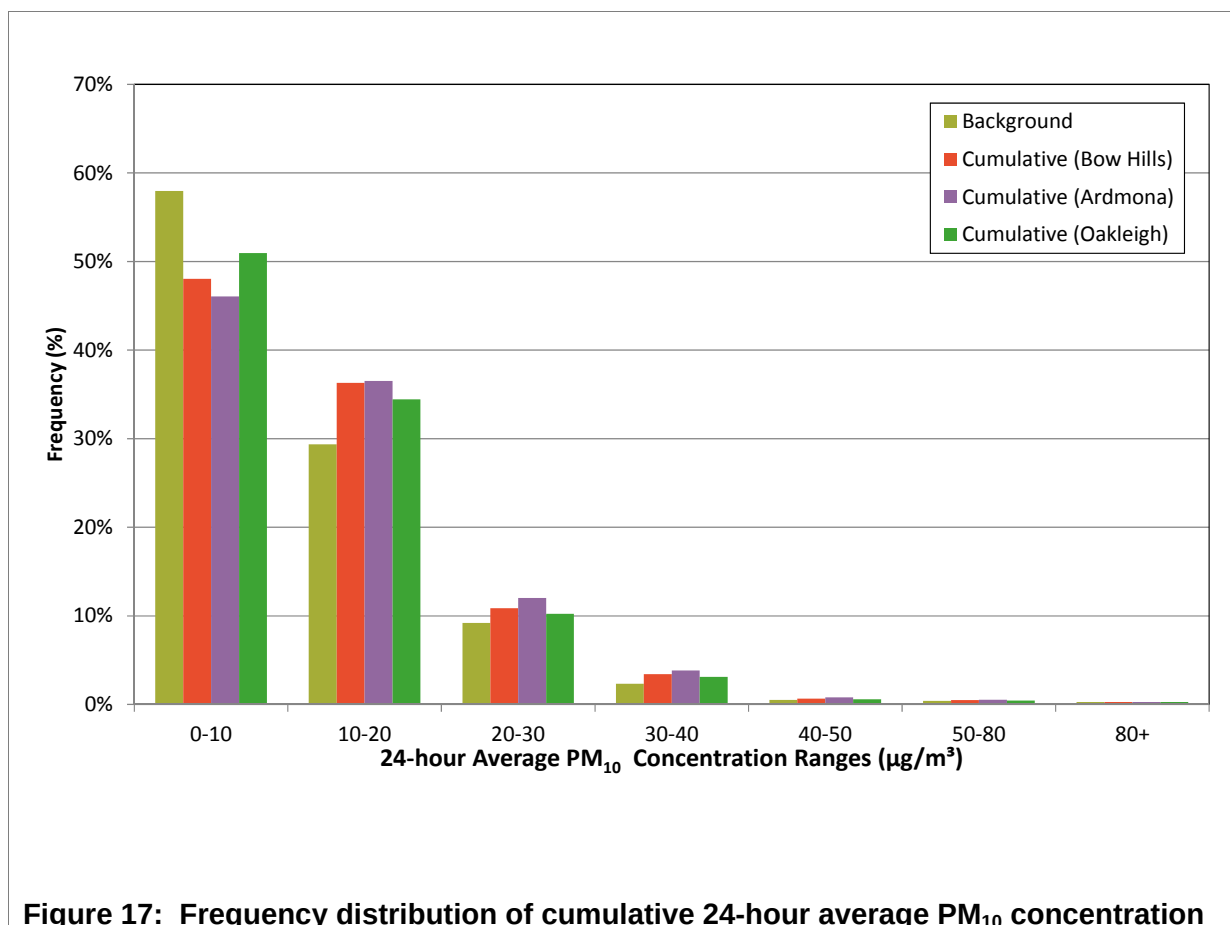
Cumulative annual average PM₁₀ concentrations are estimated by adding a background concentration of 11 µg/m³ to the predicted incremental concentration. This provides a conservative assessment of impact, particularly at locations close to and in a prevailing downwind direction from the NM operations.

The potential for cumulative short term impacts (exceedances of the 24-hour average PM₁₀ impact assessment criteria) are assessed in two ways. The cumulative predictions presented in **Table 13** are estimated by adding the measured daily PM₁₀ data at ND9 (Claremont) to the predicted incremental PM₁₀ concentration from the NM for the same day.

It is noted, that the HVAS data are available every sixth day and the maximum cumulative 24-hour PM₁₀ concentration is therefore based on a limited cumulative dataset.

Additional analysis is therefore presented using a statistical approach which presents the likelihood of additional exceedances of the 24-hour average assessment criterion of 50 µg/m³. A frequency distribution of cumulative impact is presented showing every possible combination of predicted increment and background concentration (i.e. every modelling prediction is added to all available background values from both HVAS sites for multiple years, resulting in over 280,000 combinations). The frequency distribution is presented in **Figure 17** for the three most affected private receptors. The analysis shows that the risk of additional exceedances of the 24-hour PM₁₀ impact assessment criteria, beyond what is caused by background, would be 0.2% or less than 1 additional exceedance day per year.

Table 13: Incremental and cumulative PM₁₀ concentration (µg/m³)				
Criteria	Maximum 24-hour		Annual Average	
	50 µg/m³		30 µg/m³	
	Increment	Cumulative	Increment	Cumulative
Private				
Ardmona	25.6	34.4	2.0	13.0
Belah Park	9.4	34.9	1.3	12.3
Bow Hills	10.0	35.3	1.5	12.5
Burragurru	2.3	32.8	0.2	11.2
Haylin View	3.4	32.8	0.4	11.4
Matilda	3.3	32.8	0.4	11.4
Merriman	5.7	34.9	1.0	12.0
Merulana	7.3	33.5	0.7	11.7
Newhaven	7.7	35.4	1.6	12.6
Oakleigh	9.8	35.1	1.1	12.1
Pineview	4.6	33.0	0.6	11.6
Mine Owned				
Barton Hedge	3.9	32.7	0.4	11.4
Claremont	4.5	32.8	0.5	11.5
Greylands	16.1	36.8	3.2	14.2
Kurrajong	1.5	32.7	0.1	11.1
Matoppo	20.0	37.4	4.9	15.9
Mayfield	3.1	32.8	0.4	11.4
Mayfield Cottage	3.0	32.8	0.3	11.3
Merrilong	2.4	32.8	0.2	11.2
Naroo	27.9	36.4	3.0	14.0
Omeo	11.4	34.9	2.1	13.1
Turrabaa	33.2	41.1	2.9	13.9
Westhaven	3.3	32.7	0.3	11.3
Willarah	37.8	53.4	8.9	19.9



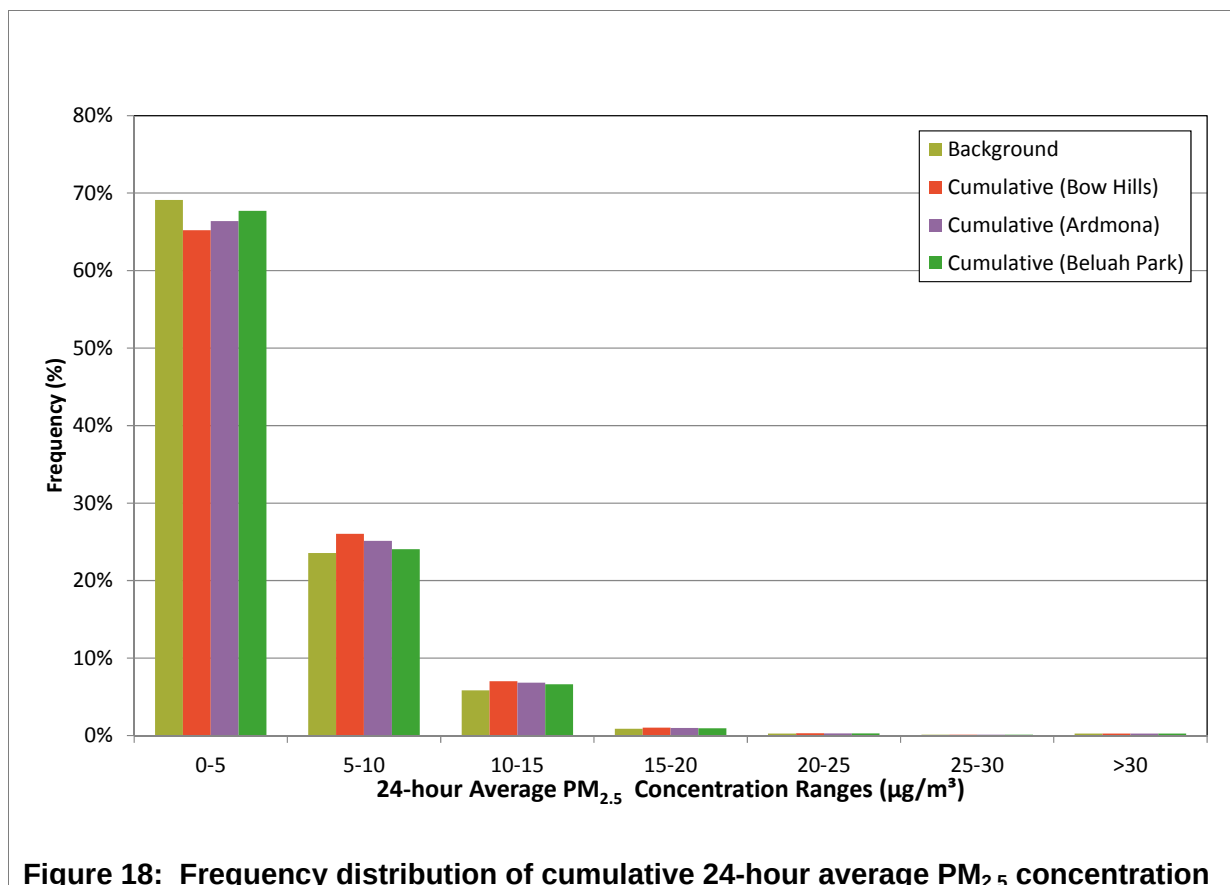
9.2.2 PM_{2.5} concentrations

The modelled incremental and cumulative PM_{2.5} concentrations for the Modification are presented in **Table 14**. There are no predicted exceedances of the impact assessment criteria for the Modification. Contour plots are presented in **Appendix C**.

Cumulative annual average and 24-hour PM_{2.5} concentrations are estimated by adding a derived background concentration to the predicted increment based on a ratio of PM_{2.5}/PM₁₀, as discussed in **Section 6.4**. Similar to PM₁₀, additional analysis is presented using a statistical approach which presents the likelihood of additional exceedances of the 24-hour average advisory reporting standard of 25 µg/m³. The frequency distribution is presented in **Figure 18** for the three most affected private receptors. The analysis shows that the risk of additional exceedances of the 24-hour PM_{2.5} impact assessment criteria is negligible.

Table 14: Incremental and cumulative PM_{2.5} concentration (µg/m³)

Criteria	Maximum 24-hour		Annual Average	
	25 µg/m ³		8 µg/m ³	
	Increment	Cumulative	Increment	Cumulative
Private				
Ardmona	4.4	13.3	0.3	4.7
Belah Park	2.2	13.5	0.1	4.5
Bow Hills	1.1	13.1	0.1	4.5
Burrigurum	0.5	13.1	0.0	4.4
Haylin View	0.3	13.1	0.1	4.5
Matilda	0.6	13.1	0.1	4.5
Merriman	1.2	13.6	0.1	4.5
Merulana	1.5	13.3	0.1	4.5
Newhaven	2.1	13.4	0.4	4.8
Oakleigh	1.5	13.7	0.1	4.5
Pineview	1.0	13.2	0.1	4.5
Mine Owned				
Barton Hedge	1.5	13.1	0.1	4.5
Claremont	2.0	13.1	0.1	4.5
Greylands	1.9	13.5	0.4	4.8
Kurrajong	0.4	13.1	0.0	4.4
Matoppo	2.2	13.6	0.5	4.9
Mayfield	0.3	13.1	0.0	4.4
Mayfield Cottage	0.3	13.1	0.0	4.4
Merrilong	0.3	13.1	0.0	4.4
Naroo	3.9	13.8	0.3	4.7
Omeo	1.6	13.4	0.3	4.7
Turrabaa	4.7	13.4	0.3	4.7
Westhaven	1.0	13.1	0.1	4.5
Willarah	2.4	13.2	0.5	4.9



9.2.3 TSP concentration and dust deposition

The modelled incremental and cumulative TSP concentrations and dust deposition for the Modification are presented in **Table 15**. There are no predicted exceedances of the impact assessment criteria. Contour plots are presented in **Appendix C**.

Cumulative annual average TSP concentrations are estimated by adding a background concentration of 22 µg/m³ to the predicted increment. This provides a conservative assessment of impact, particularly at locations close to and in a prevailing downwind direction from NM operations. Cumulative annual average dust deposition is estimated by adding a background of 1.9 g/m²/month to the predicted increment.

Table 15: Incremental and cumulative TSP concentration ($\mu\text{g}/\text{m}^3$) and dust deposition ($\text{g}/\text{m}^2/\text{month}$)				
Criteria	Annual average TSP		Annual average dust deposition	
	90 $\mu\text{g}/\text{m}^3$		2 $\text{g}/\text{m}^2/\text{month}$	4 $\text{g}/\text{m}^2/\text{month}$
	Increment	Cumulative	Increment	Cumulative
Private				
Ardmona	3.7	25.7	0.1	2.0
Belah Park	2.3	24.3	0.1	2.0
Bow Hills	2.8	24.8	0.1	2.0
Burrigurum	0.3	22.3	0.0	1.9
Haylin View	0.7	22.7	0.0	1.9
Matilda	0.6	22.6	0.0	1.9
Merriman	1.6	23.6	0.0	1.9
Merulana	1.2	23.2	0.0	1.9
Newhaven	2.8	24.8	0.1	2.0
Oakleigh	1.8	23.8	0.1	2.0
Pineview	1.0	23.0	0.0	1.9
Mine Owned				
Barton Hedge	0.9	22.9	0.0	1.9
Claremont	1.0	23.0	0.0	1.9
Greylands	6.0	28.0	0.2	2.1
Kurrajong	0.1	22.1	0.0	1.9
Matopppo	10.6	32.6	0.3	2.2
Mayfield	0.5	22.5	0.0	1.9
Mayfield Cottage	0.5	22.5	0.0	1.9
Merrilong	0.3	22.3	0.0	1.9
Naroo	6.4	28.4	0.3	2.2
Omeo	3.6	25.6	0.1	2.0
Turrabaa	6.3	28.3	0.2	2.1
Westhaven	0.5	22.5	0.0	1.9
Willarah	20.6	42.6	0.7	2.6

10 Conclusion

Dispersion model predictions for the NM incorporating Modification (at the currently approved ROM coal production rate of 8 Mtpa) show that the Modification would not result in any exceedances of the impact assessment criteria for key pollutants, including PM₁₀, PM_{2.5}, TSP and dust deposition.

Cumulative annual average PM₁₀, PM_{2.5}, TSP and dust deposition predictions are well below the applicable assessment criteria and the risk of additional days over the 24-hour average PM₁₀ and PM_{2.5} assessment criteria is minimal.

The dispersion modelling presented in this report assumes dust controls, as outlined in Section 2, are implemented.

11 References

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Appendix A

Annual wind roses

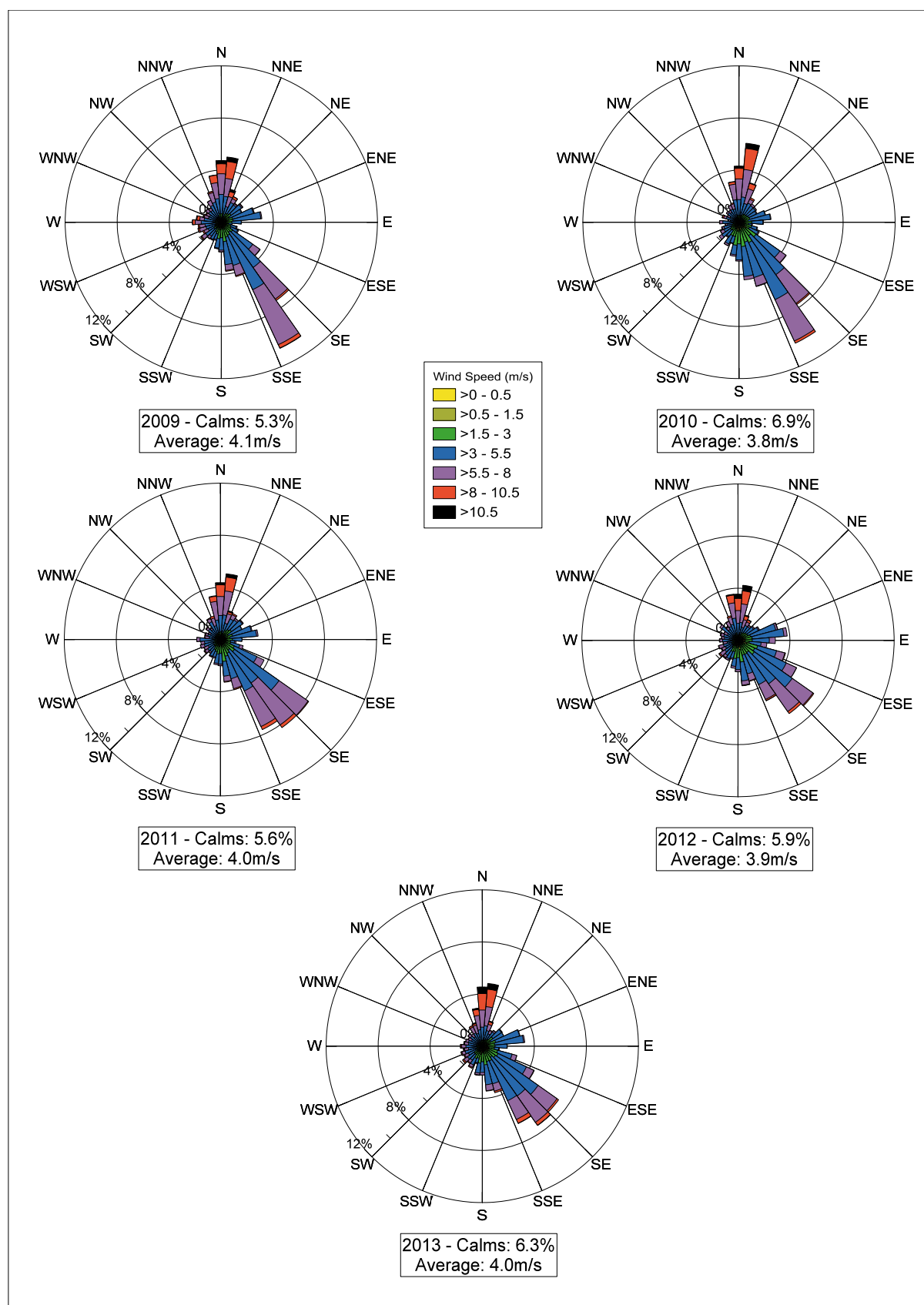


Figure 19. BoM Narrabri Airport AWS wind roses – 2009 – 2013

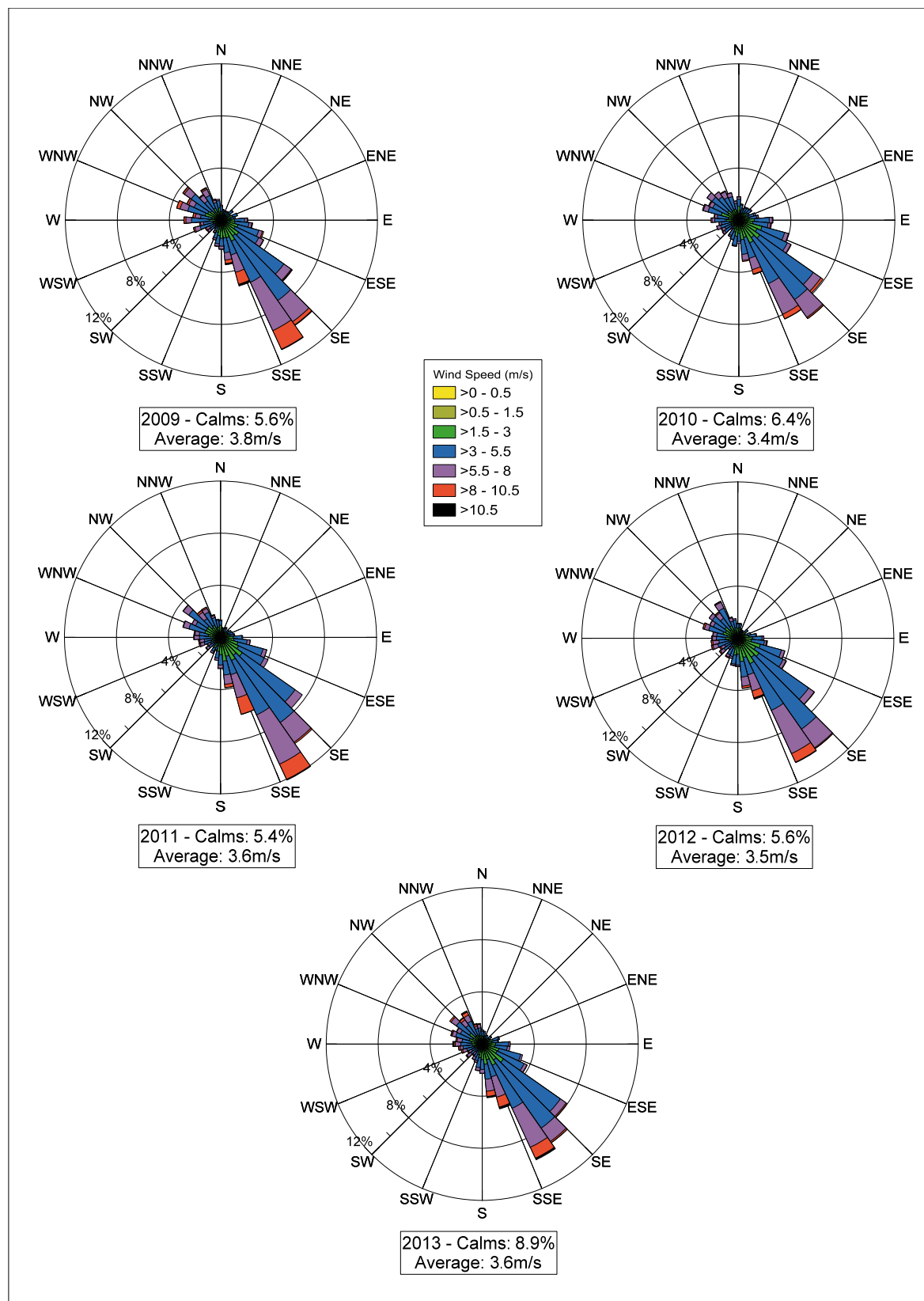


Figure 20. BoM Gunndah Airport AWS Windroses – 2009 – 2013

Appendix B

Emissions inventory

Emission inventory development

Dust emissions were estimated using United States Environmental Protection Authority (USEPA) AP-42 emission factors and predictive equations listed below, taken from the following chapters:

- Chapter 11.9 Western Surface Coal Mining.
- Chapter 13.2.2 Unpaved Roads.
- Chapter 13.2.4 13.2.4 Aggregate Handling and Storage Piles
- Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing.
- Chapter 13.2.5 Industrial Wind Erosion.

Full emission inventories are provided below.

Inventory activity	Units	TSP emission factor/equation	PM ₁₀ emission factor/equation	PM _{2.5} emission factor/equation	Input variables		EF source
					Parameter	Value	
COAL HANDLING							
Loading ROM stockpile	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2} \right)^{1.3}}{\left(\frac{M}{2} \right)^{1.4}} \right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2} \right)^{1.3}}{\left(\frac{M}{2} \right)^{1.4}} \right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2} \right)^{1.3}}{\left(\frac{M}{2} \right)^{1.4}} \right)$	U (wind speed)	3.1 m/s	AP42 Chapter 13.2.4
Loading PCI product stockpile					M (moisture content)		
Loading Thermal (CHPP) product stockpile					ROM coal	4.7 %	
					PCI coal	4.9 %	
Loading 2ndry bypass coal					CHPP thermal	6.6 %	
					Bypass coal	4.7 %	
Loading rejects pile					Rejects	5.2%	
Loading product coal to trains							
Conveyor transfer - ROM							
Conveyor transfer – product coal							
DOZERS							
Dozers on ROM coal	kg/hr	$35.6 \times \frac{S^{1.2}}{M^{1.3}}$	$6.33 \times \frac{S^{1.5}}{M^{1.4}}$	0.022 x TSP	S (silt content)	7 %	AP42 11.9 Table 11.9-2
Dozers on Product coal					M (moisture content)		
					ROM coal	4.7 %	
					Product coal	5.4%	

Inventory activity	Units	TSP emission factor/equation	PM ₁₀ emission factor/equation	PM _{2.5} emission factor/equation	Input variables		EF source
					Parameter	Value	
WIND EROSION							
'Live' stockpile (hourly varying)	kg/ha/h	$Emission\ Factor = k \sum_{i=1}^N P_i$ where: $P_i = 58(u * - ut *)^2 + 25(u * - ut *)$	0.5 * TSP (0.5 from AP42 13.2.5)	0.075 * TSP (0.075 from AP42 13.2.5)	u* (friction velocity (m/s)) ut* (threshold friction velocity (m/s))	hourly varying 1.12 m/s	AP42 13.2.5
Stockpile wind erosion and maintenance	kg/ha/h	1.8 * u	0.5 * TSP (0.5 from AP42 13.2.5)	0.075 * TSP (0.075 from AP42 13.2.5)	u (wind speed)	3.1 m/s	AP42 11.9 Table 11.9-2
UNSEALED HAUL ROADS							
Hauling	kg/VKT	$\left(\frac{0.4536}{1.6093}\right) \times 4.9 * \left(\frac{S}{12}\right)^{0.7} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 1.5 * \left(\frac{S}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 0.15 * \left(\frac{S}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	Silt content (s) Mean vehicle weight (W)	2% 80 tonnes	AP42 13.2.2
Grading roads	kg/VKT	$0.0034 \times S^{2.5}$	$0.00336 \times S^{2.0}$	$0.0001054 \times S^{2.5}$	S (speed)	4 km/hr	AP42 11.9 Table 11.9-2
COAL PROCESSING							
Rotary breaker / crushing	kg/t	0.0027	0.0012	No data			AP42 11.19.2 Table 11.19.2-2
2ndy bypass screening	kg/t	0.0125	0.0043	No data			AP42 11.19.2 Table 11.19.2-1
TOPSOIL							
Topsoil stripping	kg/t	0.029	TSP x 0.6 ¹	TSP x 0.031 ¹			AP42 11.9 Table 11.9-4 (Scrapers)
Topsoil spreading	kg/t	0.02	TSP x 0.6 ¹	TSP x 0.031 ¹			AP42 11.9 Table 11.9-4 (Scrapers)

Note: ¹ No PM₁₀ and PM_{2.5} factors defined for this activity and therefore scaling factors for PM₁₀ and PM_{2.5} emissions from Grading are applied.

Appendix C

Contour plots

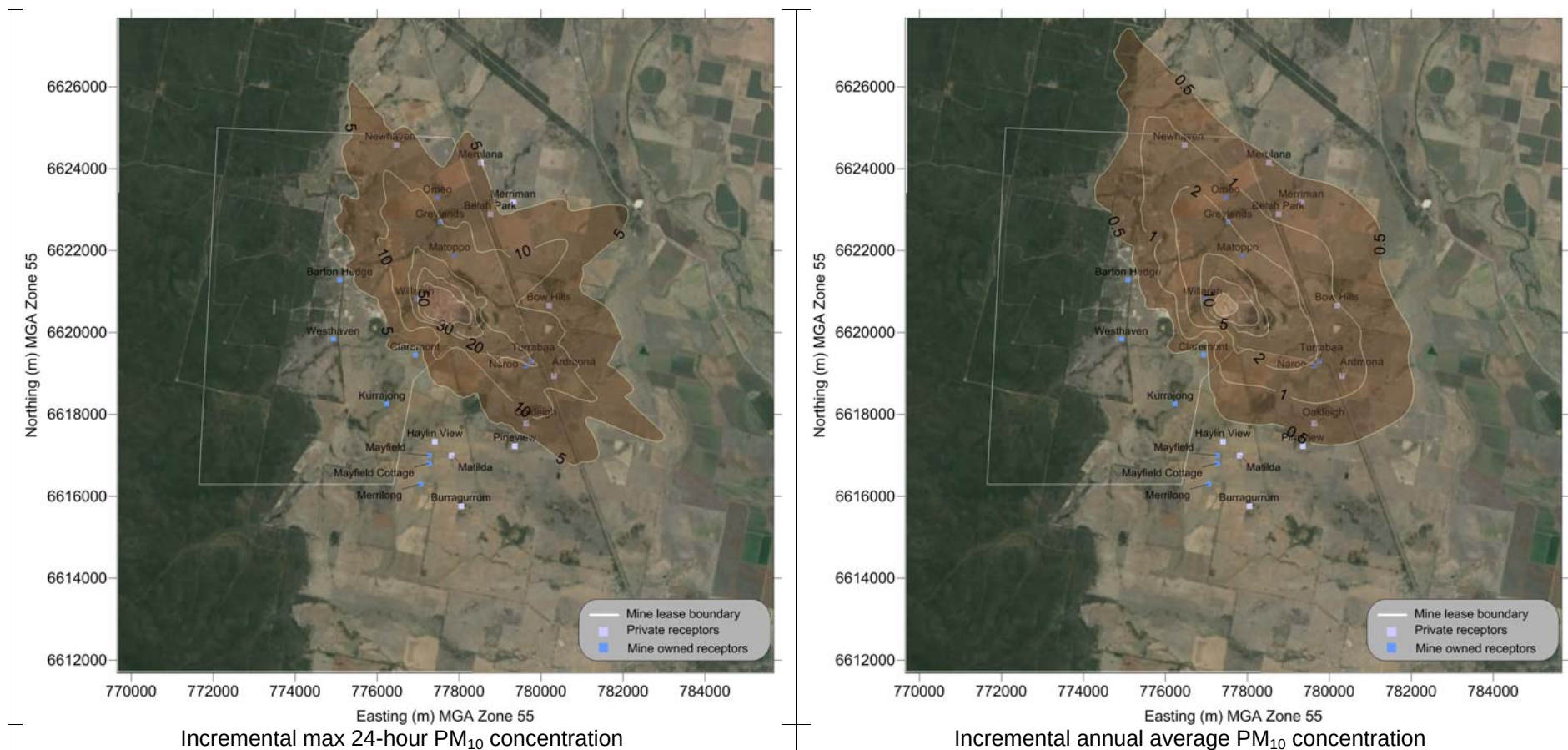
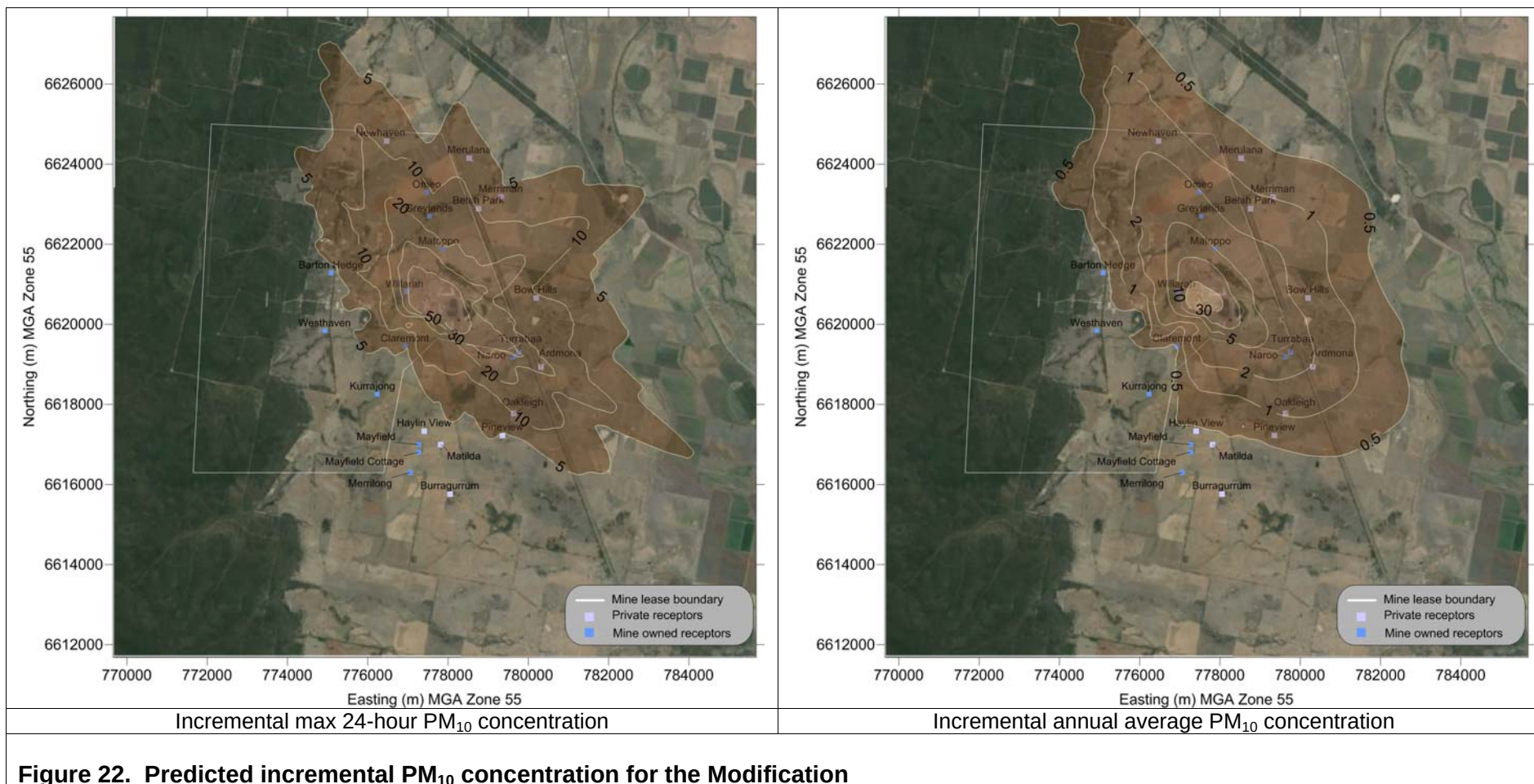


Figure 21. Predicted incremental PM₁₀ concentration for existing operations



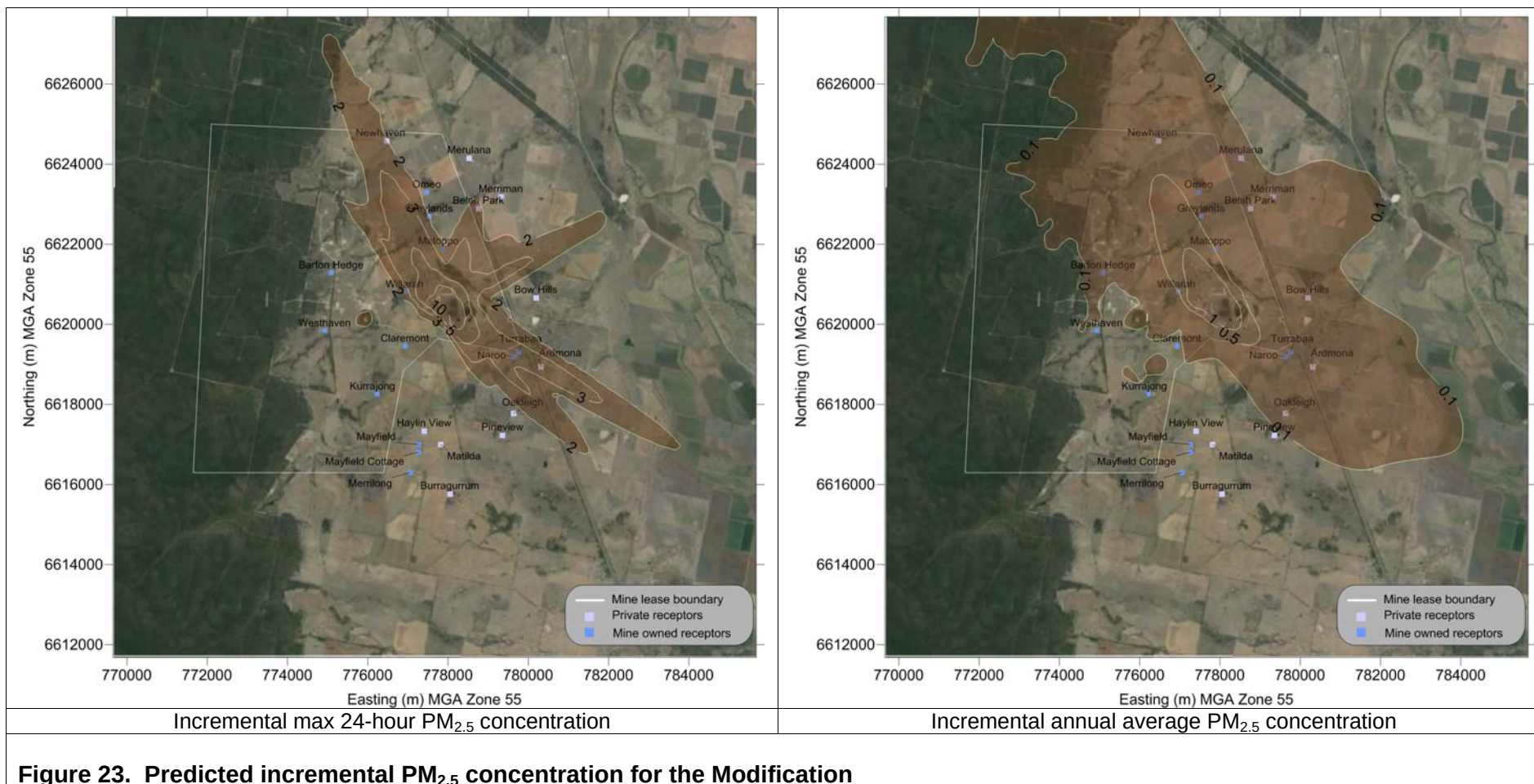


Figure 23. Predicted incremental $PM_{2.5}$ concentration for the Modification

